DOE/EIS-0073

DOE TIC

Final Environmental Impact Statement
Volume 1 of 2

Solvent Refined Coal—I Demonstration Project

Newman
Daviess County
Kentucky

U.S. Department of Energy

July 1981

Cover Sheet

Final Environmental Impact Statement

Solvent Refined Coal-I Demonstration Project

Newman, Kentucky

DOE/EIS-0073

(a) Lead Agency: U.S. Department of Energy (DOE)
Cooperating Agencies: U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (COE)

(b) Proposed Action:* A cost-shared agreement between the U.S. Department of Energy (DOE) and International Coal Refining Company (ICRC), a general partnership consisting of Air Products Coal Refinery, Inc., and Wheelabrator Coal Refinery, Inc., leading to the construction and operation of a 6000 tons per stream day (tpsd) solvent refined coal demonstration project (SRC-I) with the potential for ultimate development by ICRC of a 30,000-tpsd commercial facility at Newman, Daviess County, Kentucky.

(c) For Further Information Contact: (1) John L. Morris, SRC-I Program Manager, Office of Coal Processing under the Assistant Secretary for Fossil Energy, Mail Station E-333, Washington, D.C. 20545, Ph: (301) 353-4670; (2) Robert J. Stern, Director, NEPA Affairs Division, Office of the Assistant Secretary for Environmental Protection, Safety, and Emergency Preparedness, Room 4G-064, Forrestal Building, 1000 Independence Avenue, SW, Washington, D.C. 20585, Ph: (202) 252-4600; or (3) Stephen H. Greenleigh, Esq., Acting Deputy General Counsel for Programs, Room 6D-033, Forrestal Building, 1000 Independence Avenue, SW, Washington, D.C. 20585, Ph: (202) 252-6947.

For Copies of the EIS Contact: James A. Reafsnyder (615/576-1055)
Research and Development Manager
SRC-I Project Office, U.S. Department of Energy
P.O. Box E
Oak Ridge, Tennessee 37830

(d) Designation: Final EIS (FEIS)

(e) Abstract: The Statement assesses the potential environmental impacts associated with the construction and operation of a 6000-tpsd-capacity coal liquefaction facility at Newman, Kentucky which will demonstrate the technical operability, economic viability, and environmental acceptability of an SRC-I process. Impacts assessed include the following: effects of the project on occupational and public health resulting from the production and use of SRC products; potential impacts on terrestrial and aquatic ecology, including State and Federally declared threatened or endangered species; potential and expected impacts on

*As part of the restructuring of the Federal Synthetic Fuels Program, the DOE proposed to rescind FY 1981 funding for the SRC-I project and to terminate its involvement in the project after prior year funds are exhausted. The Congress, however, decided not to rescind the FY 1981 funding. As stated in Senate Report 97-67, $22.5 million is made available for the SRC-I demonstration to continue detailed design activity and other related work during FY 1981, and $135 million is deferred until FY 1982. The Administration is currently developing plans to meet the Congressional directive.

land use; withdrawal and alteration of "prime" agricultural land; projected effects on floodplain and wetland areas; potential impacts on surface water and groundwater; potential impacts on ambient air quality; potential change of the cultural landscape; potential impacts on sites of archaeological significance; and changes to existing economic and social characteristics of the site area. Additionally, the statement presents an assessment of potential long-range and cumulative impacts of a future commercial expansion of the proposed facility at the proposed site to an approximately 30,000-tpsd capacity. The effects of continued operation of the demonstration plant at demonstration plant capacity, mothballing, conversion to another government use, and decommissioning are also considered. A construction and operational monitoring plan to assess the effectiveness of the planned mitigatory measures for the duration of the demonstration phase is also presented. In assessing the potential environmental impacts of the proposed action, several programmatic and project alternatives are considered and evaluated. The range of alternatives assessed includes proceeding with the proposed action, modifying the action and subsequently continuing the project, delaying the action, and terminating the contract with no further action. The alternatives section includes evaluation of alternative plant designs. Impacts of constructing and operating the proposed facility at two alternative sites are evaluated.

(f) A Record of Decision will be issued no earlier than 30 days after the FEIS Notice of Availability is published in the *Federal Register*. A Floodplain-Wetlands Statement of Findings will also be issued.

FOREWORD

This Final Environmental Impact Statement (FEIS) is issued by the U.S. Department of Energy (DOE) in accordance with DOE's guidelines published in the *Federal Register* on March 28, 1980 (45 FR 20694), for compliance with the National Environmental Policy Act (NEPA) as implemented by regulations promulgated by the Council on Environmental Quality (40 CFR Parts 1500-1508, November 1978).

As part of the restructuring of the Federal Synthetic Fuels Program, the DOE proposed to rescind FY 1981 funding for the SRC-I project and to terminate its involvement in the project after prior year funds are exhausted. The Congress, however, decided not to rescind the FY 1981 funding. As stated in Senate Report 97-67, $22.5 million is made available for the SRC-I demonstration to continue detailed design activity and other related work during FY 1981, and $135 million is deferred until FY 1982. The Administration is currently developing plans to meet the Congressional directive. If ICRC continues with the project without DOE involvement, ICRC has indicated that, although it is not required to do so, it currently intends to carry out the monitoring and mitigation measures described in Sects. 4.5 and 4.6, with the exception of the following: socioeconomic measures and the long-term environmental and health research plan in Appendix Z. ICRC has committed to develop a traffic monitoring and mitigation plan, although not necessarily the specific program identified in Sects. 4.5 and 4.6.

The proposed action will not require the opening of a dedicated coal mine or significant expansion of existing mines to supply the necessary feed coal. Therefore, mining impacts at specific mines are not addressed in this statement. However, regional mining impacts will increase incrementally as a result of this project, so these are discussed generically and on a regional basis in Sect. 1.4.3.5.

One of the primary objectives of the demonstration plant program is to obtain an environmental data base. This data will be used by regulatory agencies to establish emission and discharge limitations for maintaining acceptable environmental quality and by industry for evaluating the economics of a commercial facility including required environmental controls. The decision to construct a commercial-scale facility at the demonstration plant site will be made in consideration of information that is currently unavailable and can only be obtained by construction and operation of the demonstration facility. The analysis that follows focuses on environmental issues which can be identified at this time as potential impacts of commercial development at the proposed site. Although the discussion of commercial-scale impacts is limited in this EIS, DOE will prepare appropriate NEPA documentation prior to any transfer by DOE of the demonstration facility to the industrial partner for use as a commercial facility.

As an initial step in the NEPA process, ICRC at DOE's direction conducted a one-year baseline monitoring program at the proposed site and prepared and submitted an Environmental Report (ER). The ER provided DOE with detailed information on the proposed project and the environment in which it would be placed. The DOE has reviewed this ER and verified the data. Information from the ER was used initially to identify key issues for detailed analysis. Refinement of these issues resulted from the public meetings held by DOE in Owensboro, Kentucky, on July 24 and October 24, 1979, and in Louisville, Kentucky, on October 25.

Conceptual design studies, designated as Phase Zero, were completed and delivered to DOE on July 31, 1979. Based on an evaluation of the Phase Zero Deliverables, DOE decided to proceed with the design phases. Copies of Phase Zero Deliverables and the DEIS are available for inspection at the following locations:

Owensboro-Daviess County Public Library
ATTN: Mrs. Alice G. Lewis, Director
450 Griffith Avenue
Owensboro, KY 42301

U.S. DOE Technical Information Center
Customer Services Branch
Post Office Box 62
Oak Ridge, TN 37830

U.S. DOE Public Document Room
ATTN: Ms. M. J. Felton
Room G-208, Federal Building
P. O. Box E
Oak Ridge, TN 37830

U.S. DOE Public Reading Room, FOI
Room 1E-090, Forrestal Building
1000 Independence Avenue, SW
Washington, DC 20585

Department of Library & Archives
Barbara M. Williams, Librarian
Box 537, Berry Hill
Frankfort, KY 40602

Evansville and Vanderburgh County
Public Library
22 SE 5th St.
Evansville, IN 47708

The University of Kentucky
ATTN: Ms. Janis Pivarnik
Government Publications Department
M. L. King Library
Lexington, KY 40506

Copies of the Phase Zero Deliverables are available on microfiche through the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161, Document Nos. ORO-3054-T3 through ORO-3054-T7.

The ER, together with the data elicited from the public meetings and additional data collected and independently analyzed by DOE and its contractor, Oak Ridge National Laboratory, were utilized in the preparation of a Draft Environmental Impact Statement (DEIS). In addition, continual updates on the plant design and results from additional onsite monitoring have also been used. That document (DOE/EIS-0073-D) was filed with the EPA on January 9, 1981, and a notice of availability was published in the *Federal Register* on January 16, 1981. Federal, state, and local agencies and groups and individuals with known interest in this proposed action were supplied copies of the draft statement and were requested to comment on its contents. Copies of the statement were also provided to other interested parties on request. Additionally, the opportunity to comment on the draft statement was provided at public hearings conducted in Owensboro, Kentucky, on February 23, 1981; Henderson, Kentucky, on February 24, 1981; and Stanley, Kentucky, on February 25, 1981. The comment period ended March 2, 1981. The FEIS includes revisions where appropriate in response to the substantive comments received during the public comment period. The FEIS also includes revised information resulting from the availability of updated data received after issuance of the DEIS. However, this revised data does not significantly alter the projected impacts described in the DEIS.

To comply with the requirements of NEPA, DOE is issuing this FEIS based on the best available information prior to any decision to proceed with major detailed design efforts and to commence construction of the SRC facility. Utilizing a tiering approach, DOE will perform supplementary NEPA reviews as necessary to address significant environmental impacts not within the scope of this FEIS. For example, further NEPA review would be required if environmentally significant new information relevant to the selection of environmental control equipment arises as a result of further design efforts.

The U.S. Department of Energy, the U.S. Environmental Protection Agency (EPA), the U.S. Army Crops of Engineers (COE), and the Kentucky Department of Natural Resources and Environmental Protection (KDNREP) have reviewed environmental issues pertinent to the proposed SRC-I demonstration plant to be constructed near Newman, Kentucky. The environmental issues of interest to EPA and KDNREP are presented in this FEIS, and the expected environmental impacts are discussed to the fullest extent possible. Significant issues raised by EPA and KDNREP with respect to the DEIS are identified in Appendix A (Sect. A.2) and detailed in a work plan presented in Appendix EE, with identification of the process required for resolution; the time frame within which the information will be available to EPA, KDNREP, and the public; continuing EPA and KDNREP involvement; and respective DOE, EPA, and KDNREP responsibilities for resolving the issues and ensuring environmental acceptability of the SRC-I demonstration plant. Additional issues may be identified during the continuing review process of this project, necessitating periodic work plan modifications. Also included in Appendix EE is the status of DOE actions taken to comply with commitments made in the work plan.

The format of this EIS follows the suggested format in the CEQ regulations. Section 1 documents the purpose, need, and status of the proposed demonstration plant. Section 2 describes the proposed action and alternatives to it, focusing on possible plant designs, and timing for the project. Section 2 also summarizes the impacts of the project on the environment. Section 3 details the critical features of the potentially affected environment at the proposed and comparative sites. Section 4 analyzes the environmental consequences of the proposed action and alternatives to it during both the construction and the operation phases of the project and identifies potentially significant issues that could arise during decommissioning or expansion to commercial scale. Impacts of constructing and operating the proposed facility at two alternate sites are also evaluated. Section 4 also describes the proposed mitigation measures, the adequacy of these measures for reducing adverse impacts, and the monitoring programs proposed for detecting environmental effects. Section 5 presents the names and professional qualifications of the persons responsible for preparing this EIS. Appendix A presents comments received on the Draft Environmental Impact Statement and DOE's responses. Additional appendixes are included to provide detailed data and documentation of the analyses presented in this FEIS.

SUMMARY

1. INTRODUCTION

This Final Environmental Impact Statement (FEIS) has been prepared by the U.S. Department of Energy (DOE) to assess the environmental impacts of a proposed DOE action* leading to the construction and operation of a solvent refined coal demonstration plant (SRC-I) at Newman, Kentucky, on a cost-shared basis with the International Coal Refining Company (ICRC), a general partnership consisting of Air Products Coal Refinery, Inc., and Wheelabrator Coal Refinery, Inc. This demonstration plant has the potential for the ultimate development of a 30,000-tons per stream day (tpsd) commercial facility. This FEIS has been prepared in accordance with DOE's guidelines (45 FR 20694, March 28, 1980) for compliance with the National Environmental Policy Act (NEPA) of 1969, as implemented by regulations promulgated by the Council on Environmental Quality (CEQ) (40 CFR Parts 1500-1508, November 1978).

2. DESCRIPTION OF THE PROPOSED ACTION

The proposed action is a cost-shared agreement between DOE and ICRC leading to the construction and operation of a 6000-tpsd solvent refined coal demonstration project (SRC-I) with the potential for ultimate development by ICRC of a 30,000 tpsd commercial facility at Newman, Daviess County, Kentucky, to demonstrate the technical feasibility, economic viability, and environmental acceptability of the solvent-refined coal (SRC-I) process. If a decision is made to proceed with construction of the demonstration plant as proposed, the contract calls for a two-year demonstration period, at the conclusion of which the facility may be offered for sale, with the industrial participants having the right of first refusal. If the demonstration plant is not sold, DOE may elect to continue operation under the existing contract for a period of up to three years. Should the demonstration plant prove successful, it is anticipated that the first commercial SRC-I plant, which will have a capacity of about 30,000 tpsd, will be constructed at the demonstration facility site by the industrial participant.

2.1 Process description

The SRC-I process converts high-sulfur coal into a low-sulfur, low-ash solid fuel product, secondary gaseous and liquid fuel products, and by-product elemental sulfur. In the process, pulverized coal is mixed with a hydrocarbon solvent produced in the process and is reacted with hydrogen at high temperature and pressure. After gaseous products and unreacted hydrogen are separated, the liquid products are processed to separate the mineral residue (ash) and unreacted coal from the primary and secondary products and to recover the solvent. The primary product, which is a liquid at process temperature and a solid at ambient temperature, is a high-heating value, low-sulfur, low-ash fuel product that may be directly substituted for coal in applications requiring reduced emissions or upgraded to replace petroleum products. In the proposed demonstration facility, about one-third of the primary molten SRC product will be calcined to produce anode-grade coke for use in the aluminum industry, one-third will be further hydrogenated to produce a variety of liquid products (which will be combined with liquids produced at other stages in the process) that may be used as boiler fuel or further

*As part of the restructuring of the Federal Synthetic Fuels Program, the DOE proposed to rescind FY 1981 funding for the SRC-I project and to terminate its involvement in the project after prior year funds are exhausted. The Congress, however, decided not to rescind the FY 1981 funding. As stated in Senate Report 97-67, $22.5 million is made available for the SRC-I demonstration to continue detailed design activity and other related work during FY 1981, and $135 million is deferred until FY 1982. The Administration is currently developing plans to meet the Congressional directive.

processed to produce transportation fuels or petrochemical feedstocks, and one-third of the molten SRC product will remain as a solid product.

2.2 Site description

The proposed site, which is 1 km (0.6 mile) south of Newman, Kentucky, encompasses 600 ha (1484 acres) on the Green River floodplain. Located in northwestern Daviess County, the site is bounded by the Green River to the south and Martin Creek to the east. Site topography is generally flat, with elevations ranging from 113 to 119 m (370 to 390 ft) above mean sea level (MSL). The dominant land-use category at the site is agricultural, with a major portion of the site being cleared for agricultural use. The second largest land use is riparian and hardwood forest (Sect. 3.2.1.3). Though residential land use is minimal at the proposed SRC-I site, 24 families residing on the site will be displaced by the proposed project. Route 60, a two-lane highway, provides access to the site. The L&N railroad runs along the north boundary of the site.

The riparian hardwood forest represents very good habitat for a wide variety of species; the agricultural land represents poor habitat for wildlife. The Indiana bat, a species listed as endangered by the U.S. Fish and Wildlife Service (USFWS), occurs on the site in the riparian forest along Martin Creek and may be affected (Sects. 3.2.1.3 and 4.2.1.3). However, the USFWS has determined that the project will not jeopardize the continued existence of the Indiana bat (Appendix I). No other species classified as threatened or endangered by the USFWS either occur on the site or should be affected by the proposed project (Appendix I).

Soils in the area of the site are primarily alluvial deposits associated with the Green River floodplain. The U.S. Department of Agriculture (USDA) Soil Conservation Service estimates that over 90% of the site is "prime agricultural soil" (see Appendix X). At the site, the alluvial material is underlain by unconsolidated sand deposited by glacial outwash.

Water quality in that part of the Green River adjacent to the proposed site is classified as "effluent limited" with respect to dissolved oxygen and conventional pollutants. Therefore, best available treatment technology economically achievable will be applied to wastewaters discharged into the river.

The proposed site is located in the Evansville-Henderson-Owensboro Interstate Air Quality Control Region (AQCR 77). Daviess County, in which the proposed site is located, is designated as attainment for all air pollution categories. Henderson County, located just west of the proposed site, is also designated as attainment for all categories.

Over one-half of the site is below the elevation of the 100-year floodplain, and over 75% of the site is below the elevation of the 500-year floodplain (Appendixes D and G).

Most of the labor required for construction of the SRC-I facility will probably come from Evansville, Indiana, and Owensboro and Henderson, Kentucky, with additional labor being imported from Paducah, Kentucky. Labor availability problems may be compounded by competition from the construction of proposed nearby facilities, including the Rockport power plant and several proposed synthetic fuel plants in the area (Sect. 4.2.5, Cumulative Impacts).

Section 3.2 presents a more complete description of the proposed site.

3. PURPOSE OF THE PROPOSED ACTION

The purpose of the proposed action is to demonstrate that the SRC-I process is a viable and competitive solution to meeting the national need for alternative energy sources. SRC-I is the most mature of all direct coal liquefaction approaches, having been the most extensively tested process at the pilot plant scale. Operation of the demonstration plant using this technology will provide the information required to minimize technical and economic risk and confirm the effectiveness of environmental control systems on a timely basis for moving forward with commercialization.

The technical feasibility of the SRC process has been proven by the operation of both bench- and pilot-scale facilities, including 6- and 50-tons/d facilities at Wilsonville, Alabama, and Fort Lewis, Washington, respectively. As a result of these activities, it has been shown that the SRC-I process offers simplicity and ease of operability. This judgment is based on the inherent nature of the SRC-I process: noncatalytic coal reactions, operations at lower temperatures and pressures, lower hydrogen consumption, and higher energy efficiency. However, there are still a number of areas of technical uncertainty associated with construction of a commercial facility. These areas of uncertainty cannot be fully resolved by the operation of pilot-scale facilities. Because many of the equipment items of greatest concern would be replicated in a commercial-size facility, adequate information can be obtained from operation of a facility using the commercial-scale equipment but having a significantly smaller overall capacity than a commercial production plant. Operation of the fully integrated process, that is, liquefaction, deashing, hydrocracking, product separation, solidification, and gasification, and hydrogen production and environmental monitoring and control equipment, would be demonstrated for the first time. Also, by providing an opportunity for design of the commercial-size equipment based on monitoring of pollution-control-equipment performance during its operation, the demonstration plant can confirm that commercial-scale plants can be operated in an environmentally safe manner.

4. NEED FOR THE PROPOSED ACTION

The large size and diversity of U.S. demands for hydrocarbon fuels and uncertainty about product slate make it prudent to demonstrate processes that are sufficiently flexible to shift with the market.

The SRC-I process followed by hydrocracking, referred to as two-stage liquefaction, provides the flexibility to vary product mix and the ability to efficiently convert a variety of coals, including some of the nation's worst ash and sulfur-laden coals. The products by themselves, or when subjected to further refining as with any coal liquid, are acceptable for a wide range of uses — from boiler fuels to fuels for transportation.

The flexibility of the product types, quantities, and quality combined with the process features of efficient use of hydrogen and high energy yield is an advantage of SRC-I that is extremely important to future investors in commercial plants. The production ratio of solids and liquids can be varied from as much as 85% solids with 15% liquids to as little as 10% solids with 90% liquids, all involving minimal by-product gas production.

5. IMPACTS RESULTING FROM THE PROPOSED ACTION

5.1 Impacts during the demonstration

Section 4 describes the environmental impacts expected to result from the construction and operation of the demonstration plant at the proposed Newman site, using the currently proposed design.

Cumulative impacts will result from the proposed SRC-I facility and other projects proposed, planned, or under construction in the area. Some of these projects are just beginning; thus, the lack of specific data concerning them limits the level of quantitative assessment that can be done on the resulting cumulative impacts (see Sect. 5.3 of the Summary and Sect. 4.2.5).

In summary, construction and operation of the plant in accordance with the proposed design and site are expected to result in the following impacts:

Health risks. Through chemical reactions involving coal, the SRC process will produce a broad range of materials that contain carcinogenic and mutagenic organic compounds, including aromatic amines, aromatic and heterocyclic compounds, highly substituted phenols, and other compounds. The health risks of operating a plant of this nature have been recognized and, therefore, the following actions are being taken: (1) engineering controls are being incorporated in the design with the philosophy that the risk should first be reduced by minimizing the exposure of workers, the public, and the environment (Sect. 4.1.3);

(2) the design and implementation of mitigation measures will be responsive to exposure data from a monitoring program that will include point and fugitive emission sources, the site and surrounding environment, in-plant area monitors, and personnel monitors (Sect. 4.1.3); and (3) an industrial hygiene program will be instituted to further reduce worker risk through identification of hazardous materials and areas, a worker education program, protective clothing and equipment, carefully developed work practices and personal hygiene procedures, and medical monitoring (Sect. 4.1.3 and Appendix Z). The current research program sponsored by DOE may continue based on available funding (Appendix Z).

The sources of these hazardous substances to which the public could be exposed include fugitive hydrocarbon air emissions (leaks), emissions from the plant flare system, wastewater discharge to the Green River, and SRC liquid spills during product transport. Point-source air emissions, onsite spills, and solid waste disposal are not significant sources. Fugitive hydrocarbon emissions will be reduced through the use of special mechanical design and equipment selection for potential leak points and a "directed maintenance" program. Emission of these hazardous substances from the flare system will be reduced through the use of a controlled combustion system. Discharge of these substances to the Green River will be reduced through the use of a tertiary wastewater treatment system with zero-discharge capability. Under some plant operating conditions, recycle of the entire treated effluent will not be possible, and treated wastewater will be discharged. The worst-case analysis of impacts (Sects. 4.2.2.3 and 4.2.2.4) assumes low river flow, high wastewater discharge flow rate, and high concentration of pollutant in the discharge. Impacts from SRC liquid product spills will be reduced by handling and transporting the liquids in accordance with all regulations and safe practices used in the transportation of other industrial products and materials such as chlorine, ammonia, gasoline, propane, and benzene. Careful selection of markets and routes will also be a part of the program to reduce accidental spills and human exposures. In addition, a plan will be developed for spill cleanup and countermeasures, and collaboration with the EPA and the Coast Guard in the event of a spill (Sect. 4.1.3 and Appendix C).

For workers involved in maintenance operations, skin contact and inhalation are of concern. For other categories of workers at the plant site, fugitive emissions to the atmosphere are expected to be the major exposure source and will be reduced by the measures discussed above. Highly detailed maintenance procedures will be developed based on experience at the SRC pilot plants and at other industries involved in handling materials that are hazardous if personal contamination occurs (Sect. 4.1.3).

The SRC pilot plants at Fort Lewis, Washington, and Wilsonville, Alabama, have operated since 1974 without any health effects unique to their operation. However, the size of the work force and study times are not adequate to draw epidemiologically significant conclusions concerning potential long-term effects. The Department of Energy and other agencies are sponsoring programs for characterizing and assessing the health risks of SRC processes before commercialization. Major long-term chemical, biological, and monitoring studies are under way to determine the specific characteristics of SRC materials and the effects of management and controls on them (Appendix Z). Results of programmatic efforts to date are encouraging. Industrial hygiene management within the Fort Lewis and Wilsonville plants appears to provide a sound basis for developing the program to be employed at the demonstration plant. Because no technological development is risk free, exposure monitoring for both the work force and public will be a major feature of the health protection program. Construction and operation of the plant in accordance with the proposed design and proposed monitoring and mitigating measures will ensure low exposures and thus low risk to the public, the work force, or the environment (Sect. 4.1).

Endangered species. The Indiana bat, a species listed as endangered by the USFWS, occurs on the site in the riparian forest along Martin Creek (Sects. 3.2.1.3 and 4.2.1.3 and Appendix K). No other species classified as threatened or endangered by the USFWS either occur on the site or should be affected by the project (Appendix I). Present layout plans indicate that no permanent facilities of the demonstration plant (except earth stockpiles) will be located within 305 m (1000 ft) of the Martin Creek Forest. A biological assessment was prepared for the USFWS (Appendix K.1). None of the Martin Creek Forest will be disturbed. However, noise and construction activities may have some impact on the bats. Direct and indirect impacts of construction and operation of the SRC-I demonstration

facility should not jeopardize the continued existence of the species because no designated critical habitat will be affected. Indiana bats are widely dispersed in summer, and the proposed SRC-I site is apparently outside the main population centers of the bats. The USFWS concurs that the proposed facility will not jeopardize the continued existence of the bat (Sect. 4.2.1.3 and Appendix I). Information received by DOE in November 1980 indicates that a power line proposed by the Big River Electric Company to serve the SRC-I plant may impact the Indiana bat (Sects. 2.2.1.2 and 4.2.1.3). However, a specific routing of the line and the location of the Newman substation have not yet been determined. As long as DOE continues to participate in the project, DOE and Big River Electric Company will work to minimize adverse impacts on the Indiana bat.

Traffic. Increased traffic on U.S. Highway 60 could produce a major adverse impact if no mitigation measures are carried out. Increased delays to traffic between Henderson, Ky., and the SRC-I site during peak use periods could be expected to average 1.25 to 2 h and to reach 4 h in extreme cases. Delays to traffic between Owensboro and the SRC-I site could be expected to average 40 min to 1.5 h and to go to as high as 3 h.

Mitigation measures have been studied, and a variety of such measures could reduce the potentially adverse impact of increased traffic on U.S. 60 (Sect. 4.2.4.1). Without effective mitigation, project-induced traffic would entail an unacceptable social impact to the communities in the vicinity of the proposed site.

DOE would take the following measures to ensure that acceptable levels of service will not be exceeded on U.S. 60: (1) construct an intersection with traffic signals and turn lanes at the SRC-I plant entrance on U.S. 60; (2) encourage voluntary ride sharing, vanpooling, and bus riding; (3) utilize staggered work shifts or establish a second shift to reduce peak period traffic; and (4) establish a company-sponsored bus-riding program if the preceding measures fail to ensure acceptable traffic conditions on U.S. 60 (Sect. 4.6.2.2).

In addition to the above actions, Federal, state, and local governments are studying the feasibility of the following mitigation measures to increase the effectiveness of those measures described in the preceding paragraph: (1) realign curves and improve railroad crossings on U.S. 60 at Stanley and Reed; (2) construct a temporary ramp from the Audubon Parkway to Kentucky 1554 to accommodate traffic to and from the areas west of the SRC-I plant site; and (3) upgrade Sauer Lane from Kentucky 1554 to the plant site (a rear entrance will be constructed to allow access from Sauer Lane). If these measures are not undertaken, an increased degree of effectiveness will be required of the four DOE-sponsored measures previously described. Specifically, a substantially larger number of company-sponsored buses is likely to be required, and worker participation in the bus-riding program will have to be correspondingly greater.

A detailed traffic mitigation plan that would elaborate on the above measures would be issued before major project construction by DOE in cooperation with KYDOT and the Green River Area Development District (GRADD), describing the costs of the measures to be taken and the institutional arrangements that would be necessary for their implementation.

Water quality. Although the goal of the wastewater treatment system is to operate primarily in the zero-discharge mode, discharge of treated water will be necessary under some conditions. Impacts to water quality will result during those occasions when wastewater is discharged from the SRC-I facility. Under normal flow conditions for the Green River, discharge from the SRC-I plant will cause only very minor changes in water quality. At present, the Green River's maximum concentrations of manganese, iron, cadmium, copper, mercury, silver, zinc, and probably phenol exceed the water quality standards or criteria (Sect. 3.2.2.3). A worst case would consist of discharge during a 7-day, 10-year low flow with the assumption that the ambient concentrations of all water quality constituents were at the maximum ever recorded. Under worst-case conditions, wastewater discharge is projected to cause small increases in the concentration of trace elements, heavy metals, cyanide, and phenol. In addition, the worst-case discharge scenario would cause violation of standards for cyanide and phenol. Because of their potential toxicity to humans and aquatic organisms, the worst-case discharge of cyanide, copper, cadmium, silver, and phenol are considered a significant degradation of water quality. The probability that wastewater discharge would be necessary during low-flow periods is uncertain but considered

to be very small. However, if periods of low stream flow do coincide with periods when zero-discharge cannot be achieved, plant shutdown or reduction of plant throughput might be required. During preliminary consultation in preparation of a National Pollutant Discharge Elimination System (NPDES) permit application, EPA and the State of Kentucky will jointly develop effluent limitations for the plant. When wastewater discharge is necessary, the plant and its wastewater treatment system will be operated in compliance with the discharge limitation stated in the NPDES permit.

Floodplain and Wetlands. The development of the SRC-I demonstration plant at Newman, Kentucky, will necessitate encroachment on the Green River floodplain between river miles 18.5 and 19.8. Facilities to be located in the 100-year floodplain include the barge dock and water intake/discharge facilities as well as portions of the coal storage, slag/ash ponds, and solid/liquid product storage areas. The slag/ash pond and the liquid product storage areas will be contained by building floodproof, impervious dikes with the tops of the dikes above the 500-year flood level. The flooding constraints associated with the development of these facilities on that part of the site located on the floodplain have been integrated into the facility's plot plan and design to minimize risk to the plant. The most environmentally significant plant areas (i.e., the process area and the hazardous waste landfills) have been located on areas of the site naturally above the 500-year flood elevation. The flooding impacts resulting from site development have been evaluated, and it is estimated that the floodplain encroachment will result in minor flood-related environmental impacts. The wetlands impacts, consisting of the loss of five small farm ponds (0.6 ha) and small acreages of riparian forest (up to 10 ha), are considered minor but unavoidable. Alternatives, including alternate sites and plant layout, to the proposed development in the floodplain/wetlands have been evaluated. Preliminary evaluation results indicate no practicable alternatives to the projected floodplain/wetlands encroachments (Sect. 4.2.2.1, Appendixes D and E).

Prime farmland. Conversion of 600 ha (1484 acres) of land from rural agricultural and residential use to industrial use will occur for the life of the plant. About 90% of the soils on the site has been designated by the U.S. Department of Agriculture Soil Conservation Service as "prime farmland soils" (Appendix X). This represents about 0.65% of Daviess County's prime farmland and 0.76% of all harvested croplands in Daviess County. The annual loss of revenue associated with removing this land from active farming will amount to $249,700 (in 1978 dollars) (Sect. 4.2.1.1).

Differential settlement. Unless densified, loose sand present beneath the southern portion of the site represents a potential for differential settlement of foundations in the southern portion of the site (see Figs. 2.3 and Fig. L.9). Mitigation of poor foundation conditions is feasible with careful design, site preparation, and construction (Sect. 4.2.1.2).

Air quality. PSD increment consumption modeling predicts compliance with new source regulations (Sect. 4.2.3.1). The criteria pollutant of greatest concern will be particulates. Plant emissions are estimated to consume 18.3% of the 24-h PSD increment (Sect. 4.2.3.1). Criteria pollutant sulfur dioxide will only consume 2% of the 3-h PSD increment (Sect. 4.2.3.1). Carbon monoxide emissions for the 1-h averaging time amount to 16% of the NAAQS limits (Sect. 4.2.3.1). Ozone concentrations are not expected to be affected locally because of the long-range transport nature of the photochemical reaction of ozones precursors (Sect. 4.2.3.1). Including fugitive sources, hydrocarbon emissions will total about 62 tons per year (Sect. 4.2.3.1 and Appendix C). Nitrogen dioxide concentrations due to the demonstration plant will be less than 3% of the NAAQS (Sect. 4.2.3.1). Hydrogen sulfide (H_2S) will be emitted from the Beavon unit in the 4 to 5 ppm range, except during upset conditions when emissions may be 60 ppm. Upset conditions could also cause an increase in SO_2 for short durations when H_2S is flared, forming SO_2. The resulting SO_2 concentrations are 29.3% of the 3-h and 32.2% of the 24-h average PSD increments. Normal start-up and shutdown operation emissions will be less than the limits allowed by the new source regulations (Appendix C and Sect. 4.1.2). Table 4.18 shows that the second-highest calendar-quarter average Pb concentration due to the SRC-I plant is predicted to be 0.82 $\mu g/m^3$ or 54.7% of NAAQS. The highest predicted 8-h concentration within plant property is 19.7 $\mu g/m^3$ or 13.1% of the TLV for Pb. Thus, based on very conservative estimates, Pb emissions from the SRC-I plant will not threaten the air

quality in the vicinity of the site, nor the health of plant workers. The worst-case traffic situation occurs in Henderson, Kentucky, on U.S. 60 between Route 41 and Tillman Bethel Road (Sect. 4.2.4.1). This section of highway was modeled using EPA's HIWAY model under worst-case meteorological conditions. The peak traffic flow resulting from both the proposed SRC-I plant and the proposed W. R. Grace plant was analyzed. The model predicted compliance with the air quality standards for the criteria pollutant carbon monoxide in the worst-case scenario (see Sect. 4.2.3.1).

Cooling tower operation. The proposed mechanical-draft, evaporative-cooling tower accounts for most of the plant's consumptive water use. Based on computer modeling, operation of the cooling system could result in localized increases in fogging (13% of the time) and icing (6% of the time) and in salt deposition resulting from drift (Sect. 4.2.3.1). However, actual experience at a large chemical complex in western Kentucky suggests that the computer prediction is conservative. Cooling tower drift losses will be small (60 gpm).

Because cooling tower makeup-water is partially supplied by treated wastewater (zero-wastewater discharge operating mode) and because cooling water is used in heat exchange subject to leaks, there is some potential for emission of contaminants with the cooling tower exhaust drift droplets. Drift deposition will be localized and mostly confined to the site. This risk will be minimized by tertiary wastewater treatment, by monitoring the stream to detect residual contaminants, and by using leak detection instrumentation on aerial coolers and indirect cooling systems for those process streams containing more than 5% of hydrocarbons with a boiling point greater than 500°F.

The impacts of increased fogging, icing, and drift deposition are expected to be low and will be mitigated by appropriate location and design of the system (Sect. 4.2.3.1, Appendix S, and Appendix C, Sects. C.3.3.1 and C.4.1.1).

Socioeconomics

Population increase. Construction employment is expected to peak at between 3500 and 5000 after about a year and a half of construction (mid-1983). Labor shortages expected in many of the required construction crafts will result in an estimated 840 to 1760 construction workers moving to the 21-county impact area. Including dependents and secondary employment, this in-migration is predicted to result in a population increase of about 1500 to 3000 people in the Daviess-Henderson-Vanderburgh county area. This local impact region appears to have adequate housing and public services to accommodate the projected population influx (Sects. 4.2.4.1 and 4.2.5).

Cumulative socioeconomics. The socioeconomic impacts of the proposed facility will not independently exceed the capacity of the local infrastructure. However, SRC-I in concert with other planned and proposed large construction projects in the area could cause considerable stress on Daviess, Henderson, and Vanderburgh counties and their municipalities unless careful planning is undertaken at the state and local level (Sects. 4.2.5 and 2.3.1.3).

Taxes. Potential removal of the proposed site from the local tax base for the duration of the demonstration operation would reduce the local tax base at a cost of $4200 in annual revenues to the relevant taxing jurisdictions. There will be no direct tax payments during the construction period. The reduction in the local tax base will be more than offset by property taxes paid by workers who relocate to new housing in the SRC-I region (Sect. 4.2.4.1). With the exception of transportation impacts and their mitigation costs, the overall costs to the local communities of providing additional services to in-migrating construction workers may be offset by plant-related income. These costs are expected to be small.

Employment. About 725 people will be employed at the facility during the operation phase. The Daviess-Henderson-Vanderburgh counties area is expected to have the capacity to absorb all long-term project-related growth without major negative effects; the plant payroll will have a positive impact on the area (Sects. 4.2.4.1 and 4.2.5).

Displacement of families. About 24 families (60 people) will be displaced from their homes in the site area (Sect. 4.2.1.1).

Rail and barge utilization. The increased rail and barge utilization will not overload the rail system or the barge-carrying capacity of the Green River. As presently envisioned, coal will be delivered to the demonstration plant by train. Train schedules will be arranged to avoid the peak vehicle travel times on U.S. 60. A barge-unloading facility is also included to permit delivery of heavy equipment during construction and to possibly supplement rail facilities in the event that coal mines providing coal for the plant are not located near rail lines (Appendix Y).

Noise. Noise impacts during construction are expected to be negligible except for the one-time steam blowout to clean high-pressure piping systems. During operation of the proposed plant, noise levels are expected to be slightly higher but comparable to existing ambient sound levels (Sect. 4.2.3.2). Construction and operation noise levels are expected to comply with Federal regulations and recommended EPA guidelines for noise at nearby residential locations (Sect. 4.2.3.2).

Solid wastes. Impacts from solid waste disposal are expected to be small (Sects. 4.2.2.2 and 4.1.3.1). Solid wastes, which will be stored onsite, include five major types: (1) slag and fly dust from the gasifier; (2) metal-bearing inorganic solids mainly from the wastewater treatment processes; (3) biological solids, also from the wastewater treatment facility; (4) water-soluble solids from wastewater evaporators when the plant is operating in the zero wastewater discharge mode; and (5) slop oil from various process sources. Slag will be stored as required to obtain an RCRA permit. Although the detailed design is not yet available, the slag/flydust ponds will have features similar to landfills suitable for hazardous waste disposal (e.g., double liners, leachate detection and collection, and dikes to prevent flood inundation). The RCRA leaching results in Appendix P indicate that slag and flydust are nonhazardous. The remaining wastes are assumed to be hazardous and, except for slop oil, will be stored in landfills suitable for disposal of hazardous materials in compliance with prevailing RCRA standards; slop oil will be incinerated or recycled. Leachates from landfills will be collected and sent to wastewater treatment, and groundwater will be monitored (Appendix C and Sect. 4.5).

Coal and product storage. Coal and solid SRC-I product will be stored onsite in lined, contoured storage piles. Leachates will be collected and treated in the wastewater treatment system. Fugitive dust will be suppressed. The American Society for Testing and Materials (ASTM) distilled water extraction test of the SRC-I product indicates that toxic trace elements are not soluble during short-term leaching of the solid product (Sect. 4.2.2.2 and Appendix C).

Erosion and sedimentation. Increased erosion and resulting sediment loads to surface waters will occur during construction. These impacts will be temporary and may be reduced to low levels by implementing control and mitigation measures (Sect. 4.2.2.1 and Appendixes EE and GG).

Habitat loss. Reduction in vegetative communities and available wildlife habitat will occur during construction. Because the vast majority of the site area has been cleared for agriculture, loss of habitat will be small. Several uncommon or rare bird species will be affected (Sect. 4.2.1.3).

Water withdrawal and consumption. Water withdrawal for the demonstration plant will not be significant in terms of regional and local water availability. The water withdrawal rate will vary with the operation mode of the wastewater treatment plant. Operating in the wastewater discharge mode, the demonstration plant will withdraw 217 liters/s (3445 gpm) from the Green River, or 1.95% of the 7-d, 10-year, low flow of 11,156 liters/s (176,855 gpm). The water withdrawal rate during the zero wastewater discharge mode will be 159 liters/s (2520 gpm) or 1.4% of the 7-d, 10-year low flow. The withdrawal rate in the discharge mode is greater because about 58 liters/s (931 gpm) of the treated effluent will return to the river. Net water consumption, however, is independent of the operation mode of the wastewater treatment system; it would be 159 liters/s (2520 gpm) for both modes of operation (Sects. 2.2.1 and 4.2.1).

Product spills. Spills of SRC-I products have the potential for causing significant adverse impacts to surface- and groundwaters. The SRC-I facility will be designed for maximum containment of any materials spilled onsite. Areas susceptible to spills will be paved or lined to prevent infiltration of contaminants to groundwater and will be surrounded by dikes or curbs to prevent contamination of surface waters. Spilled material will be collected by the runoff containment system and routed to oil/water separators for recycle to the process or treatment in the wastewater treatment system. These facility-design and spill-control measures will greatly reduce the probability and consequences of onsite spills.

Spills of SRC-I products during transportation may at some time result in direct or indirect exposure of the public (Sect. 4.1.3.7 and Appendix DD). Shipments of the liquid product probably pose the greatest risk, because spilled materials may enter surface- or groundwater supplies, be dispersed into the atmosphere, or cause exposure during cleanup operations. For the purpose of this analysis, it is assumed that SRC-I liquid products would be shipped to Pittsburgh, Pennsylvania, and Lake Charles, Louisiana, and would pass through several major metropolitan areas and cross numerous major rivers and creeks. The light SRC-I liquid product (naphtha and middle distillate fractions) would be produced in the largest quantities and be carried over the longest route — 1600 km from Newman, Kentucky, to Lake Charles, Louisiana. Based on the statistics for rail spills of hazardous materials, the frequency of occurrence for spills of light product to water bodies can be calculated as ranging from once every 3000 months (based on the number of shipments) to once every 26 months (based on car-miles) (see Table 4.2 and Appendix DD, Sect. DD.4). The impacts of worst-case spills are assessed by identifying those locations where spilled SRC-I product could affect public water supplies. Such spills could cause water supply emergencies for Evansville, Indiana, and Nashville, Tennessee, requiring that water withdrawals for municipal supply be suspended during the passage of spill-contaminated water past the water supply intakes in the Ohio and Cumberland rivers. These worst-case spills of SRC-I product are considered to be exceedingly unlikely (see Appendix DD, Sect. DD.5).

5.2 Impacts of alternative fates of the facility after the demonstration

The following fates for the demonstration plant may result from a decision to proceed with construction:

- commercialization at an expanded capacity,
- continued operation of the facility at demonstration-plant capacity,
- conversion of the facility to another government use,
- mothballing of the facility (cold storage for later use), and
- decommissioning (salvage).

The suitability of the site for a commercial facility and the environmental impacts of its construction and operation are primary considerations in a decision to proceed with the project. It is possible that the sale of the demonstration plant will not occur and that one of the alternate fates will result. The probable impacts associated with each of the possible alternate fates are identified below. Impacts of commercial operation at expanded capacity are also discussed throughout Sect. 4.

5.2.1 Commercialization at an expanded capacity

One of the primary objectives of constructing and operating a demonstration plant is to obtain an environmental data base. This data will be used by regulatory agencies to establish emission and discharge limitations for maintaining acceptable environmental quality and by industry for evaluating the economics of a commercial facility, including required environmental controls. It is assumed that the decision to construct a commercial-scale facility at the demonstration plant site will be made in consideration of information that is currently unavailable and can only be obtained by constructing and operating the demonstration facility. The analysis that follows focuses on environmental issues that can be identified at this time as potential

impacts of commercial development at the proposed site. Though the discussion of commercial-scale impacts is limited in this FEIS, DOE will prepare appropriate NEPA documentation prior to transfer by DOE of the demonstration facility.

Socioeconomic

Commercialization at expanded capacity would provide a significant economic benefit to the area. The local tax base would increase significantly because ownership of the facility is expected to be transferred to private industry at the end of the demonstration phase. Further improvements to the property preparatory to commercialization would increase the valuation of the facility. Operation of the facility would result in a continuing monetary input to the local area in the form of salaries and wages as well as primary services provided to the facility by local businesses and by secondary services to support the personnel employed at the plant.

Secondary commercial development is expected to occur to support the demonstration facility in the short term. Commercialization would cause a long-term demand for these services as well as a probable expansion of such secondary commercial development. The initial operating labor force of 725 would expand to approximately 2200 workers, many of whom are expected to be local, thus providing a major local employment base. (The exact number is difficult to predict until operating experience has been gained during the demonstration phase. However, based on experience in scale-up of similar facilities, the labor force should not increase in direct proportion to plant capacity.) Balanced against this positive impact is the negative impact of an increased strain on community services and resources, especially during construction. Assuming that the socioeconomic infrastructure existing during the construction and operation phases of SRC-I demonstration remains unchanged during the commercialization phase, it is estimated that about 1000 to 2800 construction workers would relocate to Daviess, Henderson, and Vanderburgh counties at the peak of construction. The demands that these workers and their families will make on housing and public services should not exceed the capacity of the local infrastructure of the area as a whole, but localized significant impacts are still possible, and some increase in police and fire protection manpower could be required for much of the impact area. In addition, unless appropriate mitigation measures have been taken during the construction and demonstration phase of SRC-I, serious traffic problems on U.S. 60 are likely to be associated with SRC-I commercialization (Sect. 4.2.4.3). These traffic impacts may be particularly severe on the residents of nearby small communities.

The required construction labor force will be larger than that for the demonstration plant, but it should not be a direct scale-up in proportion to plant capacity. Labor requirements are expected to be distributed much more evenly over a longer period of time compared with construction of the demonstration plant. Construction of the other proposed commercial-scale synthetic fuel plants and electrical generating plants simultaneously with construction of the SRC-I commercial plant would likely cause severe competition for labor and the need to import more workers (Sect. 7.3 of this Summary and Sect. 4.2.5). Assessment of the available labor pool would be done when planning and scheduling construction of the commercial plant. This would have to take into account competition with whatever other projects are under way in the area at the time. Appropriate adjustments would have to be made to minimize distortion of the local labor pool. Based on the current best-available estimates, the peak construction labor force will be about 5,000 to 10,000, compared with 3,500 to 5,000 for the demonstration plant.

Because of the duration of the commercialization construction project and the probable development of other projects, in-migrating skilled laborers could tend to be of a less transient nature than those present during the demonstration plant construction. Continuous sequenced construction projects of many years' duration requiring similarly balanced distribution of skills might result in a long-term increase in the labor force. This would affect the local communities less than would a purely transient force, especially in the area of providing services for those workers. Experience gained by the local area in accommodating demonstration plant construction should help in planning for growth during commercial plant construction (Sect. 7.3 of this Summary and Sect. 4.2.5).

Air quality

The commercial plant, which will process five times as much coal as the demonstration plant, will not result in five times as much impact on air quality. The emission rates from the commercial plant will depend on many factors, such as product slates and process design. Because planning for the commercial plant is still in an early stage, the emission rates cannot be estimated with a high degree of certainty. A worst-case analysis is used in the EIS in lieu of a definitive design.

It is estimated that the emissions rates of the commercial plant will be less than five times those of the demonstration plant for all pollutants. The emission rates for SO_2 and particulates will be less than directly proportional to the plant capacity, because the capacity of the coker/calciner, which is the major source (75 to 80%) of these pollutants in the demonstration plant, would not be greatly expanded beyond the demonstration plant capacity. Also, emerging process and control technologies, such as flash coal drying, which could greatly reduce emissions but is not yet commercially proven, will likely be employed for the commercial plant. Extensive monitoring in the demonstration plant, too, may reduce emissions in the commercial plant by providing more accurate emission data that can be used for design improvement.

Increases in ground-level concentrations of the pollutants may not be directly proportional to increases in the plant capacity either. About 75% of the site would be occupied by the commercial plant; some sources of emissions are separated by hundreds of meters. The relatively large distances separating the sources reduce the additive impact of each source.

The first key assumption is that the production rate of coke of the commercial plant will be about the same as that of the demonstration plant and that the production rates of the other products will be approximately five times that of the demonstration plant.

The PSD standards for an expanded commercial plant are expected to be met. It should be noted, however, that the availability of PSD increments cannot be projected to the date of operation of the commercial plant. Monitoring data recorded during demonstration will indicate the actual dispersion characteristics and will be applied to project dispersion for the commercial plant. This will result in greater accuracy in the model, which should help in designing the plant to meet guidelines.

Sulfur dioxide. The SO_2 emissions from the commercial plant are estimated to be less than two times those of the demonstration plant. The commercial plant is anticipated to be a minor source of SO_2 in the area. No violations of the NAAQS are anticipated. It is also expected to consume a very small portion of the PSD increment. Even if increases in the ground-level concentration were directly proportional to increases in the emission rate, it is estimated that only 8% of the 24-h increment for SO_2 would be consumed by the commercial plant.

Particulates. The particulate emission rates for the commercial plant are derived by scaling up the estimated emission rates from the demonstration plant. Since issuance of the DEIS, changes have occurred in the plant design and operating plans resulting in lower demonstration plant particulate emissions and consequently lower air quality impacts. The following discussion describes these changes and how they have affected the prediction of emissions and air quality impacts for the commercial plant. The DEIS stated that an estimated 73% of the PSD 24-h increment for particulates will be consumed by the demonstration plant. However, updated Industrial Source Complex (ISC) dispersion-modeling analyses have reduced that estimate to 18.3% for the demonstration plant. The DEIS predicted a maximum 24-h ground-level concentration of 26.9 $\mu g/m^3$; the new estimate is 6.74 $\mu g/m^3$ for the demonstration plant alone and 8.1 $\mu g/m^3$ for all PSD sources in the area. The new estimated average annual concentration for all PSD sources in the area is 1.26 $\mu g/m^3$.

Based on overly conservative emissions assumptions, it was estimated in the DEIS for the demonstration plant that 20 of the 26.9 $\mu g/m^3$ maximum 24-h concentration was caused by fugitive emissions alone; new results have reduced this contribution to 2.4% of the 6.74 $\mu g/m^3$ total concentration. The reduction in fugitive particulate air-quality impact was achieved by considering three key factors which had not been considered for the DEIS: the effect of wind

speed on SRC- and coal-pile wind erosion losses, the impact of scheduling SRC- and coal-loading and unloading operations for only 8 out of 24 h, and the effects of using prewashed coal. Each factor is discussed in more detail in Appendix S. The particulate emission rate from point sources in the commercial plant is expected to increase by a factor of 4 and fugitive emissions by a conservative factor of 5 over the demonstration plant to a total of about 615 tons per year. Considering point and fugitive sources, preliminary modeling indicates that about 56% of the allowable 37-$\mu g/m^3$, 24-h increment for particulates would be consumed. Modeling results indicate that the commercial plant can be constructed within the 24-h and annual incremental restrictions, if point-source contributions increase by four; fugitive emissions are conservatively assumed to increase fivefold for the commercial plant.

Accurate fugitive particulate emission predictions cannot be made at this time; only monitoring during demonstration plant operation can give a reliable estimate from which to scale. Fugitive particulate emissions from the demonstration plant were estimated using a variety of EPA publications and sources. The available fugitive particulate emissions literature is not very reliable because the information is typically based on actual testing of coal dust sources, and the emission factors do not take into account many important factors that can affect the emissions, such as surface area of coal piles and their orientation with respect to the prevailing wind, whether the coal has been washed to reduce the silt content, or the effects of wind speed on pile losses. Only actual monitoring can accurately determine fugitive emission rates from the demonstration plant and provide a better basis for estimating fugitive emissions and the effectiveness of control measures from the commercial plant.

Hydrocarbons. The hydrocarbon emissions from point sources in the demonstration plant, as well as the commercial plant, will be small. As for the demonstration plant, hydrocarbon emissions from the commercial facility will depend on control of the fugitive sources. Fugitive sources of hydrocarbons in the demonstration plant are estimated to contribute almost 90% of the plant's overall 62 tons per year hydrocarbon emission rate. The estimates utilized for the demonstration plant emission inventory in Appendix C are based on the EPA guideline document *Assessment of Atmospheric Emissions from Petroleum Refining*, Vol. 3, Appendix B, April 1980. This document is based on emission measuring activities at 13 petroleum refineries throughout the United States. Overall fugitive emission rates from fittings such as valves, flanges, pumps, and compressors varied greatly among the refineries investigated; and none of the refineries studied employed maintenance or design consideration programs as stringent as those planned for the SRC-I plant. Consequently, the emissions inventory for the demonstration plant may be conservative. Operating experience at the demonstration plant would allow for more precise estimation of emissions for expansion to commercial capacity. If analysis prior to commercialization indicates the plant could be a major source of hydrocarbons, appropriate design considerations will be employed by the commercial plant operator as necessary. As a worst-case assumption, the hydrocarbon emission rate from point and fugitive sources in the commercial plant can be assumed to be five times that of the demonstration plant, or less than 350 tons per year. This hydrocarbon emission from the commercial plant would not result in a significant impact.

Nitrogen oxide. The nitrogen oxide emission rate of the commercial plant is estimated to be four to five times that of the demonstration plant. The resulting maximum increase in nitrogen dioxide due to the commercial plant is not anticipated to violate NAAQS for nitrogen dioxide even if the ground-level concentration were to increase fivefold.

Carbon monoxide. The commercial plant would emit a maximum of five times the CO of the demonstration plant. The plant commercialization may result in only 2.5 times the CO emissions of the demonstration plant, if the large CO_2 vent stream (which also contains 50% of the facility's CO emissions) can be pipelined to a tertiary oil recovery operation, rather than vented to the atmosphere. This option appears feasible for a commercial-sized plant. Even if CO emission is five times that of the demonstration plant, no violation of the NAAQS is expected.

Hydrogen sulfide. Modeling for H_2S concentrations carried out for the PSD permit application for the demonstration plant indicates that the odor threshold for the demonstration plant (10 parts per billion) will not be exceeded. If the H_2S emissions are conservatively estimated to scale upward by a factor of 5 for the commercial plant, the odor threshold for H_2S could be exceeded under certain meteorological conditions. Analysis during the demonstration phase will determine whether H_2S emissions must be lower than these conservatively estimated rates to meet

odor standards for the commercial plant. Mitigation measures will be taken in the design of the commercial plant if required.

Lead. Lead concentrations for the demonstration plant were predicted using very conservative estimates of atmospheric lead emissions (i.e., all lead entering with the coal was assumed to be vented to the atmosphere at each of two locations, thus doubling accounting). Actual lead emissions from the demonstration plant are expected to be much less than this conservative estimate, and emissions from the commercial plant are thus expected to be much less than a 5 times scale-up of this conservative estimate. The resulting lead concentrations will be lower than the ambient air quality standards. Monitoring during the demonstration phase will be done to confirm this analysis.

Solid waste

Alternatives for solid waste management for the commercial facility include, but are not limited to, onsite vs offsite disposal; alternative landfill configurations for gasifier slag and fly dust; waste stabilization vs hazardous landfilling; and disposal vs reutilization of the materials. The ultimate decision on the solid waste management at the commercial facility will be most effectively determined on the basis of studies and monitoring conducted at the demonstration plant. The demonstration plant will have an extensive monitoring program (Sect. 4.5) to determine the long-term fate of the contaminants in the solid waste materials. Runoff and leachate will be routinely analyzed. Such data will determine more definitely the environmental concerns related to disposing of such wastes and whether or not the waste is hazardous under RCRA criteria.

Because of the large quantities generated, the gasifier slag and fly dust occupy a large land area. For example, during the operation of the demonstration plant, a 16-ha (40-acre) area will be required for ash disposal and storage. During a 14-year period of commercial operation, 224 ha (560 acres) would be required for ash storage only 72 ha (180 acres) of which could be stored onsite. Offsite storage areas may be required during commercial operation of the facility. Precise area requirements will depend on landfill configuration. Alternative configurations to minimize land requirement are being evaluated, and the best alternative will be employed in the demonstration plant. Experience gained in the demonstration plant will facilitate the landfill design at the commercial plant. Characterization and groundwater monitoring during operation of the demonstration plant will provide data for evaluating the adequacy of the disposal facility. Utilization of the gasifier wastes as by-products will also be fully evaluated in the demonstration plant. A long-range program is required for the evaluation. One potential application would be to use the materials as aggregates for road construction. Utilization of materials would be a solution to the solid waste management problems at the commercial facility. While no additional impacts are anticipated as a result of commercialization, actual large-scale production and disposal of SRC-I solid wastes have not been demonstrated.

The additional onsite storage of more process wastes (in addition to process chemicals and products) increases the potential for accidental contamination of groundwater and surface water. Hazardous solid wastes generated by the commercial facility will scale up to a conservatively estimated 81,000 dry tons per year. Sufficient hazardous landfill capacity will exist to dispose of this material onsite. In situ evaluation of several commercially available waste stabilization processes will be a part of the solid waste testing program at the demonstration plant. The evaluations will determine whether or not the processes can convert hazardous wastes to nonhazardous wastes, or improve handling properties of solid wastes. Again the data will be used in the scale-up to the commercial plant.

Aquatic ecology and surface-water quality

Water quality impacts resulting from the expansion of the SRC-I demonstration plant to commercial scale are difficult to predict. The fivefold expansion in plant capacity will cause less than a fivefold increase in the demand for water. Like the demonstration plant, the commercial plant is assumed to have the capability for wastewater recycling and to operate primarily in

the zero-discharge mode. (It should be noted that zero wastewater discharge operation generates a considerable volume of water-soluble wastes that require special landfill disposal. The environmentally preferable wastewater treatment strategy involves an assessment of the trade-off between discharging dissolved solids vs attempting to landfill dried soluble salts.) For a worst-case analysis of water quality impacts, a fivefold increase in the volume of wastewater discharged was considered (Table 4.11). When fully mixed with the 7-d, 10-year low flow from the Green River (11,156 liters/s), the 295 liters/s discharged from the commercial plant is projected to cause violations of water quality standards for chromium, cyanide, iron, manganese, mercury, phenol, copper, silver, zinc, and selenium. The discharges of cadmium, chromium, copper, phenol, silver, zinc, and selenium would substantially degrade water quality and could require occasional plant shutdown or reduction of plant throughput during low flow to maintain water quality standards.

During the demonstration phase, much experience will be gained in wastewater handling. The characteristics of the raw wastewater and the performance of treatment systems will be determined under a variety of loading, operating, and environmental conditions. In addition, the impacts of the demonstration plant on the Green River will be monitored (Sect. 4.5). Performance and reliability of the wastewater treatment and recycling system will be established. The information and experience thus gathered will provide a sound basis for the design of the commercial-scale wastewater treatment system. If necessary, backup wastewater recycling systems can be included in the design to ensure that no discharge occurs when river flows would provide insufficient dilution. The ultimate impacts to water quality from commercial-scale plant operation will depend on the operating experience and a number of unknown factors, including the effluent limitations, other regulations applied to the solvent-refining process, and possible changes in the process technology.

Land use

Construction of a commercial facility at the demonstration plant site would have minor additional impacts on land use. Acquisition of the site and construction of the demonstration plant would result in the major land-use impacts. Whereas about one-half of the site would be utilized during the demonstration phase, about three-fourths of the site would be utilized during the commercial phase for the process area, product storage area, and solid waste storage area.

Endangered species

The Indiana bat, a species listed as endangered by USFWS, occurs on the site along Martin Creek and may be affected (Sects. 3.2.1.3 and 4.2.1.3). No other species classified as threatened or endangered by the USFWS or Kentucky should be affected by the project. Commercial facilities would be located closer to Martin Creek than the demonstration facility but would not require clearing of the forest. A biological assessment has been prepared for the USFWS (Appendix K.1). Appendix K contains a detailed discussion of mitigation options for fish and wildlife resources.

Increased barge traffic

Impacts will occur from increased barge utilization for shipment of construction equipment, feed coal, and some products. Commercialization of the demonstration plant would require expansion of the barge-docking facilities. A small amount of prime farmland and riparian woodland would be destroyed. Erosion would increase during expansion construction, but this impact would be short term. Coal transportation to the commercial plant is intended to be essentially 100% by barge. This additional coal barge traffic should not cause the total traffic to approach the current capacity of the Green River. However, cumulative effects resulting from other projects on the Green River combined with SRC-I could cause the capacity to be exceeded (Sect. 4.2.5).

Prime farmland

Additional disturbance of site soils and loss of prime farmland would occur. Expansion of the project to commercial scale would adversely impact site soils not directly impacted during construction of the demonstration plant. Approximately 90% of the site's soils are classified as "prime" by the U.S. Department of Agriculture Soil Conservation Service (Appendix X).

Habitat loss

Additional impacts on terrestrial ecology could occur. Commercialization would result in additional loss of wildlife habitat. During operation of the demonstration plant, monitoring programs will determine if any unexpected impacts to terrestrial ecology (e.g., severe vegetation stress from air pollutants) have occurred.

Floodplains and wetland encroachment

Increased encroachment in the floodplain-wetlands would occur. Because of local site relief and topography and the need for barge facilities and water intake and discharge structures, it is not possible for the proposed demonstration plant to completely avoid encroachment in the Green River floodplain. The process area for the demonstration plant will be located on the southern part of the site in an area that is naturally above the 500-year flood elevation. During the commercial stage of the project, additional floodplain area would be required for plant facilities, product storage, barge facilities, and solid waste disposal. Risks to the commercial facility would be mitigated by filling the affected areas to an elevation above the project-design flood stage. Filling to raise required floodplain areas above flood elevation will reduce the flood storage area of the Green River floodplain. Calculations derived from the Army Corps of Engineers HEC-2 computer model indicate that the impacts of such action will be minor and almost undetectable (Appendixes D and E). Large quantities of soil must be imported from offsite to fill additional floodprone areas and to build dikes. Solid waste landfills will be built in areas prone to floods, and unless bases of the landfill are raised (as may be required by RCRA), the liners will be subjected to uplifting forces from high groundwater tables during major floods. The design of all landfills will take the flooding potential into account and will be consistent with any applicable RCRA guidelines. [An additional wetland effect will be modification of a small additional amount of Green River shoreline and associated riparian forests because of expansion of the barge facility (Appendix D).]

Erosion and sedimentation

The potential exists for increased erosion and sediment loading as a result of construction. The relatively small area to be disturbed, the use of sediment control facilities, and the experience gained in constructing the demonstration plant are expected to effectively mitigate these potential impacts. Because site preparation during the construction phase for commercial expansion would be of relatively short duration, impacts would be short term and would end essentially at the completion of construction.

Noise

Commercial plant construction will slightly increase sound levels and may exceed both EPA's short-term guidelines for residential locations and the U.S. Housing and Urban Development (HUD) standards for residences. Commercial plant operation sound levels would not change the present ambient sound levels significantly. The estimated change is small, although the future day/night equivalent sound level may exceed the EPA's long-term goals of 55 db for residences near the plant boundary (Sect. 4.2.3.2).

5.2.2 Continued operation of the facility at demonstration plant capacity

It is possible that the proposed two-year operation of the demonstration facility will not provide the data base desired for commercialization. A likely result would be an extension of the demonstration program and continued operation of the plant.

Changes in the design and operation of the plant will undoubtedly occur during the operating phase. Process and environmental monitoring during the operation will be used to identify the significant environmental impacts, their sources within the plant, and the available methods for mitigating them (see Sects. 4.5 and 4.6). Consumption of available water and PSD air quality increments would continue and would limit other potential users. Solid waste would continue to accumulate. Rail and possibly barge traffic would continue.

If the Federal government continues to own the site, the area would continue to experience a modest loss of tax revenues. However, this loss of tax revenue would be offset somewhat by the continued employment of about 725 workers and with the additional indirect or secondary jobs created through the growth of support industries and services during construction and initial operation of the plant. The local jurisdictions have a more than adequate infrastructure capacity to absorb the demands of a continued operation-phase work force of 725 employees, secondary employees, and their families.

5.2.3 Conversion of the facility to another government use

If, at the conclusion of the demonstration plant operation, private industry is not interested in constructing a commercial plant, DOE may elect to convert the facility to another use or to offer it to other Federal agencies. Conversion to another use by either DOE or another Federal agency would be subject to NEPA review. In addition, appropriate permits would have to be modified or obtained.

The potential environmental impacts of an alternative use of the site would depend on the intended use and therefore cannot be evaluated at this time. In view of the availability of on site facilities for the receipt, transport, storage, and preparation of coal, it is likely that an alternative use would be related to coal utilization and that impacts associated with coal receipt and handling would continue.

Continued government ownership of the site would result in continued loss of tax revenue and, more significantly, would prevent an increase in revenue resulting from transfer of the site and improvements to private ownership. The significance of this loss of anticipated revenue would depend on the degree to which local financial plans had been developed in anticipation of such revenues. This reduction in revenue would be partially offset by continued employment resulting from the alternative use of the site.

Conversion of the facilities to an alternative use would probably require some construction work and associated work force. Impacts resulting from construction would probably be relatively minor because most of the disturbance would have occurred during construction of the demonstration facility, and construction activities would probably be limited primarily to the process area. The work force required for conversion would probably be smaller than that required for construction, and significant impacts would not be anticipated in the absence of a major competing project.

5.2.4 Mothballing of the facility

If there is no interest in constructing a commercial facility or in converting the site to an alternative use, DOE may elect to discontinue operation of the demonstration facility indefinitely with the intention of resuming operation at some future time. In this alternative, it is assumed that all process operations would cease and that equipment would be drained, cleaned as necessary, and prepared for extended shutdown. There would be minimal dismantling or removal of process equipment. Coal and product would be removed from the site. The slag disposal area and any other solid waste disposal areas would be closed and revegetated.

Leachate monitoring and treatment, if required, would be continued in accordance with RCRA requirements. Appendix C contains the proposed landfill closure plans.

Mothballing of the demonstration facility would result in elimination of air emissions, process wastewater discharge, consumptive water use, and slag production. Solid waste production would be reduced to that resulting from treatment of leachates from solid waste disposal areas and surface runoff. The facility would probably be maintained on the State air emissions inventory for a period of 18 months, temporarily limiting siting options for other emission sources. Location of other industries in the area could result in reduced availability of PSD increments and water resources for resumed operation.

Continued government ownership of the site would result in continued loss of property tax revenue and would prevent an increase resulting from transfer of the improved site to private ownership. This loss of revenue would not be offset by continued employment. It is anticipated that mothballing of the facility would result in layoff of most of the demonstration facility work force of about 725 and the elimination of essentially all secondary employment. The loss of this payroll would result in a minor, short-term decline in area income levels and a slight increase in local unemployment.

5.2.5 Decommissioning

If there is no interest in constructing a commercial facility, converting the site to another government use, or resuming operation of the demonstration facility, DOE may elect to decommission the facility and declare it excess property to be disposed of by the General Services Administration; the appropriate NEPA review would be done at that time.

If decommission occurs, it is probable that the significant value of the improvements and the short operating history would make the site desirable as an industrial facility and that it would be sold for this purpose. Impacts resulting from conversion to an industrial use other than an SRC commercial facility would result in impacts that cannot be fully evaluated at this time. As in the case of conversion to another government use, it is probable that an alternative use would involve coal utilization and that the impacts of coal receipt, handling, and preparation would continue. As in the case of conversion to another government use, impacts of construction required for conversion to another use would probably be relatively minor. Sale of the facility for an industrial use would result in a tax benefit because the site and improvements would be placed on the tax rolls. Continued employment would also be a positive benefit. Should there be no interest in purchase of the site for alternative use or should the government elect not to sell, the impacts would be essentially equivalent to those resulting from mothballing.

It is probable that major vessels and equipment would be removed. However, complete restoration of the site to its original condition would not be undertaken, and the site would be available for future development for industrial use.

5.3 CUMULATIVE EFFECTS

The proposed SRC-I project (both the demonstration and expanded commercial phases) is one of nine energy projects under construction, proposed, or planned for construction and operation within a 70-mile commuting radius (40 air miles) of the proposed Newman site. The nine projects are SRC-I, W. R. Grace, Tri-State Synthetic Fuels, H-Coal, Rockport I and II, D. B. Wilson, Gibson, Hancock, and A. B. Brown. Some of these construction efforts are currently scheduled to have simultaneous peak construction periods and all (except SRC-I demonstration phase) are scheduled to overlap significantly during the construction phase.

Construction of three electrical coal-fired generating plants are scheduled to be under way while the SRC-I demonstration plant is being built: Rockport I and II, D. B. Wilson plant, and the A. B. Brown plant. During the latter half of the SRC-I demonstration construction phase, construction will continue on the Rockport, A. B. Brown, and Wilson plants, and construction of two commercial synthetic fuel plants is projected to begin (W. R. Grace plant and Tri-State Synthetic Fuels plant).

Construction on three synthetic fuel plants and two electrical generating plants within a 70-mile commuting radius is scheduled to be ongoing when construction of the expanded SRC-I commercial plant is scheduled. The synthetic fuel plants are the W. R. Grace, Tri-State, and H-Coal plants, and the generating plants are the Hancock and A. B. Brown plants. During the latter half of the SRC-I commercial plant construction, only the Hancock plant should still be under construction.

The W. R. Grace and Tri-State synthetic fuel plants and the Rockport generating plant would have the most interaction with the SRC-I project.

The potential adverse economic, social, and cultural impacts are the most significant cumulative effects of the region's development. The SRC-I project will take place within the framework of this large regional development of energy projects.

The projected labor demand in the region will require a cumulative peak construction work force of about 27,700, of which 3,000 will be employed at the start of SRC-I construction at other power plant projects in the area. Of the 24,700 new jobs at peak for the major energy facilities, it is estimated that about 75% of this work force will be imported from outside the region. The population will increase by about 55,000 over a period of several years as a result of these in-migrating workers, their families, and indirect economic expansion. This population increase is only 8% of the existing population of the 21-county impact region and would not cause a boomtown effect at the regional scale. However, the three-county area of Henderson, Daviess, and Vanderburgh, all of which are within easy commuting distance of the SRC-I plant and several other facilities, would receive a disproportionately large number of in-migrants and could face severe impacts.

Should this situation occur, the public services, housing, transportation, and local economic infrastructures would likely be faced with adverse impacts such that significant planning and mitigation measures would be required. According to present, very tentative schedules for all of the projects, it appears that construction of the SRC-I demonstration plant would contribute somewhat to adverse impacts to area communities because of several simultaneous projects, but that construction of the SRC-I commercial facility may actually aid some communities by extending the cumulative impact period. This latter situation could provide greater community incentive to undertake permanent improvements and could also help prevent rapid population fluctuations and their accompanying social impacts. These conclusions are very sensitive to schedules of the projects. Relatively minor delays or accelerations in construction schedules of individual plants would greatly affect the level of impacts (Figs. 4.10 and 4.11).

In regard to SRC-I specifically, the present schedule calls for construction of the demonstration plant to begin in late 1981 and end in 1984. Such a schedule would place SRC-I construction prior to the mid-1980s period of greatest impacts, thus making the SRC-I demonstration plant relatively noncontributory to cumulative impacts. On the other hand, delay of SRC-I by even one year would result in the plant's contributing more significantly to cumulative impacts, if other projects remain on schedule. In respect to the construction of the commercial plant beginning in 1987, the contribution of SRC-I to cumulative impacts would appear again to be negligible, based upon current schedules of all the facilities. Indeed, the SRC-I plant could actually prove beneficial to local communities by helping prevent rapid population fluctuations and their accompanying social impacts due to regional construction and by providing sufficient additional employment to encourage communities to invest in more permanent facilities for accommodating the overall population growth. Again, it should be pointed out that the SRC-I schedule as well as those of the other facilities are very susceptible to substantial change and that such changes could alter the magnitude of impacts. DOE would cooperate with the states of Kentucky and Indiana and with local jurisdictions to monitor the situation, do appropriate planning, identify any necessary mitigating measures, and provide project data on a quarterly basis.

To prevent SRC-I construction activities from contributing significantly to peak cumulative impacts, the SRC-I construction schedule should be coordinated with those of the W. R. Grace and Tri-State Synthetic Fuels facilities to avoid concurrence of their peak or near-peak construction periods. To address those cumulative impacts which do occur, mitigation measures should be developed and implemented jointly by the management of all major construction projects

in the area, with a special emphasis on coordinating the mitigation activities of SRC-I, Grace, and Tri-State. To maximize effectiveness, a joint mitigation plan should be developed by the area developers acting in cooperation with local and regional governments. Such a regional mitigation plan resulting from these efforts would guide the timely provision of those services and accommodations necessary to handle construction-induced growth without any serious disruptions to local infrastructures. Contingency plans would also be made to deal with any worsening of projected impacts which may arise as a result of delayed construction schedules. In the event of construction delays, the potential for SRC-I contributing significantly to severe cumulative socioeconomic impacts would exist without the coordinated scheduling and cooperative mitigation planning described above.

Cumulative impacts on barge movement on the Ohio River are expected to be minimal. Barge traffic on the Green River, however, may experience delays because existing locks do not have the capacity to meet projected barge requirements for coal transport (Sect. 4.2.5).

The cumulative water consumption for the SRC-I commercial plant, the W. R. Grace synfuel plant, and the D. B. Wilson and Paradise generating plants could exceed 30% of the Green River's 7-d, 10-year low flow. The Ohio River Basin Commission has adopted 10% of the 7-d, 10-year low flow as the guideline criterion for identifying potential adverse impacts from water consumption for energy. Water consumption from the Green River is a potentially serious cumulative effect. A study to assess the severity of impacts caused by cumulative water consumption will need to be performed before commercialization.

Cumulative water quality effects will be limited to the lower course of the Green River downstream of the SRC-I plant. Cumulative impacts are unlikely in other portions of the region because of the distance between plants, and the dilution capacity of the Ohio River. If, like the proposed SRC-I plant, all the coal conversion facilities operate predominantly in a zero-discharge mode, impacts to water will result from occasional wastewater discharge and from infrequent spill events. Because pollutant releases will be relatively small, any direct cumulative effects are expected to be infrequent and minor. If wastewater discharge is more frequent or is predominant mode of operation, water quality impacts would have to be reassessed using data from the proposed plants, which are currently unavailable.

Because of the distance separating the plants from the SRC-I site, cumulative air quality impacts with SRC-I are insignificant, except for a small impact from the Grace plant, which is the closest and largest of the proposed plants. It is located at the edge of the 15-km (10-mile) zone considered to be the area likely to experience cumulative impacts on air quality. Cumulative effects are thus expected to have only minor impacts on regional air quality, although they will add slightly to problems of nonattainment of TSP standards in the cities.

For the most part, effects on land use, geology, soils, terrestrial ecology, noise, and groundwater will be site specific and localized. Of these potential effects, loss of prime farmland would probably be the most significant effect of a cumulative nature. No endangered terrestrial species occur in the area with the exception of the Indiana bat, whose habitat extends throughout the area during summer months. The facilities occupy an insignificant portion of the species range and will have no cumulative effect on the winter habitat considered critical to the species' survival.

Cumulative impacts at the proposed site are discussed in greater detail in Sect. 4.2.5.

6. SELECTION OF AN ALTERNATIVE SITE, PLANT DESIGN, OR PLANT LAYOUT

One of the three alternatives available to DOE is to modify the currently proposed action by use of alternative sites or plant designs. From an environmental standpoint, such modifications could be used to lessen the environmental impact of the proposal. The following section evaluates the feasibility of using alternative sites and plant designs to lessen the environmental impacts of the project.

6.1 ALTERNATIVE SITES

Emissions and discharges from the demonstration plant are determined primarily by the design of process and support facilities and may be reduced through application of the various design alternatives discussed in Sect. 2.3.2.2. Assuming that the design of the demonstration plant is unchanged, the significance of the impacts produced by construction and operation is determined to a large extent by the physical characteristics and quality of the environment of the site at which the plant is located.

The contract awarded for the Phase-Zero design study required that the industrial participant submit a site-specific proposal. Although environmental factors were considered by Rust Engineering Company in the site-selection work, they were considered in combination with a number of other factors to arrive at the choice of Newman as the proposed site. In 1976 Rust Engineering Company under the sponsorship of the Kentucky Center for Energy Research (KCER) undertook this alternate site analysis for selection of a site for a 2000-tons/d SRC-I plant. The Rust study evaluated sites from a list of potential Kentucky sites supplied by KCER. The siting criteria used in the Rust study were primarily physical, engineering, and economic factors that were judged to be important for construction and operation of the SRC-I plant. The Rust study consisted of four phases that, by eliminating potential sites from a large list, sequentially narrowed the number of potential SRC-I sites. Phase I of the analysis concentrated on potential siting "areas" and evaluated these areas on general, physical, and environmental requirements and constraints. Phase II of the analysis consisted of a more detailed evaluation of the 24 potential siting areas identified in Phase I. This phase reduced the number of potential sites to ten. Phase III of the analysis eliminated five of these ten sites because of site-specific physical constraints and land availability. The final phase included a more stringent evaluation of the physical, cultural, and economic constraints of the five remaining sites. In the final phase, seven site requirements were assigned weighted values and the sites compared. Newman, Kentucky, was selected as the preferred site in Rust's study, and Equality and Lewisport were rated as prime alternative sites. At that time, the Executive Orders 11988 and 11990 concerning floodplain/wetland encroachment had not been issued, and DOE was not a participant in the project.

After Rust Engineering completed its site-selection activity for the SRC-I project, several important events occurred. DOE became a participant in the project, the proposed plant capacity was increased to 6000 tpsd, with the goal of commercial expansion to 30,000 tpsd in the future, and Executive Orders pertaining to floodplain/wetland encroachment were issued (May 24, 1977).

Although a site had already been proposed for the project [as specified in DOE's Request for Proposal (RFP) and in its contract with the industrial partner], it was recognized that an evaluation of the impacts of the proposed plant at alternative sites would be necessary. To evaluate the impacts of construction and operation at possible alternative sites, an independent analysis of available sites was conducted. Based on this analysis, which is described in detail in Appendix B, two sites were identified as reasonable alternatives to the proposed site: one on the Green River near Equality, Kentucky, and one on the Ohio River near Ravenswood, West Virginia (Fig. 2.6). Appendix B (Sect. B.2) describes the actual site selection process conducted by Rust Engineering Company in 1976, which includes the proposed site. Section B.3 describes the ORNL analysis, which evaluates sites other than Newman for the selection of two reasonable alternative sites for evaluation against Newman in Sects. 2.3.2, 4.3, and 4.4.

A definitive comparison of the environmental acceptability of alternative sites is severely constrained not only by the degree to which judgmental factors enter the analysis but also by the availability of consistent and detailed information on each site. In this case, detailed information exists for the proposed site from over one-year of baseline monitoring, whereas only the reconnaissance-level information is available for the alternative sites. Even though environmental comparisons such as these are based on dissimilar levels of baseline data, sufficient information is available to enable a reasonable evaluation of the alternative sites.

6.2 ALTERNATIVE PLANT DESIGNS

Analysis of alternative plant designs began with the screening of the major process areas to identify effluents and emissions under normal and upset conditions, potential for adverse environmental impacts, and control requirements. Within the limits of the existing conceptual plant design, 12 major process areas and control options, identified as having potential for causing significant adverse impacts, were evaluated to identify the environmentally preferable alternatives and, when possible, to determine the potential for reducing impacts through selection of this alternative. The following areas and options were evaluated and are summarized below and discussed in Sect. 2.3.2.2 and Appendix C:

- separation of mineral residue,
- disposition of mineral residue,
- hydrogen production,
- gasification processes,
- sulfur recovery and emission control,
- process hydrocarbon emission control,
- waste heat rejection,
- wastewater treatment,
- plant fuels,
- particulate emission control,
- product solidification, and
- slag/flydust disposal.

This evaluation indicates that the proposed design includes the environmentally preferable alternative for (1) separation and disposition of the mineral residue; (2) hydrogen production; (3) sulfur recovery; (4) particulate emission control for process emissions and the storage of coal, SRC solid product, coke, and sulfur; (5) plant fuels; and (6) wastewater treatment. The evaluation of alternatives for gasification processes did not identify significant differences in the potential environmental impacts of the technologically viable alternatives.

Evaluation of alternatives for heat rejection, process hydrocarbon emission control, product solidification, slag/flydust disposal, and sulfur emission control indicates that further study might reveal an alternative with less environmental impact than the proposed design. It should be noted that this evaluation is limited by the conceptual nature of the current plant design. These alternatives are being further evaluated by both DOE and the industrial participant to determine their technical and economic feasibility and to obtain a more quantitative evaluation of their potential for reducing adverse environmental impacts. The work plan between DOE, EPA, and the KDNREP discusses the review role of these agencies in some of the pollution control decisions (Appendix EE). Process and control alternatives currently under study are discussed below.

6.3 ALTERNATIVE DESIGNS CURRENTLY UNDER EVALUATION

The designs of several plant features of environmental significance are incomplete and will be highlighted for environmental review during the detailed-design phase.

- Although the main processing units will normally not emit hydrocarbons, other than fugitive releases, process upsets and emergencies may occur that require immediate disposal of combustible vapors and gases to relieve internal pressures. Some of these combustible materials may contain complex organic compounds, including carcinogenic substances, and flaring from an elevated flarestack (a conventional refinery and petrochemical industry practice) may not adequately destroy these compounds. Separation of light materials from heavy ones by cooling and condensation, then flaring the easily combustible light vapors while incinerating the heavy liquids may provide complete combustion of all hydrocarbons.

A controlled combustor system could be used to incinerate the heavy hydrocarbons. The design of this system is under evaluation by DOE and the industrial participant and represents one of the major environmental control decisions to be made during the detailed design phase.

- The proposed design calls for predominantly wet evaporative cooling for heat rejection and for the use of dry aerial and indirect cooling for process units containing heavy-hydrocarbons compounds (the compounds of principal concern from a health standpoint). Such systems would virtully eliminate potential cooling system emissions of such hydrocarbons to the atmosphere. However, several alternative cooling configurations exist for accomplishing this objective, with varying amounts of water consumption and varying atmospheric effects. Furthermore, the choice of a cooling system is linked to the use of a zero-wastewater discharge treatment system that would require some wet evaporative cooling as a means of water consumption. Consequently, alternatives for both the cooling and wastewater recycle systems are being evaluated concurrently because most of the treated effluent will be used as makeup water for evaporative cooling.

- The proposed SRC product solidification system using indirect cooling is the environmentally preferable alternative of the technically proven processes. A direct contact cooling alternative is currently being investigated to determine technical feasibility. Should this alternative prove to be technically viable, it will probably be the environmentally preferable alternative.

- The proposed design for SO_2 control from the coke/calciner is a wet soda ash scrubber that appears to be the preferred alternative among the wet-scrubbing systems. Dry scrubbing with soda ash and cloth filters is also being considered. Dry scrubbing could provide a higher particulate-removal efficiency than wet scrubbing at the potential expense of less certainty in the level of SO_2 control achieved since dry scrubbing is not considered commercially proven technology for the low feed concentration found in this application. Sending the flue gas to the gas treatment system (sulfur recovery) would not be a feasible alternative because the gas would be too voluminous and the concentration of SO_2 would be too dilute for effective removal.

- Laboratory tests on gasifier slag and flydust (Appendix P) indicate that these materials are nonhazardous under RCRA criteria. This would suggest that these solids could be acceptably stored in a "nonhazardous" landfill. The Phase-Zero conceptual design proposed storing the wastes in a nonhazardous landfill having a 6-in.-thick clay liner. During preparation of the DEIS, DOE/ICRC evaluated alternatives to this landfill design and proposed constructing the first slag landfill as a hazardous waste disposal facility having a 3-ft-thick clay liner above a synthetic liner. Currently, several alternatives are under consideration, and EPA and KDNREP are providing guidance to DOE/ICRC. In any case, the design will incorporate compacted clay and synthetic liners, leachate detection and removal systems, and dikes to prevent inundation in the event of a 500-year flood. The design alternatives being evaluated relate to liner thickness, liner permeability, and the elevation of the landfill base relative to the groundwater table.

6.4 ALTERNATIVE PLANT LAYOUTS

The possibility of building the facilities above the designated floodplain areas has been studied. If the ability to expand to a commercial plant (30,000 tpsd) were not an objective, it would be possible to build the demonstration plant (6000 tpsd) completely above the base floodplain with the exception of the barge facility and the water intake/discharge structure. This assumes that the estimated areas for gasification (for which detailed information is not yet available), coal storage (30-d inventory and no provisions for blending), and the slag/ash pond would not increase in size. Piping running to the storage areas would be longer and cost more. Construction areas would be more confined and would probably result in higher cost. Such an approach would preclude or seriously constrain the possibility of expansion to a commercial plant since only low-lying flood prone areas with inferior subsoil conditions would remain available. Therefore, construction of all facilities above the base floodplain is impractical.

The facilities plan (Appendix D, Figs. D.1 through D.3) calls for grading the site and locating all the demonstration plant processing facilities and hazardous waste landfills above 500-year flood level (118-m or 388-ft elevation), locating all remaining facilities above the 100-year base flood level (117-m, or 385-ft elevation), and building floodproof, impervious dikes around liquid storage and ash ponds, with the top of the dike above 500-year flood level.

Using onsite soils as the only source of fill material, these elevations would only be possible if the bottom of the slag ponds and the liquid storage tank farm are allowed to stay below the 100-year base flood level. The slag landfill bottom elevation would be 114 m (373 ft), and the base of the liquid storage dike would be at 115 m (377 ft) (Appendix C, Fig. C.14). No problem is foreseen in constructing high dike walls to prevent flood inundation of these storage areas. The ponds would be constructed to provide low permeability consistent with RCRA standards. In the event of a 100-year flood, the slag ponds would be weighted with the addition of water to resist the uplifting force on the liner from the rising groundwater table.

If it were considered essential to raise the bottom of the storage tanks and the slag ponds to above the 117-m (385-ft) flood elevation, it could be done by lowering the elevation of the nonprocessing facilities (administration building, coal storage piles, etc.) to 117 m (383 ft). The processing facilities could still be maintained above the 500-year flood level (118 m, or 388 ft). But there is not enough soil available onsite to level the entire site above the 100-year flood elevation.

Alternatives to the proposed layout and grading plan (Fig. D.3) that were considered are as follows:

- Site the demonstration plant only on nonfloodplain areas. This alternative would severely constrain commercial expansion of the demonstration plant. This limitation is caused by the inferior subsoil conditions of the remaining lowland areas.

- Utilize an adjacent 90-acre tract of flood-free land not currently within the site boundaries. This alternative may be feasible for the commercial phase but not practicable for the demonstration phase because of delays (up to 11 months) which would be necessary for additional environmental monitoring and plot plan rearrangements and would not materially change the floodplain/wetlands impacts of the proposed action.

- Grade the plant site area to above the 500-year flood elevation. Although this alternative is feasible, it would still result in floodplain encroachment and would require fill materials to be brought in from off site at considerable added expense (approximately $30 million in 1980 dollars).

- Alter the proposed grading plan by raising bases of the slag ponds and liquid storage areas above the 100-year flood elevation. This would require that nonprocess areas be lowered to 117 m (383 ft). If offsite fill were used, however, these elevations would not have to be lowered. The liquid storage area and the slag disposal area will be diked above the 500-year flood elevation to mitigate the flood danger. The threat of uplifting forces on the slag pond base from a high groundwater table can be mitigated by weighting the top side of the liner with additional water. In view of these mitigation measures the cost of filling these areas is not justified.

7. NO ACTION

7.1 NO DOE ACTION — PROJECT TERMINATED

If the decision is made to choose the alternative of terminating the contract to go forth with the demonstration project, the SRC-I process may not be demonstrated in the near future and the opportunity to obtain the intended environmental, technical, and economic data on the SRC-I process at near-commercial scale would be greatly reduced. If the proposed SRC-II demonstration plant project is carried out, that project could provide information of a generic nature similar to that which would be obtained from SRC-I such as hydrogen production via gasification; ash and slag disposal; pressure letdown; large-scale oxygen production; wastewater treatment; solid-liquid separation; and high-temperature and -pressure handling of

hydrocarbon, hydrogen, and oxygen mixtures. However, the conceptual designs for each of the two SRC demonstration plants have unique features such as solid-liquid separation and wastewater treatment. Demonstrating both technologies would provide a valuable diversity of information and operating experience about alternative designs. The Exxon Donor Solvent and H-Coal pilot plants have been constructed and are currently in the mechanical shakedown and testing phase. These plants could also contribute generic information for advancing the SRC-I technology (Sect. 1).

The adverse impacts on the physical and biological environment and the socioeconomic conditions in the region would not occur if the no action alternative is chosen.

Another aspect of the no action alternative is that the private sector may decide to commercialize the SRC-I technology. If commercialization takes place without the benefit of a demonstration plant, it is likely that development would proceed in a less controlled manner, with large-scale technical and environmental problems solved during the operation of the plant rather than during the design and demonstration of the plant.

7.2 NO DOE ACTION — PROJECT CONTINUES UNDER OTHER SPONSORSHIP

If DOE withdraws from the project and if the proposed action continues under other sponsorship at the proposed site, the project could, but would not necessarily, result in the same environmental impacts as the proposed action. The project under other sponsorship would be required to comply with all appropriate environmental requirements. Before issuance of appropriate permits, EPA and COE would perform necessary NEPA reviews.

The proposed action discussed in this FEIS includes certain monitoring and mitigation measures that exceed legal requirements and that may not be undertaken if the project proceeds under other sponsorship. These measures include the long-term environmental and health research plan outlined in Appendix Z.2 and ecological, traffic, and other socioeconomic monitoring and mitigation measures.

The major impact associated with this no action alternative would be the unacceptable social impacts to local communities if effective traffic mitigation measures are not undertaken. Other major social impacts would occur because of cumulative effects with other projects if the construction schedule is delayed by transfer of sponsorship from DOE to other parties. A benefit of the project continuing under other sponsorship would be increased tax revenues.

If ICRC continues with the project without DOE involvement, ICRC has indicated that, although it is not required to do so, it currently intends to carry out the monitoring and mitigation measures described in Sects. 4.5 and 4.6, with the exception of the following: socioeconomic measures and the long-term environmental and health research plan in Appendix Z. ICRC has committed to develop a traffic monitoring and mitigation plan, although not necessarily the specific program identified in Sects. 4.5 and 4.6. The effectiveness of this yet-to-be-developed ICRC plan cannot be evaluated at this time.

7.3 DELAY THE ACTION

Another possible alternative available to DOE is delay of the project and the EIS process until the design for the plant has been finalized and until ongoing environmental and health studies have been completed. It has been suggested that this course of action would give DOE a more comprehensive data base to assess the likely environmental impacts of the project and to decide whether to proceed with it. This alternative might also enable DOE to assess more completely the adequacy of the mitigation measures that will be implemented to ameliorate the adverse impacts associated with the project.

On the other hand, it is estimated that plant design will not be finalized until late 1982. Moreover, some of the research necessary to determine the full extent of the environmental impacts of the demonstration plant must await actual construction, operation, and monitoring of the plant; other ongoing studies will require a substantial amount of time before definitive

results can be reported and evaluated. It must be remembered that one of the objectives of this project is to obtain information regarding the environmental and ecological effects of a technology that is unproven and heretofore untested at this scale. This information, along with the effectiveness of environmental control systems, must necessarily be developed in stages. Therefore, even if the EIS were to be delayed until final design is complete, many unknowns would remain concerning actual environmental and health effects.

After seriously considering this delay alternative, DOE has concluded that it is not reasonable because it would mean that a major, irreversible, and irretrievable commitment to the project would be made without benefit of an EIS, perhaps foreclosing other options. By preparing an EIS now, DOE can gain valuable information that can be used to determine whether it should proceed with actions leading to construction and operation of the proposed plant.

8. MONITORING

Extensive monitoring is planned on and around the plant site throughout the project (Sect. 4.5). A substantial portion of the monitoring program will be required of this project, as it would be for any large energy facility of emission source, to demonstrate that the plant is being constructed and operated in compliance with existing environmental quality standards. A portion of the monitoring program will focus on early detection of pollutants or contaminants in ambient and work-place environments so that adverse effects can be avoided or mitigated. The remainder of the monitoring program will be used to acquire an understanding of environmental and health effects caused by the presence or release of chemical substances from SRC technology for which no legislated standard exists. Obtaining this data is one of the fundamental purposes of the SRC-I demonstration project.

The objectives of the monitoring program are fourfold and are largely interrelated:

1. to determine both acute and chronic effects of construction and operation on the biosphere, with particular emphasis on man and his environment;

2. to identify and understand the causes of these effects and find direct technological efforts to mitigate them;

3. to provide adequate process information for control, optimization, and evaluation of the treatment systems; and

4. to demonstrate compliance with environmental quality standards.

The monitoring program has been divided into four segments: (1) environmental, (2) in-plant, (3) health effects, and (4) socioeconomic. Where applicable, the monitoring program segments are being designed for each of the chronological phases of the project (i.e., preconstruction, construction, start-up, and operation). The preconstruction monitoring program will be a continuation and supplementation of the baseline monitoring that was conducted for preparation of the EIS. It has been designed to determine a statistically significant baseline for chemical, physical, biological, and socioeconomic characteristics. The preconstruction monitoring program will enable subtle environmental changes due to construction and operation of the demonstration facility to be detected and statistically substantiated. Data will be integrated in an attempt to describe basic ecological interrelationships. Monitoring programs for the construction and operational phases are outlined; however, many of the program details will depend on the results of the preconstruction monitoring program and the final design.

Construction and operation of the plant must comply with a large number of environmental and health-related standards and regulations. These standards and regulations for construction and operation include consideration of occupational safety and health, air quality, water quality, solid waste disposal, spill prevention and cleanup, noise, endangered species, proper management of floodplains and wetlands, and preservation of national historic landmarks. Appendix W identifies all of the permits required for construction and operation of the facility.

One of the purposes of the SRC-I demonstration program is to identify any serious health risks associated with the demonstration plant itself and a future commercial SRC industry and to minimize those risks before the onset of adverse effects.

To understand these risks, the project sponsors are developing a program to

1. monitor routine, fugitive, and emergency emissions from the plant to characterize the actual contaminants leaving the plant;

2. monitor the ambient environment to predict impacts and the effectiveness of measures to mitigate them, detect impacts that were not predicted, and in general, identify how contaminants are transported through the environment and where they appear of accumulate;

3. monitor occupational environments to determine worker exposure to routine, toxic, and biologically active chemical compounds so that they may be controlled to within established limits;

4. conduct medical surveillance of the work force to enable early detection of any signs of stress or adverse effects related to occupational exposures; and

5. conduct research studies to develop a fundamental understanding of how the physical environment and the biological environment respond to the unique chemical contaminants that appear in and around the plant as a result of the project.

The emphasis of the monitoring program is on prevention of adverse impacts through early detection and mitigation.

Monitoring of plant emissions and the ambient environment, although related to health protection, are discussed in separate sections (4.5.3 and 4.5.2) of the monitoring program. The research program is outlined in more detail in Appendix Z. Personnel exposure and medical monitoring are uniquely part of the plant operation phase health effects monitoring and will be handled by the medical and industrial hygiene staff at the plant. Detailed personnel exposure and medical monitoring plans are expected to be finalized during the detailed design and construction phase of the demonstration project. The plans will be based on the results of the ongoing research program (Appendix Z), which includes toxicological testing.

CONTENTS

Volume I

	Page
FOREWORD	iii
SUMMARY	v
LIST OF FIGURES	xxxiii
LIST OF TABLES	xli
1. PURPOSE, NEED, STATUS, AND PROGRAMMATIC OVERVIEW	1-1
1.1 INTRODUCTION	1-1
1.1.1 Description of the proposed action	1-1
1.1.2 Location of the proposed facility	1-1
1.1.3 Status of the proposed action	1-2
1.2 PURPOSE AND NEED FOR COAL LIQUEFACTION ACTIVITIES	1-2
1.2.1 National policy	1-2
1.2.2 Need for additional domestic energy resources	1-3
1.2.3 Energy options	1-4
1.2.3.1 Contribution of nonfossil energy sources	1-4
1.2.3.2 Contribution of fossil energy sources	1-9
1.2.4 Coal liquefaction	1-14
1.2.4.1 Goals and objectives of DOE's coal liquefaction activities	1-14
1.2.4.2 Indirect liquefaction	1-14
1.2.4.3 Direct liquefaction	1-15
1.2.4.4 Advanced liquefaction development research	1-16
1.2.5 Need for environmental, health, and safety information	1-17
1.2.5.1 Health risk assessment methodology	1-18
1.2.6 Liquid alternatives and environmental impacts	1-21
1.2.6.1 Increased domestic oil production	1-21
1.2.6.2 Oil shale development	1-23
1.2.6.3 Enhanced oil recovery	1-24
1.2.6.4 Outer continental shelf petroleum	1-24
1.2.6.5 Tar sands and heavy oil	1-25
1.2.6.6 Biomass/alcohol	1-25
1.2.6.7 Coal-oil mixture technology	1-25
1.2.6.8 Imported oil	1-26
1.2.6.9 Direct coal combustion	1-26
1.2.7 Coal liquefaction programmatic alternatives and environmental impacts	1-26
1.2.7.1 No action	1-26
1.2.7.2 Limited-involvement, long-term research and development	1-31
1.2.7.3 Extensive-involvement research, development and demonstration	1-32
1.3 PURPOSE AND NEED FOR THE PROPOSED ACTION	1-32
1.3.1 Summary	1-32
1.3.2 Purpose	1-32
1.3.2.1 Demonstration plant objectives	1-33
1.3.3 Need	1-34
1.3.3.1 Process features	1-34
1.3.3.2 Solids	1-35
1.3.3.3 Anode coke	1-37
1.3.3.4 Liquids	1-37

Page

1.4 POTENTIAL FOR COMMERCIALIZATION AND CUMULATIVE IMPACTS 1-37
1.4.1 Unit plant emissions 1-38
1.4.2 Description of existing environment 1-38
1.4.2.1 Water availability 1-39
1.4.2.2 Socioeconomics 1-40
1.4.2.3 Coal supplies 1-40
1.4.2.4 Air quality 1-40
1.4.2.5 Transportation systems 1-41
1.4.3 Cumulative environmental consequences 1-41
1.4.3.1 Approach 1-41
1.4.3.2 Air quality 1-42
1.4.3.3 Water availability 1-44
1.4.3.4 Water quality 1-45
1.4.3.5 Land disturbed 1-46
1.4.3.6 Solid waste 1-47
1.4.3.7 Socioeconomic 1-47
1.4.3.8 Occupational safety and health 1-49
1.4.4 Unavoidable adverse impacts 1-50
1.4.4.1 Air 1-50
1.4.4.2 Water 1-50
1.4.4.3 Soils 1-51
1.4.4.4 Topography 1-51
1.4.4.5 Flora and fauna 1-51
1.4.4.6 Socioeconomic values 1-51
REFERENCES FOR SECTION 1 1-52

2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION 2-1
2.1 INTRODUCTION 2-1
2.1.1 Background 2-1
2.1.2 Alternative actions available to DOE 2-1
2.1.3 Summary comparison of alternatives 2-1
2.2 DESCRIPTION OF THE PROPOSED ACTION 2-2
2.2.1 Proposed plant design 2-2
2.2.1.1 Overall process description 2-3
2.2.1.2 Supporting facilities 2-6
2.2.2 Proposed site: Newman, Kentucky 2-19
2.3 COMPARISON OF ALTERNATIVES AVAILABLE TO DOE 2-20
2.3.1 Impacts resulting from the proposed action 2-20
2.3.1.1 Impacts during the demonstration 2-20
2.3.1.2 Impacts of alternative fates of the facility after the demonstration 2-25
2.3.1.3 Cumulative effects 2-33
2.3.2 Selection of an alternative site, plant design, or plant layout 2-35
2.3.2.1 Alternative sites 2-35
2.3.2.2 Alternative plant designs 2-43
2.3.2.3 Alternative plant layouts 2-55
2.3.3 No action 2-56
2.3.3.1 No DOE action — project terminated 2-56
2.3.3.2 No DOE action — project continues under other sponsorship 2-56
2.3.3.3 Delay the action 2-57
REFERENCES FOR SECTION 2 2-57

3. DESCRIPTION OF THE EXISTING ENVIRONMENTS 3-1
3.1 INTRODUCTION 3-1
3.2 PROPOSED SITE — NEWMAN, KENTUCKY 3-1
3.2.1 Land 3-1
3.2.1.1 Land use and development 3-1
3.2.1.2 Geology and soils 3-3

Page

3.2.1.3 Vegetation and wildlife 3-9
3.2.2 Water 3-12
3.2.2.1 Surface water hydrology 3-12
3.2.2.2 Groundwater hydrology and quality 3-13
3.2.2.3 Surface water quality and aquatic ecology 3-17
3.2.3 Air 3-27
3.2.3.1 Meteorology and air quality 3-27
3.2.3.2 Noise 3-30
3.2.4 Economic, social, and cultural features 3-30
3.2.4.1 Population 3-32
3.2.4.2 Economic base 3-35
3.2.4.3 Housing 3-39
3.2.4.4 Public services and finance 3-42
3.2.4.5 Transportation 3-47
3.2.4.6 Historical, cultural, and archaeological features 3-51
3.3 ALTERNATIVE SITE 1 — EQUALITY, OHIO COUNTY, KENTUCKY 3-52
3.3.1 Land 3-52
3.3.1.1 Location 3-52
3.3.1.2 Land use and development 3-52
3.3.1.3 Geology and soils 3-56
3.3.1.4 Terrestrial ecology 3-57
3.3.2 Air 3-57
3.3.3 Water 3-58
3.3.3.1 Surface water hydrology 3-58
3.3.3.2 Groundwater 3-58
3.3.3.3 Surface water quality and aquatic ecology 3-58
3.3.4 Economic, social, and cultural 3-59
3.3.4.1 Population 3-59
3.3.4.2 Housing 3-60
3.3.4.3 Public services 3-61
3.3.4.4 Transportation 3-62
3.3.4.5 Economic base 3-63
3.3.4.6 Labor and income 3-64
3.3.4.7 Local government taxation 3-64
3.3.4.8 Historical and archaeological resources 3-65
3.4 ALTERNATIVE SITE 2 — RAVENSWOOD, JACKSON COUNTY, WEST VIRGINIA 3-66
3.4.1 Land 3-66
3.4.1.1 Location 3-66
3.4.1.2 Land use and development 3-66
3.4.1.3 Geology and soils 3-70
3.4.1.4 Terrestrial ecology 3-70
3.4.2 Air 3-71
3.4.3 Water 3-71
3.4.3.1 Surface water hydrology 3-71
3.4.3.2 Groundwater 3-71
3.4.3.3 Surface water quality and aquatic ecology 3-71
3.4.4 Economic, social, and cultural resources 3-73
3.4.4.1 Population 3-73
3.4.4.2 Housing 3-74
3.4.4.3 Public services 3-75
3.4.4.4 Transportation 3-77
3.4.4.5 Economic base 3-78
3.4.4.6 Labor and income 3-79
3.4.4.7 Local government taxation 3-79
3.4.4.8 Historical and archaeological resources 3-80
REFERENCES FOR SECTION 3 3-81

4. ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES 4-1
4.1 OCCUPATIONAL AND PUBLIC HEALTH EFFECTS 4-1
4.1.1 Introduction 4-1

Page

4.1.2 Materials of concern and research priorities 4-3
4.1.3 Sources of exposure and control plans 4-4
4.1.3.1 Engineering control of process emissions during normal and upset conditions 4-4
4.1.3.2 Major emergency upsets 4-6
4.1.3.3 Engineering controls of fugitive emissions 4-7
4.1.3.4 Maintenance 4-8
4.1.3.5 Monitoring 4-8
4.1.3.6 Occupational health protection 4-9
4.1.3.7 Transportation accidents 4-11
4.1.3.8 Control of other industrial health hazards 4-15
4.1.3.9 Summary of health and environmental research program 4-16
4.1.3.10 Exposure from product end-use applications 4-17
4.1.3.11 Hydrotreatment of SRC liquids 4-18
4.2 PROPOSED SITE — NEWMAN, KENTUCKY 4-19
4.2.1 Land 4-19
4.2.1.1 Land use 4-19
4.2.1.2 Geology and soils 4-21
4.2.1.3 Terrestrial ecology 4-23
4.2.2 Water 4-26
4.2.2.1 Surface water hydrology 4-26
4.2.2.2 Groundwater quality and hydrology 4-28
4.2.2.3 Surface water quality 4-33
4.2.2.4 Aquatic ecology 4-41
4.2.3 Air 4-47
4.2.3.1 Air quality 4-47
4.2.3.2 Noise 4-64
4.2.4 Economic, social, and cultural impacts 4-67
4.2.4.1 Socioeconomic impacts from project construction 4-67
4.2.4.2 Operations phase impact 4-96
4.2.4.3 Impacts related to commercialization at an expanded capacity 4-98
4.2.4.4 Impacts of decommissioning and mothballing 4-101
4.2.5 Cumulative impacts 4-101
4.2.5.1 Introduction 4-101
4.2.5.2 Land 4-105
4.2.5.3 Water 4-106
4.2.5.4 Air 4-108
4.2.5.5 Noise 4-109
4.2.5.6 Economic, social, and cultural 4-109
4.2.5.7 Traffic 4-115
4.2.5.8 Coal reserves 4-116
4.2.5.9 Transport of coal and products 4-116
4.3 ALTERNATIVE SITE — EQUALITY, KENTUCKY 4-118
4.3.1 Land 4-118
4.3.1.1 Land use and development 4-118
4.3.1.2 Geology and soils 4-118
4.3.1.3 Terrestrial ecology 4-119
4.3.2 Water 4-119
4.3.2.1 Surface water hydrology 4-119
4.3.2.2 Groundwater 4-120
4.3.2.3 Surface water quality and aquatic ecology 4-120
4.3.3 Air quality 4-122
4.3.3.1 Construction impacts 4-122
4.3.3.2 Operational impacts 4-122
4.3.4 Economic, social, and cultural 4-122
4.3.4.1 Population 4-122
4.3.4.2 Housing 4-124
4.3.4.3 Public services 4-126
4.3.4.4 Transportation 4-127

Page

4.3.4.5 Economic base 4-129
4.3.4.6 Labor and income 4-129
4.3.4.7 Local government taxation and spending 4-130
4.3.4.8 Historical and archaeological resources 4-130
4.3.4.9 Impacts of commercialization, decommissioning, or mothballing 4-131
4.3.5 Cumulative impacts 4-131
4.4 ALTERNATIVE SITE — RAVENSWOOD, WEST VIRGINIA 4-133
4.4.1 Land 4-133
4.4.1.1 Land use and development 4-133
4.4.1.2 Geology and soils 4-134
4.4.1.3 Terrestrial ecology 4-134
4.4.2 Water 4-135
4.4.2.1 Surface water hydrology 4-135
4.4.2.2 Groundwater 4-135
4.4.2.3 Surface water quality and aquatic ecology 4-136
4.4.3 Air quality 4-136
4.4.3.1 Construction impacts 4-136
4.4.3.2 Operational impacts 4-137
4.4.4 Economic, social, and cultural impacts 4-137
4.4.4.1 Population 4-137
4.4.4.2 Housing 4-139
4.4.4.3 Public services 4-140
4.4.4.4 Transportation 4-141
4.4.4.5 Economic base 4-143
4.4.4.6 Labor and income 4-143
4.4.4.7 Local government, taxation, and spending 4-144
4.4.4.8 Historic and archaeological impacts 4-144
4.4.4.9 Impacts of commercialization or decommissioning 4-145
4.4.5 Cumulative impacts 4-145
4.5 MONITORING PROGRAM 4-146
4.5.1 Introduction 4-146
4.5.2 Monitoring in the surrounding environment 4-147
4.5.2.1 Preconstruction environmental monitoring program 4-148
4.5.2.2 Construction environmental monitoring program 4-154
4.5.2.3 Operations environmental monitoring program 4-154
4.5.3 In-plant monitoring 4-155
4.5.4 Health effects monitoring 4-156
4.5.5 Socioeconomic monitoring 4-159
4.6 MITIGATION MEASURES 4-160
4.6.1 Process controls 4-160
4.6.2 Socioeconomic 4-161
4.6.2.1 Mitigation measures for noise levels 4-161
4.6.2.2 Mitigation measures for transportation problems during construction 4-162
4.6.2.3 Mitigation measures for other socioeconomic impacts 4-162
4.6.3 Archaeological resources 4-163
4.6.4 Land 4-163
4.6.5 Water 4-164
4.6.6 Aquatic ecology 4-165
4.6.7 Air quality 4-165
4.6.8 Terrestrial ecology 4-166
4.6.9 Occupational health 4-166
4.7 THE CARBON DIOXIDE ISSUE 4-168
4.8 FLOODPLAIN/WETLANDS REVIEW 4-168
4.9 NO ACTION 4-169
4.9.1 No DOE action 4-169
4.9.2 No DOE action — project continues under other sponsorship 4-169
4.9.3 Delay the action 4-170
REFERENCES FOR SECTION 4 4-171

Page

5. LIST OF PREPARERS AND PROFESSIONAL QUALIFICATIONS 5-1
5.1 PROJECT MANAGEMENT 5-1
5.2 METEOROLOGY AND AIR QUALITY 5-2
5.3 GEOLOGY, HYDROLOGY, AND SOILS 5-2
5.4 SOCIOECONOMICS 5-3
5.5 WATER QUALITY AND AQUATIC ECOLOGY 5-6
5.6 TERRESTRIAL ECOLOGY 5-7
5.7 PLANT DESIGN 5-8
5.8 OCCUPATIONAL AND PUBLIC HEALTH EFFECTS 5-9
5.9 HAZARDS IDENTIFICATION 5-9

Appendix A. COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT A-1

Volume II

LIST OF FIGURES v
LIST OF TABLES ix

Appendix B. SELECTION OF THE PROPOSED AND ALTERNATE SITES B-1

Appendix C. PLANT DESIGN AND CHARACTERIZATION OF EFFLUENTS C-1

Appendix D. SRC-I FLOODPLAIN/WETLANDS REVIEW D-1

Appendix E. IMPACTS ON FLOOD ELEVATION E-1

Appendix F. SURFACE WATER HYDROLOGY F-1

Appendix G. LETTER FROM THE CORPS OF ENGINEERS ON FLOOD ELEVATIONS G-1

Appendix H. SURFACE WATER QUALITY H-1

Appendix I. U.S. DEPARTMENT OF ENERGY — U.S. FISH AND WILDLIFE SERVICE CORRESPONDENCE I-1

Appendix J. AQUATIC ECOLOGY J-1

Appendix K. TERRESTRIAL ECOLOGY K-1

Appendix L. GEOLOGY AND SOILS L-1

Appendix M. GROUNDWATER HYDROLOGY M-1

Appendix N. GROUNDWATER QUALITY N-1

Appendix O. GROUNDWATER AVAILABILITY O-1

Appendix P. COAL, SLAG, AND SRC SOLID PRODUCT LEACHING TESTS P-1

Appendix Q. PROJECT ENVIRONMENTAL PLAN FOR THE SRC-I DEMONSTRATION PLANT Q-1

Appendix R. MOBILITY OF POTENTIAL CONTAMINANTS IN SITE SOILS R-1

Appendix S. AIR QUALITY S-1

Appendix T. SOCIOECONOMICS T-1

Appendix U. LETTERS CONCERNING ARCHAEOLOGICAL AND HISTORICAL SURVEYS U-1

Page

Appendix V. THE CARBON DIOXIDE ISSUE V-1

Appendix W. PERMITS W-1

Appendix X. U.S. DEPARTMENT OF AGRICULTURE — SOIL CONSERVATION SERVICE LETTER ON PRIME FARMLANDS X-1

Appendix Y. BARGE DOCKING FACILITY Y-1

Appendix Z. HEALTH EFFECTS Z-1

Appendix AA. HAZARDS EVALUATION PROGRAM FOR THE SRC-I DEMONSTRATION PLANT AA-1

Appendix BB. COAL-MINING-IMPACT ALGORITHMS BB-1

Appendix CC. WORKER RELOCATION MODEL CC-1

Appendix DD. TRANSPORTATION SPILLS DD-1

Appendix EE. U.S. DEPARTMENT OF ENERGY, U.S. ENVIRONMENTAL PROTECTION AGENCY, AND KENTUCKY DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION WORK PLAN TO ASSURE ENVIRONMENTAL ACCEPTABILITY OF THE SRC-I PROJECT EE-1

Appendix FF. IMPLICATIONS OF THE TOXIC SUBSTANCES CONTROL ACT FOR SOLVENT REFINED COAL PROCESSES FF-1

Appendix GG. PRELIMINARY EROSION CONTROL PLAN GG-1

Appendix HH. GROUNDWATER CONTAMINATION CONTINGENCY PLAN HH-1

LIST OF FIGURES

Figure		Page
1.1	Scheme for technology assessment	1-18
1.2	Health risk analysis	1-19
1.3	Water requirements, land use, and solid waste production comparisons for 100,000 bbl/d energy alternatives	1-22
1.4	Air pollutant emissions normalized to 100,000 bbl/d production level	1-22
1.5	Qualitative and subjective comparative assessment of the potential for water quality degradation and health safety hazards	1-23
2.1	Basic flow diagram for the proposed SRC-I demonstration plant	2-4
2.2	Basic flow diagram for proposed SRC processing	2-5
2.3	Plant layout for the proposed SRC-I demonstration plant	2-6
2.4	Proposed zero wastewater discharge system	2-10
2.5	Details of the proposed wastewater treatment system	2-11
2.6	Regional setting of alternative sites	2-36
3.1	SRC-I study areas	3-2
3.2	Present land use of proposed site	3-3
3.3	The proposed SRC-I site	3-5
3.4	Soils map of the area	3-6
3.5	Regional geologic structure and fault map	3-7
3.6	Generalized cross sections on the site	3-9
3.7	Distribution of prime farmland soils in the site	3-10
3.8	Limits of approximate 100-year flooding on the site	3-14
3.9	Limits of an approximate 500-year flood on the proposed Newman site	3-15
3.10	Groundwater hydrologic setting	3-16
3.11	Surface water quality and sediment sampling locations on or near the proposed SRC-I site	3-19
3.12	Aquatic biology sampling locations on or near the proposed SRC-I site	3-23

Figure		Page
3.13	Wind direction and speed, frequency of occurrence on site, October through December 1977	3-28
3.14	Sound measurement locations on or near the proposed site	3-31
3.15	Examples of outdoor day-night average sound levels in dB measured at various locations	3-32
3.16	Commuting zones within 60- and 90-min areas	3-33
3.17	Map of the Newman, Kentucky, SRC-I plant transportation impact area	3-48
3.18	The Equality, Kentucky, alternative SRC-I site	3-53
3.19	Equality alternative site, regional location	3-54
3.20	Topography and general setting of the Equality, Kentucky, alternative site	3-55
3.21	100-year floodplain areas of the Equality, Kentucky, site	3-59
3.22	Current peak hourly traffic and hourly capacity for major roads in the Equality, Kentucky, region	3-63
3.23	The Ravenswood alternative SRC-I site in Jackson County, West Virginia	3-67
3.24	Ravenswood alternative site, regional location	3-68
3.25	Topography and general setting of the Ravenswood, West Virginia, alternate site	3-69
3.26	100-year floodplain areas of the Ravenswood, West Virginia, site	3-72
3.27	Current peak hourly traffic and hourly capacity for major roads in socioeconomic impact region	3-77
4.1	Isopleths of predicted annual mean SO_2 concentrations from all PSD sources within the study area	4-52
4.2	Isopleths of predicted second highest 24-h SO_2 concentrations from all PSD sources within the study area	4-53
4.3	Isopleths of predicted second highest 3-h SO_2 concentrations from all PSD sources within the study area	4-54
4.4	Isopleths of predicted annual mean TSP concentrations from all PSD sources within the study area	4-56
4.5	Isopleths of predicted second highest 24-h concentrations from all PSD sources within the study area	4-56
4.6	Isopleths of predicted annual mean NO_2 concentrations from all PSD sources within the study area	4-57
4.7	Isopleths of predicted second highest 8-h CO concentrations from all PSD sources within the study area	4-58
4.8	Isopleths of predicted second highest 1-h CO concentrations from all PSD sources within the study area	4-59
4.9	Energy project locations in the vicinity of the SRC-I site	4-103

Figure		Page
4.10	Projected cumulative construction and operation schedule for nine energy projects in the vicinity of the Newman site	4-104
4.11	Relative locations of the nine energy projects located in the drainage basin of the Ohio River	4-107
4.12	Projected cumulative construction labor demand according to present schedule	4-111
4.13	Rail lines and waterways near the SRC-I site	4-117
4.14	Estimated number of commuter vehicle round trips on selected road sections, Equality impact region	4-128
4.15	Estimated number of commuter vehicle round trips on selected road sections, Ravenswood impact region	4-142
C.1	Basic flow diagram for the proposed SRC-I demonstration plant	C-8
C.2	Basic flow diagram for proposed SRC processing	C-9
C.3	Plant layout for the proposed SRC-I demonstration plant	C-9
C.4	Sulfur balance	C-13
C.5	Conventional raw water intake device	C-16
C.6	Submerged raw water intake device	C-17
C.7	Proposed wastewater effluent river diffuser	C-17
C.8	A conceptual diagram of the treatment facility	C-20
C.9	Flow diagram for zero-discharge wastewater system	C-23
C.10	Preliminary water balance when treated wastewater is discharged	C-26
C.11	Preliminary water balance for the zero wastewater discharge case	C-27
C.12	Proposed controlled combustor/flare system	C-31
C.13	Cross-sectional diagram of the proposed hazardous waste landfill	C-40
C.14	Cross section of the proposed site showing the grading plans and the relative elevations of waste facilities, clay, and groundwater table	C-42
C.15	Alternative cooling systems	C-57
C.16	Emission levels of SO_2 from heaters during startup	C-64
D.1	SRC-I plot plan (shading shows areas above the 100-year flood elevation)	D-5
D.2	SRC-I plot plan (shading shows areas above the 500-year flood elevation)	D-6
D.3	Site development plans for the proposed SRC-I facility at Newman, Kentucky	D-8
D.4	Planned location of barge dock facility for the proposed SRC-I site	D-9
D.5	Preliminary design showing cross section of the barge dock facility planned for the proposed SRC-I site	D-10

Figure		Page
D.6	Conventional raw water intake device	D-11
D.7	Submerged raw water intake device	D-12
D.8	Proposed wastewater effluent river diffuser	D-12
D.9	Cross-sectional diagram of the proposed hazardous waste landfill	D-16
F.1	Major tributaries of the Green River and the common floodplain of the Green River and the Ohio River	F-4
F.2	Areas of the site inundated by historical and 5-year floods	F-5
F.3	Surface water systems in the vicinity of the site	F-6
J.1	Ichthyoplankton sampling locations by transect and station	J-8
K.1	Summer distribution of *Myotis sodalis* that winters in two of Kentucky's cave regions	K-5
K.2	Comparison of habitat values of forest and cropland areas based on values assigned in Table K.1	K-21
L.1	Physiographic provinces of Kentucky	L-3
L.2	Generalized stratigraphic column of the study area	L-5
L.3	Bedrock topography within 2 km (1.2 miles) of the site	L-7
L.4	Structure contours drawn on the base of the Vienna limestone	L-8
L.5	Structural areas of northwestern Kentucky	L-9
L.6	Modified Mercalli epicentral intensity scale for earthquakes	L-10
L.7	Seismic risk map of the United States	L-11
L.8	Generalized isoseismal map of the South Central Illinois earthquake, November 9, 1968	L-16
L.9	Approximate extent of loose sand lens in foundation	L-18
L.10	Oil and gas pools in site vicinity	L-27
L.11	Oil and gas wells within 1 km (0.6 mile) of site	L-29
L.12	Schematic relationships of soils in area	L-31
L.13	Surficial soils map of proposed site	L-33
M.1	Availability of groundwater in Daviess County and Henderson County	M-4
M.2	Piezometer well locations	M-6
M.3	Hydrographs of the Green River and SRC-I site piezometers — April 1980 through February 1981	M-7
M.4	Groundwater hydrologic setting	M-8
M.5	Columnar section for Newman site	M-9

Figure		Page
M.6	Proposed and existing observation well locations	M-11
M.7	Typical observation well installation	M-12
N.1	Well water quality sampling locations	N-8
O.1	Locations of test wells and drawdown of simulation well	O-4
O.2	Withdrawal well simulation	O-5
R.1	Concentrations of arsenic (unlined landfill) k = 1 x 10^{-6} cm/s for silty clay	R-8
R.2	Concentrations of cadmium (unlined landfill)	R-9
R.3	Concentrations of cadmium in an unlined landfill (50 years)	R-10
R.4	Concentrations of arsenic in an unlined landfill (50 years)	R-10
R.5	Concentrations of cadmium in an unlined landfill (100 years)	R-11
R.6	Concentrations of arsenic in an unlined landfill (100 years)	R-11
Y.1	Planned location of barge dock facility for the proposed SRC-I site	Y-6
Y.2	Preliminary design showing cross section of the barge dock facility planned for the proposed SRC-I site	Y-7
Z.1	Estimated time to complete Phase I biomedical and ecological studies, assuming receipt of material at time zero	Z-14
Z.2	Estimated time to complete Phase II biomedical studies, assuming receipt of material at time zero	Z-16
Z.3	Estimated time to complete Phase II ecological studies, assuming receipt of material at time zero	Z-16
AA.1	SRC-I demonstration plant simplified block flow diagram	AA-11
AA.2	Coal preparation system block diagram	AA-12
AA.3	Hydrogen production system block diagram	AA-12
AA.4	SRC process system block diagram	AA-13
AA.5	Gas systems block diagram	AA-14
AA.6	Product upgrading system block diagram	AA-15

LIST OF TABLES

Table		Page
1.1	U.S. energy consumption (quads)	1-4
1.2	Environmental impacts associated with a coal-fired power plant equipped with wet scrubbers and electrostatic precipitator	1-27
1.3	Environmental impacts associated with a coal-fired power plant utilizing an atmospheric fluidized bed and appropriate environmental controls	1-28
1.4	Environmental impacts associated with a power plant utilizing SRC-I solid fuel	1-30
1.5	Atmospheric emissions, direct coal liquefaction processes, SRC-I unit plant for point sources	1-38
1.6	Worst-case, treated wastewater discharges from SRC-I coal liquefaction plant	1-39
1.7	Coal liquefaction commercialization scenario	1-39
1.8	The national ambient air quality standards	1-42
1.9	PSD increments ($\mu g/m^3$)	1-43
1.10	Air pollutant emission inventory from coal liquefaction	1-43
1.11	Air emissions from liquefaction commercialization compared with energy sector and state total	1-43
1.12	Aggregate water use requirements	1-44
1.13	Land disturbed	1-46
1.14	Solid waste generation by state (10^3t/year)	1-47
1.15	Project-related employment	1-48
1.16	Increase in local population related to project	1-48
2.1	Products from SRC-I demonstration plant	2-3
2.2	Emission inventory of criteria pollutants from SRC-I point sources after control and nearby power plant	2-13
2.3	Identification of potential hazardous and nonhazardous solid wastes	2-17
3.1	Existing land uses for proposed site and adjacent area	3-4
3.2	Coal seams of the local area	3-8

Table		Page
3.3	Vegetation and cover types on the proposed site	3-11
3.4	Summary of significant onsite water quality analyses, 1977 and 1979	3-17
3.5	Summary of the water quality data collected during baseline monitoring of the Green River and onsite streams	3-20
3.6	Summary of water quality standards violated in selected reaches of the Green River	3-21
3.7	Summary of analyses performed on sediment collected in 1979 from the Green River and onsite bodies of water	3-22
3.8	Summary of the sampling conducted during baseline monitoring of aquatic biota in the Green River	3-24
3.9	Maximum concentrations of chemicals present in tissue samples from representative Green River fishes	3-25
3.10	Summary of the sampling conducted during baseline monitoring of aquatic biota in the bodies of water on or near the SRC-I site	3-26
3.11	Summary of air quality data for the proposed SRC-I site and surrounding area	3-29
3.12	Ambient sound levels at noise-sensitive locations surrounding the SRC-I site	3-30
3.13	Historical population growth characteristics for counties and principal urban areas in the SRC-I local impact area	3-34
3.14	Population estimates and projections for Daviess, Henderson, and Vanderburgh counties	3-34
3.15	Distribution of employment by major industry group, 1974 and 1979	3-36
3.16	Distribution of employment by major occupation group, SRC-I regions in Kentucky and Indiana, 1976	3-37
3.17	SRC-I multiplier analysis regions	3-38
3.18	Estimated employment of construction workers by craft in the 90-min, 116-km (70-mile) zone around Newman, Kentucky, 1979	3-39
3.19	Civilian labor force and unemployment for local impact counties of Kentucky and Indiana and U.S. average, selected years, 1973 to 1980	3-40
3.20	Per capita income in the SRC-I regional area for selected years, 1950 through 1977, by counties	3-40
3.21	Enrollments and school district enrollment capacities for Henderson, Daviess, and Vanderburgh counties, 1980-1981 school year	3-42
3.22	Health services characteristics of Henderson, Daviess, and Venderburgh counties, 1980	3-43
3.23	Property tax rates by county for Kentucky	3-46
3.24	Property tax rates by county for Indiana	3-46

Table		Page
3.25	Population at Henderson, Owensboro, and intermediate Route 60 points	3-47
3.26	Level of service description for a two-lane rural road	3-49
3.27	Population of counties and towns in the Equality, Kentucky, impact area	3-56
3.28	Percentage of current land use in Equality, Kentucky, impact region	3-56
3.29	Water quality and flow rate in the vicinity of the Equality, Kentucky, site	3-60
3.30	Impact area population growth from 1960-1980	3-61
3.31	Housing stock in the Equality, Kentucky, impact area, 1970-1980	3-61
3.32	Water and sewerage statistics for the Equality, Kentucky, impact region	3-62
3.33	Number of jobs by type of employment in the Equality, Kentucky, impact area, 1979	3-64
3.34	Wholesale and retail trade volumes for the Equality, Kentucky, impact area	3-64
3.35	Labor and income statistics for the Equality impact area	3-65
3.36	Combined State and local rates per $100 valuation	3-65
3.37	Current land use in socioeconomic impact region	3-69
3.38	Water quality and flow rate in the vicinity of the Ravenswood site	3-73
3.39	Population for counties and major municipalities in socioeconomic impact region	3-74
3.40	Housing stock and vacancies in socioeconomic impact region, 1970-1980	3-74
3.41	Essential public services in socioeconomic impact region	3-76
3.42	Number of jobs by type of employment in the socioeconomic impact region, 1979	3-78
3.43	Wholesale and retail trade volumes for impact region, 1977	3-79
3.44	Labor and income statistics for socioeconomic impact region	3-79
4.1	Summary statistics for projected SRC-I liquids movements	4-11
4.2	Predicted spill frequencies during rail shipment for the SRC-I demonstration plant liquid product	4-13
4.3	Approximate percentage of site area (by land-use classification) to be removed by SRC-I facility	4-20
4.4	Estimated annual value of agricultural production at the SRC-I facility site	4-21
4.5	Solid waste production rates	4-31
4.6	Chemical loading of SRC-I plant effluent to Green River under average conditions	4-34

Table		Page
4.7	Compliance of selected chemical constituents in projected plant effluent with water quality standards or criteria (after mixing using Q_{7-10})	4-35
4.8	Minimum daily flows for the Green River Lock Number 2 near Calhoun, Kentucky	4-36
4.9	Compliance of selected chemical constituents in projected plant effluent with water quality standards or criteria (after mixing using average annual minimum flow, 1966-1978)	4-37
4.10	Organic compounds in the projected SRC-I effluent	4-38
4.11	Compliance of chemical constituents in worst-case commercial plant effluent with water quality standards or criteria (after mixing using Q_{7-10})	4-40
4.12	Compliance of projected mixing zone concentration of potential toxicants with Kentucky water quality standard	4-42
4.13	Compliance of fully mixed concentrations (projected highest using Q_{7-10}) with Kentucky water quality standards for toxic substances	4-43
4.14	Compliance of fully mixed concentrations (projected highest using average annual minimum flow from 1966 to 1978) with Kentucky water quality standards for toxic substances	4-44
4.15	Potential toxicity and bioaccumulation of selected elements in SRC-I effluent	4-45
4.16	Air emissions from highway vehicles during combined peak 1982 traffic with and without SRC-I and W. R. Grace plants, assuming worst-case meteorological conditions	4-48
4.17	Estimated emissions to air for normal operation	4-50
4.18	Projected maximum pollutant concentrations of the SRC-I Plant, $\mu g/m^3$	4-51
4.19	Estimated daytime (L_d), nighttime (L_n), and day-night (L_{dn}) sound levels for general construction (excavation phase)	4-65
4.20	Estimated daytime (L_d), nighttime (L_n), and day-night (L_{dn}) sound levels for plant operation	4-66
4.21	Distances in feet to noise-sensitive areas	4-66
4.22	Construction effects on equivalent sound levels in decibels	4-66
4.23	Plant operation effect on day (L_d), night (L_n), and day-night (L_{dn}) sound levels in decibels	4-67
4.24	Proposed manpower schedule for SRC-I by construction craft	4-69
4.25	Baseline and projected construction employment in SRC-I impact region	4-70
4.26	Synfuels facilities and power plants scheduled for completion, 1981-1995	4-71
4.27	Projected number and distribution of construction workers, SRC-I demonstration peak employment 1983	4-72

Table		Page
4.28	Distribution of direct workers for four major impact counties	4-73
4.29	Projected indirect employment and in-migration at peak of SRC-I demonstration-phase construction, 1983	4-74
4.30	Projected total in-migration at peak of SRC-I demonstration phase construction, 1983	4-75
4.31	Incomes induced by SRC-I direct construction employment during twelve months surrounding 1983 construction peak	4-76
4.32	Housing requirements of SRC-I induced in-migrants (direct and indirect), peak construction year (1983)	4-77
4.33	Water and wastewater treatment requirements as a result of project-induced population growth in Owensboro, Henderson, and Evansville, peak construction year (1983)	4-80
4.34	Projected property tax revenues for each jurisdiction within SRC-I impact area, peak construction year (1983)	4-81
4.35	Projected state revenue contribution (in $) by school district, peak construction year (1983)	4-82
4.36	Residual capacities for alternate routing	4-87
4.37	Bus system	4-88
4.38	Louisville and Nashville Railroad current freight train schedule	4-89
4.39	Rail equipment and terminal costs for 3500 work force	4-90
4.40	Commuter system yearly operating cost for 3500 work force	4-90
4.41	Estimated system costs dedicated rail line	4-92
4.42	Estimated SRC-I plant worker vehicles at anticipated construction peak (1983) for ridesharing and park-and-ride alternatives	4-93
4.43	Synfuel facilities and electrical generating plants proposed or under construction in the Newman, Kentucky, area	4-102
4.44	Anticipated degrees of spatial interaction with SRC-I	4-105
4.45	Preliminary worst-case estimates of direct construction craft labor demand by project within 110 km of the SRC-I site	4-112
4.46	Project-induced in-migration during peak cumulative construction period, 1986	4-112
4.47	Counties most heavily impacted by worker in-migration resulting from cumulative regional labor demands	4-113
4.48	A comparison of project-induced in-migration for SRC-I alone and all large construction projects in cumulative impact region	4-113
4.49	Mixing of SRC-I effluent with seven-day, ten-year low flow of Green River (9500 liters/s) Equality site	4-121

Table		Page
4.50	Distribution of direct workers for major impact counties, Equality, Ky. site — SRC-I demonstration, peak employment (1983)	4-123
4.51	Projected indirect employment during peak construction period (1983), Equality, Ky., site	4-123
4.52	Projected in-migration to Equality, Ky., impact area, peak of SRC-I demonstration phase construction (1983)	4-125
4.53	Percentage of total in-migrants (movers and travelers) demanding various housing types	4-126
4.54	Construction-induced traffic and road capacities for the Equality site	4-127
4.55	Secondary incomes received by impact counties as a result of construction employment spending, 1983	4-130
4.56	Counties most heavily impacted by worker in-migration resulting from cumulative regional labor demands, Equality, Ky., site	4-132
4.57	Mixing of SRC-I effluent with seven-day, ten-year low flow of Ohio River, Ravenswood site (194,000 liters/s)	4-137
4.58	Distribution of direct workers for major impact counties, Ravenswood, W. Va., site, SRC-I demonstration peak employment (1983)	4-138
4.59	Projected in-migration to Ravenswood, W. Va., impact area, peak of SRC-I demonstration phase construction (1983)	4-139
4.60	Housing supply and project-induced demand in Ravenswood, W. Va., impact area, peak construction year (1983)	4-140
4.61	Construction-induced traffic and road capacities for the Ravenswood site	4-141
4.62	Major standards and regulations applicable during construction	4-147
4.63	Major standards and regulations applicable during operation	4-148
4.64	Summary of the preconstruction air quality monitoring	4-149
4.65	Meteorological monitoring program	4-149
4.66	Parameters for soil monitoring	4-150
4.67	Parameters for groundwater monitoring	4-151
4.68	Summary of proposed aquatic supplemental baseline monitoring	4-153
4.69	Components of the aquatic studies	4-153
4.70	Analytical parameters for periphyton, sediment, and fish	4-154
4.71	Terrestrial ecology monitoring program	4-155
4.72	Gaseous systems monitoring (preliminary)	4-157
4.73	Liquid systems monitoring	4-157
4.74	Solid waste systems monitoring	4-158

Table		Page
4.75	Fugitive NMHC monitoring	4-158
B.1	Initial site screening — sites not satisfying physical constraints	B-7
B.2	SRC-I sites remaining after initial screening	B-7
B.3	Comparison of two sites on seven important environmental variables	B-8
B.4	Rating of the ten remaining potential sites on seven environmental variables	B-8
B.5	Comparison matrix for potential SRC-I sites	B-9
B.6	Site rating following the pair-wise comparison for potential SRC-I sites	B-9
B.7	Second evaluation ratings for potential SRC-I sites	B-10
B.8	Second comparison matrix for SRC-I sites	B-10
C.1	Products from SRC-I demonstration plant	C-10
C.2	Sources of naphtha and fuel oils	C-10
C.3	Approximate enthalpy balance	C-27
C.4	Identification of potential hazardous and nonhazardous solid wastes	C-39
C.5	Process line fittings and predicted control efficiences	C-51
C.6	Summary of base case and alternate cooling systems	C-59
C.7	Estimated emissions to air for normal operation	C-61
C.8	Feed coal composition	C-62
C.9	Emission inventory of criteria pollutants from SRC-I point sources after control and nearby power plant	C-62
C.10	Estimated drift composition	C-63
C.11	Estimated flarestack emissions during 8-h startup	C-65
C.12	Sulfur dioxide emissions from flarestack during startup	C-65
C.13	Sulfur dioxide emissions from flarestack during emergency upsets	C-66
C.14	Emissions from mobile plant equipment during operation	C-67
C.15	Emissions from highway vehicles during operation	C-67
C.16	Estimated treated wastewater contaminants and levels after all treatments	C-68
C.17	Organic compounds in the projected SRC-I effluent	C-69
C.18	Chemical composition of slag and flydust from GKT gasifier (SRC-I residue)	C-71

Table		Page
C.19	Trace element concentrations in gasifier coal feedstock and gasifier slag and flydust	C-71
C.20	Environmental Protection Agency extraction procedure results for ash and flydust produced by GKT gasifier on SRC-I residue	C-72
C.21	Summary of leachate data collected from Kentucky No. 9 coal	C-73
C.22	Summary of leachate data collected from Illinois No. 6 coal	C-73
C.23	Chemical analysis of leachates produced from SRC-I product using the ASTM Type "A" leaching procedure	C-74
C.24	Gaseous boiler emissions from dual register burners	C-75
C.25	Summary of emissions monitoring results	C-76
C.26	Particulate emissions from dual register burners	C-77
C.27	Air emissions from construction equipment	C-80
C.28	Air emissions from highway vehicles during construction of demonstration plants	C-80
H.1	Water quality standards and criteria applicable to the Green River	H-3
H.2	Water quality data for the Green River Lock and Dam No. 1, at RM 9.1	H-5
H.3	Water quality data for the Green River near Sebree, Kentucky, at RM 41.3	H-6
H.4	Water quality data for the Green River near Beech Grove, Kentucky, at RM 49.1	H-7
H.5	Average trace element concentrations in geologic formations	H-8
H.6	Estimated area disturbed by construction in and near the Green River	H-9
J.1	Fish species collected during baseline monitoring	J-3
J.2	Fish species collected in Green River lock and dam chambers, 1960-1963	J-4
J.3	Ichthyoplankton species collected in the Green River during baseline monitoring	J-5
J.4	Peripheral fish species (considered rare or threatened in Kentucky, but more abundant in other parts of their range)	J-5
J.5	Average daily densities (No./100 m^3) of ichthyoplankton collected at Green River sampling stations during 1979	J-6
J.6	Ichthyoplankton densities (No./100 m^3) at the site of the proposed SRC-I water intake during 1979	J-6
J.7	Derivation of Kentucky toxicity-based standards	J-7
K.1	Value to breeding birds and mammals of land with mostly crops and a small amount of forest and standing water compared to floodplain forest or forested swamp	K-18

Table		Page
L.1	Sequence of deposits in boring No. 3	L-6
L.2	List of earthquakes believed to have affected the proposed site at modified Mercalli intensity levels of V or greater	L-12
L.3	Earthquakes of epicentral intensity V, or greater, within 200 miles of the site	L-13
L.4	Oil and gas pools near the proposed SRC-I site	L-28
L.5	Oil and gas well records for a part of the Reed Quadrangle, Henderson and Daviess counties, Kentucky	L-30
L.6	Representative surficial soil profiles of the Elk-Otwell-Ginat association	L-34
L.7	Selected characteristics of surficial soil series on the proposed site	L-35
M.1	Sequence of deposits in boring No. 3	M-5
M.2	Recommended parameters for groundwater monitoring	M-13
M.3	Summary of groundwater studies	M-14
N.1	Analyses of water from wells in the Green River alluvium	N-4
N.2	Analyses of water from Ohio River alluvial aquifer	N-5
N.3	U.S. EPA and Kentucky drinking water standards	N-6
N.4	Summary of significant onsite water quality analyses, 1977 and 1979	N-7
N.5	List of water wells and analyses of water samples, 1977	N-9
N.6	List of water wells and analyses of water samples, April 1979	N-10
N.7	List of water wells and analyses of water samples, September 1979	N-11
N.8	Analyses of groundwater from the Carbondale formation, Henderson and Daviess counties	N-12
N.9	Summary of groundwater samples collected from five wells on April 29, July 31, and November 12, 1980	N-13
N.10	Summary of groundwater samples exceeding EPA interim primary and proposed secondary drinking water standards	N-14
N.11	Groundwater samples collected April 29, 1980	N-15
N.12	Groundwater samples collected July 31, 1980	N-16
N.13	Groundwater samples collected November 12, 1980	N-17
O.1	Drawdowns in m (ft) resulting from well pumping	O-6
P.1	Summary of leachate data collected form Kentucky No. 9 coal	P-3
P.2	Summary of leachate data collected from Illinois No. 6 coal	P-4

Table		Page
P.3	EPA extraction procedure results for ash and flydust produced by GKT gasifier on SRC-I residue	P-5
P.4	Chemical analysis of leachates produced from SRC-I product using the ASTM Type "A" leaching procedure	P-6
R.1	Leachate residence time in surficial soils	R-4
S.1	Summary of modeled and measured maximum SO_2 concentrations	S-4
S.2	Summary of modeled and measured maximum total suspended particulate (TSP) concentrations	S-5
S.3	Cooling tower characteristics used for dispersion modeling	S-6
T.1	Craft availability through local labor unions	T-3
T.2	Representative major construction projects in the SRC-I regional area	T-4
V.1	Relative amounts of carbon released in carbon dioxide for various fossil fuels	V-4
W.1	Permit requirements	W-3
Y.1	Uncontrolled emissions	Y-16
Y.2	Uncontrolled and controlled emissions	Y-18
Z.1	Surface water quality at the Ft. Lewis SRC plant	Z-6
Z.2	Coal tar pitch volatile (CTPV) monitoring SRC-I pilot plant, Wilsonville, Alabama	Z-8
Z.3	PNA analytical results in $\mu g/m^3$ for personal samples, SRC-I process — Wilsonville, Alabama, Nov. 12-17, 1979	Z-9
Z.4	Wilsonville personnel monitoring	Z-10
Z.5	Slate of samples for phase I biological and ecological assays	Z-11
Z.6	Submammalian biomedical assays: Phase I	Z-12
Z.7	Phase I biomedical assays in rodent species	Z-12
Z.8	Phase I ecological assays	Z-13
Z.9	Phase II biomedical assays	Z-15
Z.10	Phase II ecological studies	Z-15
Z.11	Operating conditions at time of sampling for preliminary screening	Z-18
Z.12	SRC-I toxicological testing results	Z-18
Z.13	Battelle comparative toxicological testing results	Z-19
Z.14	The effect of catalytic hydrogenation on the mutagenicity of SRC-II distillate blend	Z-20

Table		Page
AA.1	Hazardous materials in SRC processes	AA-6
AA.2	SRC-I demonstration plant preliminary hazardous identification	AA-7
BB.1	Average seam thickness and percent of total coal strip-mined for selected states	BB-6
BB.2	Strip-mining air pollutant loading factors for selected states	BB-6
BB.3	Water use factors for dust control and revegetation	BB-6
DD.1	Selected population centers on rail route from Newman, Kentucky, to Lake Charles, Louisiana	DD-5
DD.2	Major river crossings on southern SRC-I shipment route to Lake Charles, Louisiana	DD-6
DD.3	Selected population centers on rail route from Newman, Kentucky, to Pittsburgh, Pennsylvania	DD-7
DD.4	Major river crossings on northern SRC-I shipment route to Pittsburgh, Pennsylvania	DD-8
DD.5	Predicted accident and spill frequencies for shipment of SRC-I liquid products	DD-9
DD.6	Railroad statistatics for hazardous commodities	DD-10
DD.7	Reported accidents and spills of hazardous liquids into water bodies	DD-11
DD.8	Aggregate accident and spill statistics for hazardous commodity shipments, 1976-1978	DD-11
DD.9	Aggregate accident and spill rates, 1976-1978	DD-12
DD.10	Summary statistics for projected SRC-I movements per month	DD-12
DD.11	Aggragate statistics on SRC-I accidents and spills into water	DD-12
DD.12	Frequency and cumulative percentage of rail spills into water, 1975-1979	DD-14
DD.13	Phenolic compounds identified in the middle/heavy distillate SRC-II product	DD-18
DD.14	Assumptions and calculations defining short-term impacts of phenolic compounds on water quality, Case 1	DD-19
DD.15	Assumptions and calculations defining short-term impacts of phenolic compounds on water quality, Case 2	DD-19
DD.16	Assumptions and calculations defining short-term impacts of phenolic compounds on water quality, Case 3	DD-20
DD.17	Summary of containment methods	DD-26
DD.18	Individual rail tank car specification requirements	DD-29
DD.19	Oils tested	DD-31

Table		Page
DD.20	Characteristics of oils tested for dissolution of water-soluble contaminants	DD-32
DD.21	Acute toxicity of WSFs to freshwater algae	DD-32
DD.22	Acute and chronic toxicity of WSFs to *Daphnia magna*	DD-33
DD.23	Concentrations (mg/liter) of contaminants in 3500 milliliters water equalibrated with 25 milliliters of oils in laboratory extraction apparatus at 22°C	DD-35
DD.24	Acute toxicity of acid, base, and neutral subfractions of WSFs to two freshwater algae	DD-36
DD.25	Acute toxicity to *Daphnia magna* of acid, base, and neutral subfractions of water extracts of five coal liquids	DD-36
DD.26	Concentrations of organic compounds in WSFs compared with acute toxicity concentrations for algae and *Daphnia magna*	DD-37
DD.27	Time (in h) required for dissolution of phenolics from oils to reach 50% of equilibrium concentrations in underlying water in laboratory extractor	DD-38
DD.28	Influence of extraction time on the toxicity of coal liquid A WSF to *Selenastrum capricornutum*	DD-39
DD.29	Influence of sunlight on the toxicity of WSFs to algae	DD-40
HH.1	Groundwater contingency plan monitoring program for the unsaturated zone	HH-4
HH.2	Groundwater contingency plan monitoring program for the saturated zone	HH-4

1. PURPOSE, NEED, STATUS, AND PROGRAMMATIC OVERVIEW

1.1 INTRODUCTION

The proposed action being considered by this Final Environmental Impact Statement (FEIS) is a cost-shared agreement between the U.S. Department of Energy and the International Coal Refining Company (ICRC), a partnership formed by Air Products Coal Refinery, Inc., and Wheelabrator Coal Refinery, Inc., leading to the construction of a 6000 tons of coal per stream day demonstration facility. The Commonwealth of Kentucky will contribute funds solely for developing environmental control technology. This facility will have the potential for ultimate upgrading to a 30,000 tons of coal per stream day commercial facility at the proposed site.

1.1.1 Description of the proposed action

The proposed demonstration facility at full capacity will process 6000 tpsd of high-sulfur coal to produce about 20,000 bbl (oil equivalent) of low-sulfur, low-ash fuel per stream day. In the process, pulverized coal is mixed with a hydrocarbon solvent produced during the process and is reacted with hydrogen at high temperature and pressure. After separation of gaseous products and unreacted hydrogen, the liquid products are processed to separate the mineral matter (ash) and unreacted coal from the primary and secondary products and to recover the solvent. The primary product, which is a liquid at process temperature, is a high-heating-value, low-sulfur, low-ash fuel product that may be directly substituted for oil or coal in applications requiring reduced emissions. Three products will be produced in the proposed demonstration facility: solid SRC-I boiler fuel, anode grade coke, and a hydrogenated liquid boiler fuel. Each of the products will account for approximately one-third of the total. The anode coke can be used in the aluminum industry, and the liquid boiler fuel may be further processed for transportation fuels or petrochemical feedstock.

In the SRC-I process, much of the sulfur and part of the nitrogen initially present in the feed coal react with hydrogen to form hydrogen sulfide and ammonia that must be removed from the gaseous products. The hydrogen sulfide is processed to produce economically valuable elemental sulfur; the ammonia is decomposed to nitrogen and water vapor. In a commercial facility, ammonia could be recovered as a by-product. The mineral matter and unreacted coal are processed in a gasifier to produce a synthesis gas, primarily carbon monoxide and hydrogen, which is reacted with steam to produce the hydrogen required by the process. The slag residue remaining after gasification is the principal solid waste produced by the process. The slag may be salable as aggregate for concrete products or other uses and will initially be stored onsite in a lined pond, pending complete characterization.

During the demonstration phase, coal will be purchased from existing mines and delivered to the plant primarily by rail, although facilities may be provided to receive coal by barge. At this time specific mines have not been identified; however, Kentucky No. 9 coal has been designated as the design coal. Products will be shipped by rail, truck, or barge.

1.1.2 Location of the proposed facility

The proposed plant site is located at River Mile 19 of the Green River in Daviess County, Kentucky, in the unincorporated community of Newman, approximately 12 miles west of the city of Owensboro and 16 miles east of the city of Henderson. The demonstration plant and support facilities will occupy approximately one-third of the 1484-acre site. If constructed, a commercial facility would require approximately three-quarters of the site. Based on the preliminary site development, it appears that the proposed site can accommodate the planned expansion; however, if the slag from the commercial facility cannot be utilized as concrete aggregate or other salable product, additional offsite area will be required for disposal.

1.1.3 Status of the proposed action

On July 10, 1978, a multiphased contract for the SRC-I demonstration plant was signed by the Secretary of Energy and representatives of Southern Companies Services, Inc. (SCS). A joint venture between Air Products Coal Refinery, Inc., and Wheelabrator Coal Refinery, Inc., was responsible for the majority of work under a subcontract to SCS. The contract provided for all phases of the demonstration project: conceptual design, process and detailed design, construction, and operation. Initially, however, only the provisions for conceptual design were defined. The contract provided for DOE funding of the conceptual design phase and allowed the option of cost-shared funding of process and detailed design, construction, and operation. On August 7, 1980, a cost-sharing agreement was signed between DOE and ICRC, a partnership of Air Products and Chemicals, Inc., and Wheelabrator-Frye, Inc. This agreement covers in phases the detailed design, construction, and operation of the plant for an initial demonstration period of two years. At the end of each phase, the government will decide whether or not to proceed. The Commonwealth of Kentucky will contribute funds solely for developing environmental control technology. At the conclusion of this demonstration period, the industrial participants will have the option of completing negotiations for purchasing the facility. Prior to the transfer of the facility by DOE to the industrial partner, DOE will prepare the appropriate NEPA documents. Should the industrial participants decline to purchase the plant, DOE may elect to continue operations at the demonstration scale, or sell to another party for possible commercialization, or to discontinue operations and mothball, decommission, or disassemble the facility.

In support of the SRC development effort, two processes, SRC-I (clean solid fuel) and SRC-II (clean liquid fuel) are being developed in two pilot plants: a 50-tons/d plant at Fort Lewis, Washington, and a 6-tons/d plant at Wilsonville, Alabama. The SRC-I pilot plant at Wilsonville, Alabama, is operated by Southern Companies Services, Inc., to continue improving operations and yield structure in the SRC-I process as well as to provide demonstration plant support. The dual-capability SRC-I and SRC-II pilot plant at Fort Lewis, Washington, is operated by the Pittsburg and Midway Company.

Successful combustion tests of SRC-I (3000 tons) and SRC-II (4500 bbl) have been conducted in commercial utility boilers. Additional combustion tests of SRC-I and SRC-II are presently under way at the Pittsburgh Energy Technology Center. An ongoing investigation of environmental, health, and safety aspects of coal liquefaction is under way at the Fort Lewis pilot plant. Operation of the two SRC pilot plants will be continued to enhance research and development for technical support to the SRC demonstration projects. Environmental and biomedical programs will be continued at both pilot plants.

A process development unit is being operated by the Pittsburg and Midway Coal Mining Company (a Gulf Oil Company subsidiary) at Harmarville, Pennsylvania, to study the effect of process variables on plant performance and to develop plant component design data.

A limited amount of site-specific design work, critical to the preparation of the FEIS and to the applications for permits required for construction was undertaken prior to the formal DOE/ICRC agreement. Site-specific environmental studies necessary for preparation of the FEIS also have been conducted. The current status of the proposed action is that DOE has proposed to rescind FY 1981 funding for the SRC-I project and to terminate its involvement in the project after prior year funds are exhausted. The Congress, however, decided not to rescind the FY 1981 funding; $22.5 million have been appropriated for FY 1981, and $135 million have been deferred to FY 1982.

1.2 PURPOSE AND NEED FOR COAL LIQUEFACTION ACTIVITIES

1.2.1 National policy

In 1979, the United States consumed approximately 79 quads (1 quad = 10^{15} Btu) (including coal exports) of energy. Almost 48% (37.9 quads) of the 1979 energy demand was supplied by petroleum, whereas natural gas supplied about 25% (19.5 quads), coal supplied 20% (15.4 quads), and nuclear and hydroelectric power supplied about 6% (5.2 quads).

Current domestic oil and natural gas production is not capable of supplying the U.S. demand for oil, gas, and their products. In 1970 imported oil supplied 12% of the U.S. oil demand, and imported gas supplied 4% of the U.S. gas demand. By 1979, these percentages had increased to 42% and 6%, respectively, generating the urgent requirement for the rapid implementation of measures to reduce foreign oil dependence.

Among the estimated recoverable domestic fossil fuel resources, coal, unconventional gas, oil shale, and petroleum from enhanced recovery methods account for 90-95% of the recoverable resource base, of which 65-85% of the recoverable base is coal. The annual rate and total amount of recovery for each of these resources is determined by economics, the successful implementation of new technologies, and the solution of environmental and socioeconomic problems. This resource base, with successful research and development of relevant technologies, does provide the potential to reduce reliance on foreign oil.

The April 1977 submission to Congress of the National Energy Plan (NEP) and accompanying legislative proposals was designed to produce a coherent energy policy for the United States. The legislative proposals of the National Energy Plan led to five acts, passed by Congress in 1978, and known collectively as the National Energy Act. The five acts were the National Energy Conservation Policy Act, the Powerplant and Industrial Fuel Use Act, the Public Utilities Regulatory Policies Act, the Natural Gas Policy Act, and the Energy Tax Act.

The National Energy Conservation Policy Act provides for several conservation and solar energy programs that offer a variety of loans and grants designed to make buildings more energy efficient. The Powerplant and Industrial Fuel Use Act prohibits the use of oil and natural gas in new electric utility generation facilities and new industrial boilers. This Act requires existing facilities to use coal and coal-oil mixtures, it limits the use by these facilities of natural gas to 1974-1976 proportions, it prohibits these facilities from switching from oil to gas, and it requires that these facilities cease using natural gas by 1990.

The Public Utility Regulatory Policies Act of 1978 provides for eleven voluntary standards for rate design, as well as other utility practices, that are to be considered by State regulatory authorities and nonregulated utilities. The Natural Gas Policy Act of 1978 sets maximum prices for various categories of natural gas. The Act provides for the deregulation of certain types of gas, although price controls on deregulated gas may be reimposed by Congress, or by the President, for one 18-month period. The Energy Tax Act of 1978 provides for tax credits for insulation and conservation measures, and for residential installation of wind or solar equipment.

The NEP-II, submitted to Congress in May 1979, further defined energy policy by emphasizing the development of oil substitutes. On July 18, 1979, the Import Reduction Program was announced, containing additional legislative proposals. The Energy Security Act, passed in June 1980, created a Synthetic Fuels Corporation (SFC) and a Solar Energy and Energy Conservation Bank. The SFC, with the potential for $88 billion in resources was established to stimulate the production of 2 million barrels per day of synthetic fuels by 1992. The Bank was authorized $3 billion in order to provide Federal subsidies for residential and commercial investments in energy conservation and renewable energy resources. The Energy Security Act also provided for a biomass financial assistance program, authorized at $1.45 billion over two years, designed to encourage the development of biomass energy, including alcohol fuel from crops, wood, and agricultural and municipal wastes. The Act required the President to immediately begin taking action to have the Strategic Petroleum Reserve filled at an average fill rate of 100,000 barrels per day for the fiscal year 1981, and for every fiscal year thereafter. Furthermore, beginning October 1, 1980, with some exceptions, oil from Naval Petroleum Reserve may not be used for any purpose other than filling the Stategic Petroleum Reserve. Finally, the Act provided statutory support for gas and electric utility investments in conservation.

Under amendments to the Defense Production Act passed in 1980, DOE was empowered to share the risk of synthetic fuel project development with the private sector through cost-sharing agreements, loan guarantees, price guarantees, purchase agreements to produce synfuels and other mechanisms. These same powers are extended to the Synthetic Fuels Corporation. All Federal support for the SRC-I project has been provided by DOE (and previously, ERDA) Fossil Energy Program. As part of the Administration's restructuring of Federal demonstration responsibilities, it has been proposed that DOE would end its program of major fossil energy technology demonstration and focus solely on supporting long-range high-risk research and development. This proposal by the Administration, however, would not preclude the industrial partners from (1) pursuing the demonstration and commercialization of fossil energy technologies with private sector funding or (2) applying for financial assistance from the Synthetic Fuels Corporation.

1.2.2 Need for additional domestic energy resources

The United States is at a pivotal point in its energy and economic development. In the past, economic growth has been fueled by abundant supplies of inexpensive, readily available domestic and foreign fossil energy. The United States currently competes in an international marketplace

to purchase the supplies of oil and gas on which the domestic economy has become dependent. In the past, economic planners could assume an uninterrupted supply of energy from a variety of sources. Now, the United States must search for new supplies of energy needed for economic expansion. The high cost and uncertain availability of energy have become major obstacles to the continued growth of the U.S. economy.

In formulating its programs for meeting the nation's broad-based energy goals, DOE must consider a wide range of program options. Although it is desirable to develop the broadest possible range of technologies, the available economic and personnel resources are limited, and each technology must be evaluated on the basis of its potential for energy production or reduction in consumption, the current status of the technology, the resources required for further development, and the economic and environmental risks associated with commercial application.

1.2.3 Energy options

The program options available to DOE are discussed briefly in the following sections.

1.2.3.1 Contribution of nonfossil energy sources

Conservation*

Increased energy conservation could be undertaken in every energy consuming sector either by more efficient use of existing technologies or by technological improvements. Often times it is found that there are institutional impediments that must be overcome in order to use existing technologies. Although some need undoubtedly exists for development and implementation of process changes that would conserve energy, the general requirement is not for new technology but for application of practices and principles that are already well-known. For a real gross national product growth rate of 3.1%, Table 1.1 shows the possible energy savings in 1990 compared with actual consumption in 1978 and a projection "business as usual" practices.

Table 1.1. U.S. energy consumption (quads)

	Residential/ commercial	Industrial	Transportation	Total
Consumption, 1978	28	30	21	78
No-change path, 1990	43	47	24	114
Possible, 1990	30	38	18	86
Savings, %	30	20	25	25

Source: U.S. Department of Energy, "Policy, Programming, and Fiscal Guidance, FY 1982-1986," Jan. 30, 1980.

1. Residential and commercial sectors. The major consumptions of energy in the residential and commercial sectors occurs in space heating, space cooling and water heating. The following are measures that could be applied to conserve energy:

- Improved design and construction of both residential and commercial buildings. For example, the use of more energy efficient shapes, double glazing and heat reflective glass, prescribed heating and cooling of occupied areas and specialized areas rather than entire buildings.

- Higher efficiency furnaces, including improved design of heat transfer surfaces and better maintenance and adjustment of burners.

*Material for this section taken from ref. 1.

- Improve the efficiency of air conditioning units.

- Replace electrical resistance heating for residential and commercial space heating with an electrical heat pump.

- Improve the efficiency of hot water systems through better insulation of heater shells and hot water transporting pipes, recovery of heat from hot water after use, and preheating feedwater for hot water tanks by utilizing by-product waste heat from other appliances.

- Lighting levels in office buildings might be reduced in cases where no danger exists to eyesight or worker performance. Replace incandescent lamps with fluorescent lamps.

2. Industrial Sector. A conservation study by the Office of Emergency Preparedness (OEP)[2] reported that, with the exception of the primary metals group, all the energy-intensive industries could cut energy demand by 10 to 15% (and probably more) over a period of time by accelerated retirement of old equipment, optimal energy process design, and upgraded and increased adjustment and maintenance of existing equipment. Major conservation opportunities include modifying equipment to improve efficiency; adjusting combustion controls and cleaning heat exchange surfaces in furnaces; and utilizing waste heat. Examples are:

- The effectiveness of industrial fuel utilization could also be improved through the application of fluidized-bed processing to cement kilns and similar apparatus. Estimates indicate that recent advances in fluidized-bed equipment design may increase the heat trasfer efficiency from present levels to about 50%.

- Another device that offers the prospect of reduced fuel demand is the heat pipe. This device would allow rapid and highly controllable heat transfer over distances with minimal drop in temperature. Heat pipes can be used as heat sources for vacuum furnaces, and indications are favorable for their application to glass furnaces. They can also be used to extract heat from stack gases, thus recovering heat that would otherwise be wasted.

- Combined electric/steam generation reduces energy consumption since the electricity generated in combined systems can displace electricity that would otherwise be generated inefficiently.

- More efficient management of systems and improved efficiency of industrial processes (e.g., petroleum refining, chemical processing, and metal manufacturing) can produce substantial energy savings.

- Improved waste heat management.

- Use of secondary materials rather than virgin materials offers a large potential for energy conservation.

3. Transportation Sector. Energy demand in this sector could be reduced by shifting to more energy efficient transportation modes; increasing load factors; and improving the efficiency of the different transport modes. Of these measures, only the latter would require additional research and development (e.g., to determine improvements or alternatives to the internal combustion engine). Some potential energy saving alternatives are:

- Increased gasoline mileage for automobiles would potentially have significant conservation impacts since private automobile fuel consumption accounted for 53% of all the energy consumed in the transportation sector and 28% of the total U.S. petroleum consumption in 1977.[3]

- A shift from energy intensive private automobiles to mass transit would reduce energy consumption. Public transit is two to four times more energy efficient than the private automobile. Most gains would have to be realized from existing mass transit systems since new systems require very long lead time for planning and construction. Increased car pooling would also increase conservation. Staggering of work hours could reduce congestion and thereby reduce fuel consumption.

- Shift long-haul freight traffic from truck to rail.

- Energy use for air travel can be reduced either by shifting to alternative modes or by improving the operating efficiencies.

Conservation is an immediate and cost-effective means to deal with the energy problem. However, it alone cannot provide a long-term solution to the country's energy needs and associated dependence on foreign resources.

Solar*

Solar and other renewable energy resources offer the nation some of its best opportunities to become self-sufficient in energy over the long-term. These technologies are already playing a small but significant role.

As oil prices continue to rise and conventional energy resources face constraints, solar energy use can be expected to continue to increase.

Several solar energy conversion systems are currently the subject of research programs designed to determine their potential energy contribution and to accelerate their ultimate utilization. These systems fall into the categories:

1. Solar heating and cooling systems. In typical heating and cooling systems, solar energy, incident on a collector surface, is converted to thermal energy in a working fluid — commonly water or air. This working fluid then delivers the heat energy to the conditioned building space, to thermal energy storage equipment, to heat-operated refrigeration equipment, or to equipment to heat water for use in the building.

The technical feasibilities of solar space heating and hot water heating have been adequately demonstrated. Solar cooling devices of several types are in the advanced development or demonstration stage. No technological breakthroughs are required to construct and operate systems of these types.

2. Solar thermal conversion systems. Solar thermal conversion (STC) systems collect solar radiation and convert it to thermal energy for use as the heat input to systems for generating electric power. The technologies required for STC systems include (a) the collector systems, (b) a system for transferring the collected energy to a working fluid or to a storage system, and (c) a system for converting heat to electrical energy, probably using turbine-generator components of a conventional electric power plant.

Most proposed solar thermal-conversion plants would not be stand-alone systems but would provide supplemental power. Except for development of storage systems there appears to be no fundamental limitations which restrict the development of STC technology.

3. Process heat systems. Process heat systems are similar to STC systems except that the thermal energy is used to supply the process heat required for industrial and other applications rather than generate electricity.

Process heat systems are of three types: low-temperature systems which could be used for fog disposal, melting of snow or ice, evaporation and distillation of water, food processing, etc.; medium-temperature systems which could be used for general industrial processes requiring heat or steam; and high-temperature systems which could be used for special industrial heat processes.

These systems appear technically feasible and, as the price of fossil fuels rises, show promise of being more and more economically competitive for a number of types of applications (e.g., industrial processes, agricultural processes, aquaculture, saline water distillation, etc.). The main drawbacks of process heat systems are the extensive use of land that would be required by the solar energy collectors, the maintenance of evacuated components and moving parts of the collectors that may be necessary for high-temperature applications, the need for large thermal storage capabilities for many applications, and the relative inflexibility of these systems, in all applications, compared to fossil-fuel process heat systems.

4. Photovoltaic conversion systems. Photovoltaic conversion systems use semi-conductor devices to convert sunlight directly into direct current electricity or fuel gas at efficiencies ranging from 5 to 20%. Efficiency depends on the materials employed and the design of the solar cells and arrays.

---

*Material for this section taken from ref. 1.

Solar cells which convert sunlight directly to electricity have been widely used in the past for photo-electric cells and other devices. In recent years they have found applications as primary sources of power for a number of types of spacecraft. Photovoltaic systems appear well adapted for use in producing not only electricity, but also hydrogen, which can be used either as a fuel gas or as an energy storage medium.

For space application, the main objectives have been to develop highly efficient and reliable, long-life, light-weight arrays of solar cells, with cost being a secondary consideration. In terrestrial applications, on the other hand, the main objectives would be to develop highly efficient and reliable, long-life, low-cost arrays of solar cells, with weight being a secondary consideration.

Principal drawbacks of photovoltaic systems are the extensive land areas required by their solar energy collectors and the low plant factors for the collectors, that is, only about 25%, even in regions of high insolation, such as the southwestern parts of the U.S. Also solar cells are still relatively expensive and low in efficiency.

Biomass

"Biomass fuels include wood and wood residues, agricultural materials and refuse, various high-energy-yield crops, and municipal refuse."[4] Generally, these are low-density and low-heating-value materials having moderate to high moisture content. Techniques are under development to use biomass as feedstock for gas and liquid synthetic fuels (similar to those derived from coal) to produce alcohol and to pyrolyze or burn for heat recovery. Production of alcohol and direct combustion of wood are the near-term uses of biomass for energy.

Alcohol. Both ethanol and methanol can be produced from biomass. Ethanol is produced from the carbohydrates in biomass. Corn, cornstalks, other vegetation-derived materials, and municipal refuse can be fermented to yield ethanol. Present plans are to blend this with gasoline, but use of ethanol fuel alone also has been proposed. Methanol can be produced by converting the organic content of biomass to synthesis gas and catalytically converting that to alcohol. Methanol also can be blended with gasoline, but at concentrations above a few percent it tends to chemically attack various components of storage tanks, pumps, and fuel systems. It is expected to have significant application in stationary equipment such as turbines.[4,5]

Wood. Currently about 2% of U.S. energy comes from wood. The major users of wood fuel are the forest industries. Wood use is increasing; however, constraints include variability, transportation and availability, and the high capital cost of wood-fired systems. Wood contains significantly less sulfur and nitrogen than most fossil fuels but particulates loadings may be high.[4] Its heating value is approximately half that of coal.

Hydroelectric

Development of hydroelectric generating capacity is limited to specific geographic areas, and, to a large extent, most of the favorable sites of adequate size have already been developed. In view of the growing public opposition to the commitment of additional land resources for hydroelectric development, the potential for significant increases is not certain. Hydropower is already the most fully developed renewable energy resource. Approximately 3 quads per year are now produced at primarily large-scale, high-head facilities. The Domestic Policy Review (DPR) in 1979 projected that an increase of 0.5 to 1 quad of high-head (mostly large-scale) production is possible. While small hydro projects produce a negligible amount of power at the present time, the DPR set a target of 0.8 quads by the year 2000 from predominantly low-head facilities. Studies underway since the DPR suggest that these estimates could be low.[6]

Environmental issues associated with hydroelectric power generation include the loss of habitats upstream and downstream; the prevention of upstream spawning by several main species, such as salmon; and the supersaturation of nitrogen in the water at high dams and spillways. Land drowned as a result of dam construction can result in severe socioeconomic impacts such as loss of prime agricultural lands, forests and mineral resources, and the displacement of resident populations.

Nuclear*

Development of nuclear power represents a significant potential for additional energy. The future growth of nuclear power is dependent upon overcoming financial, environmental, and social issues which it now faces.

The salient feature of nuclear energy forecasts has been their systematic decline. Although the excesses of the past (forecasts of up to 1000 GWe of installed nuclear capacity by the year 2000) are now widely recognized, there has been a continued erosion of even recent forecasts that had been considered conservative. For example, the 1977 Energy Information Administration (EIA) Annual Report predicted that from 200 to 275 GWe of nuclear capacity would be on line in the United States by 1995. By contrast, the 1979 EIA Annual Report placed the estimate at 143 GWe. Since 1975, the number of new plants ordered has been exceeded by cancellations.[8]

Each of the various stage of nuclear energy production is a source of potential environmental concern. These stages include: mining, milling, uranium hexafluoride production, enrichment, fuel fabrication, power generation, reprocessing and waste disposal. Mining operation, both open pit and underground, produce impacts similar to those associated with coal production, and include land disturbance, water consumption, and effluent discharges. In addition, miners are exposed to low levels of radiation from radon gas, a decay product of uranium. Milling operations to produce yellow cake and uranium oxides generate large volumes of solid and liquid tailings, which must be disposed of as low-level radiation wastes. Uranium hexafluoride production, enrichment and fuel fabrication are also sources of low-level liquid and gaseous radiation wastes. Power generation creates problems of thermal pollution and radioactive emissions. More significant, however, are the problems associated with fuel reprocessing and waste disposal. Fuel reprocessing has been opposed on the basis of possible proliferation of nuclear materials, especially plutonium, and can result in the highest levels of radioactive emissions of any of the previously noted operations, and disposal of high-level radiation wastes have not been commercially demonstrated.

Geothermal

Efforts to make productive use of geothermal energy currently focus on exploration and low-temperature energy conversion. Similar to natural oil and gas production, geothermal energy efforts require geophysical exploration techniques and drilling technology. In addition, electric power production facilities or other facilities to use the available heat are required. The thrust of the geophysical exploration is to identify locations where the geothermal heat can be reached by drilling holes to economically feasible depths. The geothermal heat source may then take several forms. Basically, the heat source may contain water or may consist of hot dry rock. In the case of hot dry rock, water would be cycled into the heat source region and then hot liquid water or steam would be pumped out. Operating plants for converting the heat of the liquid water or steam to electrical energy consist of low-pressure steam-turbine systems or organic fluid bottom cycles.

The four major types of geothermal resources are:

- dry steam (vapor-dominated),
- wet steam (hot water-dominated),
- hot dry rock, and
- geopressured zones.

Each type of resource requires different technological considerations.

1. Dry steam. Dry steam is currently the most extensively developed type of geothermal resource; however, dry steam systems are relatively rare. Dry steam is formed when hot water boils in an underground reservoir. Saturated steam and water are thought to coexist within the reservoir with the steam phase controlling the pressure. With a decrease in pressure due to production through a well bore, the heat contained in the rocks evaporates and superheats additional steam.

---

*Material for this section taken from ref. 7.

2. Wet steam. Wet steam is a much more abundant geothermal resource than dry steam. The wet steam resource consists of water heated by the surrounding rock to temperatures from slightly above ambient up to temperatures above the boiling point. The waters at temperatures above the normal boiling point remain a liquid because of the high pressure underground. Wet steam fields are thermally driven, convective systems in which subsurface water picks up heat from a local heat source and is manifested as hot springs, geysers, and other thermal surface phenomena. Thermal energy is stored both in the hot rock and in the water and steam that fill the pore spaces in the rock.

3. Hot dry rock. Hot dry rock systems are those geothermal reservoirs where the heat is contained in impermeable rock of very low porosity which overlays a local heat source, such as a magma chamber. Hot dry rock systems are potentially the most extensive and widely distributed geothermal resource in the nationa. A large volume of hot dry rock is located in the earth's crust at depths which are beyond current drilling capability. Development of such systems is in the early research state.

4. Geopressurized systems. Geopressurized zones consist of highly porous sands saturated with fluids of high temperature and very high pressure and are located principally beneath the U.S. Gulf Coast. These zones are thought to occur as a result of normal heat flow being trapped by uncompacted clays which serve as an insulating layer. Waters derived from the compaction and dehydration of the clays accumulate in the sands and greatly increase the fluid reserve.

1.2.3.2 Contribution of fossil energy sources

The DOE Fossil Energy Program is structured to develop appropriate technologies to help meet future U.S. energy needs. The technology base effort develops basic information and advanced concepts with potential applications in providing energy from coal, oil, gas, and other fossil resources. The technology base elements are basic research, applied research, and exploratory development of the extraction, conversion, and utilization of fossil energy resources. The technology base focuses on better scientific and engineering data for research and development programs and on basic improvements to process efficiencies and/or use of lower cost technology that can operate in an environmentally acceptable manner. Implementation of improved environmental controls will also be needed to ensure acceptability of the new technologies for use of fossil fuels. At this time three options available to the DOE Fossil Energy Coal Liquefaction Program include limited research and development activities, research and development activities leading to large demonstration, and no further action.

In addition to the energy sources mentioned above (Sect. 1.2.3.1), the following fossil energy sources are also available as energy options. They are divided between nonliquid and liquid options.

Nonliquid fuels

Natural gas currently plays an important role in domestic energy markets for two reasons: (1) natural gas currently provides a quarter of total U.S. energy supply and (2) natural gas can, as a technical matter, easily displace oil in large portions of the industrial and electric utility sectors. Uncertainties exist about the size of the future contribution of domestic, imported, and synthetic/substitute natural gas to total U.S. energy needs. Estimates range from 22 to 24% of total U.S. energy needs in 1985 and from 15 to 20% in 2000.

There are two main categories of conventional natural gas. The first is made up of gas associated with oil production, shallow gas and other easily obtainable gas, and constitutes the majority of present gas production. Production from these sources is projected to decline from 16.2 trillion cubic feet in 1980 to 8 trillion cubic feet in 1990 and 4.3 trillion cubic feet in the year 2000. The other category of conventional gas includes those resources that can be recovered using conventional technology but that have been too technically difficult or expensive to discover, verify, and extract. This category includes outer continental shelf gas, deep gas basins, the western overthrust belt, and Alaskan gas.

Proven gas reserves off of the Gulf of Mexico and southern California are estimated at 5.7 trillion cubic feet. Atlantic and Alaskan off-shore areas are thought to contain large quantities of potential, but as yet, unproven reserves. Estimates of gas production during the next 20 years from the outer continental shelf vary greatly.

Natural gas produced at depths of 15,000 feet or more below the surface is known as deep gas. Deep gas basins with potentially large deposits include the Appalachian Basin, Anadarko Basin, Gulf Coast, the Delaware Basin (Texas), the Mississippi Embayment and basins in the Rocky Mountains. Of the above, the Anadarko Basin, covering 11,080 square miles in the Oklahoma and Texas panhandle, has the greatest prospect for the production of deep gas with proven reserves of 3 trillion cubic feet and potential reserves of 88 trillion cubic feet. Previous to deregulation of deep gas, high production costs were a serious constraint to development.

The Western Overthrust Belt is a strip of folded and faulted sedimentary strata running from northern Alaska, southwest through Canada and the western United States into Mexico. The Overthrust Belt is considered one of the most promising oil and gas producing provinces in North America. Proven reserves of natural gas are over 2.25 trillion cubic feet. The extremely complex geological structures and the complicated land and mineral ownership patterns have contributed to the expensive drilling costs which were considered deterrents to resource development.

Alaskan gas from the North Slope is estimated at 26 trillion cubic feet of proven reserves, or more than ten percent of total U.S. reserves. Plans are currently underway for construction of a 4800-mile pipeline which would bring this gas to California and the Midwest.

Production from all of these sources is projected to increase from 1.4 trillion cubic feet in 1980 to 6.6 trillion cubic feet in 1990 and to 6.9 trillion cubic feet by 2000. Overall production from conventional gas resources is expected to decrease from 17.6 trillion cubic feet in 1980 to 14.6 trillion cubic feet in 1990 and 11.2 trillion cubic feet in 2000. Increases in production potential of the conventional gas resources would result from increased exploration and development of the harder to find resources, or from unexpected, but possible, new discoveries of easily recovered gas.

Enhanced gas recovery

Natural gas, despite a 15 percent decline in production in the past 5 years, remains the largest contributor to domestic energy supply. Continued decline in gas production will increase reliance on imported oil and gas. If more of this fuel becomes available, the decline could be offset and gas could be diverted to industrial users of oil, thus reducing oil imports. Production from unconventional gas sources could play an important role in achieving this goal.

Domestic production and reserves, dominated by conventional gas resources, have generally declined. Annual production (dry) in 1979 was 19.5 trillion cubic feet (Tcf), slightly higher than 1978 production 19.1 Tcf but down from the 1973 peak of 21.7 Tcf. Estimated production for the first eleven months of 1980 was 17.6 Tcf compared to 17.8 Tcf for the same period of 1979. Proven reserves have dropped below 200 Tcf from their 1967 peak of 293 Tcf. In only one year since 1967 have additions to reserves kept pace with depletion of reserves through production. (That year was 1970, when the associated gas reserves of Prudhoe Bay were "booked.") The ratio of reserves to production for the lower 48 states at the end of 1978 was an all-time low of 8.8 to 1, compared to almost 15 to 1 only a decade earlier. Reserve additions (excepting Prudhoe Bay) have replaced only 46 percent of the withdrawals during the 1970s.

This serious decline in production, reserves, and reserve-production ratios has continued despite a near tripling of average natural gas price (in real terms) since 1973, the emergence of still higher price intrastate markets, and a corresponding doubling of exploratory effort. Additions to reserves per successful exploratory well drilled since 1970 have decreased from 10.7 to 2.3 billion cubic feet (Bcf) per well. Estimates of conventional gas resources in two areas for which a re-evaluation is complete resulted in a 60% decrease in the estimated recoverable resource. The prior estimate was in 1974. Similar downward revisions have been made in estimates of inferred reserves for these areas.

These data point to sharply declining availability and rapidly increasing costs of conventional gas production from the contiguous United States. The phased decontrol and special provisions of the Natural Gas Policy Act (NGPA) of 1978 provide incentives for accelerated exploration, but the apparent decline in the number and quality of conventional gas prospects suggests that numerous supplementary gas sources will be required to meet the demand of gas.

National energy policy identifies unconventional gas resources as a potential supply target. As a result, the DOE Unconventional Gas Recovery Research, Development and Demonstration Program

was established. Four large, unconventional gas resources have been identified as having significant potential for development and positive impact of future supplies. These are:

- Low-permeability (tight) lenticular and blanket-type gas sandstones of the western United States,
- Gas-bearing Devonian and Mississippian shales of the eastern United States in Appalachia and the Midwest,
- Natural gas present within coal seams and associated strata, and
- High-temperature, high-pressure (geopressured) aquifers of the Gulf Coast.

It is estimated that these resources could produce four to five Tcf per year by 2000.

Direct coal utilization. Coal constitutes about 77% of the U.S. conventional energy reserves but currently supplies less than 20% of energy consumption. The increased utilization of domestic coal reserves appears to offer the greatest near-term potential for increased domestic energy production. Available technology for utilization of coal is currently limited primarily to direct combustion in conventional boilers. Intensive efforts are underway to develop improved combustion techniques.

1. Conventional direct combustion. Although direct combustion of coal with required controls on particulate and sulfur dioxide emissions currently appears to be the most cost-effective method for the large-scale utilization of coal (particularly for electric power generation), the cost of required pollution control equipment limits the utilization of coal in small- and moderate-size plants. Requirements for the disposal of large quantities of ash and flue gas desulfurization residues also limit the applicability of direct combustion. In addition, many applications require either gaseous or liquid fuels and are unsuited for direct coal utilization.

2. Fluidized bed combustion. Fluidized bed combustion is currently under development as a direct combustion alternative to conventional combustion of coal. In this technology, coal is burned in a fluidized bed of an inert material, usually dolomite. During combustion, the sulfur content of the coal is oxidized to SO_2 which then chemically combines with the dolomite, eliminating the need for further SO_2 control systems. While solid waste, which includes ash and spent dolomite, is the major discharge for disposal from fluidized-bed combustion, it is less of a problem than scrubber sludges. Combustion occurs at a lower temperature in the fluidized bed than in conventional fireboxes, thereby reducing the amount of NO_x produced. Both pressurized and atmospheric systems are under development for use in steam generation. The pressurized systems may offer a slightly higher efficiency than atmospheric systems; however, environmental effects will be similar.

3. Magnetohydrodynamics. When a hot, ionized gas is passed through a magnetic field, an induced potential is developed and can be used to generate an electrical current. Magneto-hydrodynamics (MHD) is the application of this phenomenon. The hot gas can be produced by burning coal, and ionization can be improved by "seeding" the gas with an alkali metal salt. This is another form of direct combustion of coal currently under development. The high temperatures required will favor NO_x formation; however, the process is expected to yield higher thermal efficiencies than most other direct combustion alternatives. Control of SO_2 can be achieved by proper choice of the seed material.

4. Fuel cells. The fuel cell represents another approach to direct coal utilization. Fuel cells operate by injecting an oxidizer and a fuel separately into an electrolyte at separated points. Electrochemical reactions occurring during the oxidation cause a potential difference between two electrodes, which yields an electrical current in an external circuit. With some fuels (e.g., hydrogen), a solid electrolyte can be used; however, with coal the electrolyte is commonly a molten salt. In the latter case, the impurities and unreactive components of the coal are left in the salt, which is continuously removed and regenerated. During this regeneration, the potential pollutants are recovered in various forms for disposal.

5. Combined-cycle power generation. Combined-cycle power generation makes use of high-temperature gas turbines and conventional steam turbines to generate electricity. Using coal as the fuel, the coal is initially converted to a low- or medium-Btu fuel gas in a pressurized gasifier. The fuel gas is cleaned to remove particles and to remove sulfur and nitrogen compounds as elemental sulfur and ammonia, respectively. The coal mineral matter is removed from

the gasifier as ash or slag. The gas is then burned in a combustor to drive a high-temperature turbine. Exhaust from this turbine is still hot enough to generate steam to drive a steam turbine. Since the high-temperature gas turbine requires a highly pure fuel to preclude blade damage, the only potential atmospheric discharge of any significance is NO_x formed from the air nitrogen in the combustor.

Coal gasification. Coal gasification is the chemical reaction of coal with oxygen or air and steam to produce carbon monoxide and hydrogen. Other gases produced include smaller amounts of carbon dioxide, methane, and sulfur compounds such as hydrogen sulfide and carbonyl sulfide. If air is used directly in the reaction as the source of oxygen, nitrogen will also be present in the gas.

1. Surface gasification. There are several approaches for the government to take regarding synthetic gas development. First, there are existing synthetic coal gas technologies that are used commercially outside of the United States. However, uncertainties involving cost and environmental performance must be resolved for these technologies to operate in the United States. To obtain a near-term contribution to the energy supply from synthetic fuels, the government can provide incentives (e.g., tax credits, price supports, and exemptions from excise taxes) that will encourage the construction and operation of these first-generation synthetic fuel technologies in the United States.

Another approach the government may take is to conduct long-range planning activities to remove uncertainties and to reduce lead times for the development of second-generation synthetic fuels technologies. The second-generation gasification technologies could use a wide range of U.S. coals, particularly caking coals, which would offer higher environmental performance and efficiency and increased reliablity. The coal gasification technologies in the DOE Fossil Energy Program fall into the category of second-generation technologies and are expected to be both economically and environmentally superior to current gasification technologies upon successful completion of demonstration plant programs.

2. Underground gasification. Underground coal gasification (UCG) is the technology now under development to convert coal to a combustible gas while still in place underground. The gas product is conveyed to the surface and, after cleanup, can be used as a low- or medium-Btu gas, upgraded to pipeline-quality gas, or used to produce liquid fuels through indirect liquefaction. The development of UCG could greatly expand the usable reserves of the United States by utilizing coal currently considered unmineable by conventional means because it is uneconomical. Underground coal gasification processes will therefore complement surface-based processes that require mined coal.

Current estimates of the most suitable UCG resources include low-volatile bituminous and lower-rank coal seams at least 5-ft thick that lie at depths between 200 and 3000 ft.

The four major program elements of DOE's UCG technology development program are:

- western low-Btu gas,
- western medium-Btu gas,
- eastern coal technology, and
- steeply dipping beds.

The overall program goal of UCG is to demonstrate in situ gasification schemes to produce low- and medium-Btu gas from coals of different ranks and from different geographical areas in an environmentally safe manner.

At the present time, a multimodule Western low-Btu test is planned for 1984 to 1985. The successful completion of this test (Hanna 5) could make low-Btu gas produced from UCG a commercial reality by 1987 or 1988. A planned pilot test will include the production of electricity from a 60-MW(e) generating facility. Because of the modular nature of UCG (i.e., commercial configuration would comprise a multiple array of systems of a type similar to those in pilot tests), demonstration before commercialization does not appear to be warranted at this time.

The Western medium-Btu gas project is expected to provide a medium-Btu gas for chemical feedstocks or as an upgraded gas, a source of synthetic pipeline gas for use in the national pipeline network. The encouraging test results from this past year and the increasing demand for

synthetic pipeline gas projected over the next few years could lead to the commercialization of this technology in the late 1980s.

The commercial application of UCG technology to Eastern coal and steeply dipping beds is not expected until the late 1980s or early 1990s, assuming that the technological uncertainties and environmental concerns associated with these options (such as the disruption of aquifers) are adequately resolved.

Liquid fuels

Increased production of domestic oil. The decontrol of domestic crude oil prices is expected to reduce petroleum imports by increasing the incentive for domestic production of oil and reducing consumer demand for petroleum products. By 1990, the increase in domestic production is expected to be 0.4 to 0.7 million bbl/d. The reduction in domestic consumption attributable to decontrol will also be substantial. By 1985, decontrol will reduce domestic petroleum consumption by 0.3 to 0.5 million bbl/d. By 1990, the reduction is estimated at 0.4 to 0.7 million bbl/d.

Coal-oil mixtures. Pulverized coal mixed with No. 6 fuel oil appears to be a viable near-term alternative fuel for oil-fired systems. With proper suspension additives, mixtures containing up to about 30% coal can be fired in industrial and utility boilers and furnaces with little or no derating. Generally, burner modification is required to maintain stabilized combustion. This technology is not new and has always suffered from the corrosive and erosive nature of the coal components during combustion. However, it appears that burner nozzle metallurgy and design is approaching the stage where coal-oil mixtures can become an article of commerce.

Enhanced oil recovery. Enhanced oil recovery (EOR)[9] involves in situ modification of the reservoir conditions or oil resource characteristics to improve the recovery of oil. Because primary recovery (from reservoir pressure) and secondary recovery (from water injection) can only capture about one-third of the oil in place, enhanced oil recovery has the potential to greatly expand the size of the nation's recoverable domestic reserves. In the United States alone, some 300 billion barrels will remain in place after past and current production of known resources.

Enhanced oil recovery is a viable, near-term option to increase recovery and production of domestic petroleum products. Actions to decontrol domestic crude oil prices will offer greater incentives for enhanced oil recovery. New production from certain enhanced recovery techniques (such as tertiary recovery) are entitled to the world oil price.

The objectives of the DOE enhanced oil recovery projects are to reduce uncertainty in the selection and operation of the appropriate technology/site combinations, to expand the application of the methods, and to improve the productivity of the technology. These objectives are to be accomplished in an environmentally acceptable manner.

One or more of the enhanced recovery technologies is generally applicable to most of the nation's existing oil fields. DOE's objective is to promote wider application of the basic technologies by reducing project risk, while improving resource productivity. These enhanced oil recovery projects will increase the output of domestic reserves, thus reducing our reliance on imported oil.

Based on the July 1979 report from the DOE Working Group on Enhanced Oil Recovery, Unconventional Gas, and Oil Shale, and reinforced by industry estimates, it is believed only two EOR processes will produce significant quantities of oil by 1990. They are steam injection and CO_2 flooding. Currently, about 373,000 bbl/d of oil are produced by EOR: 250,000 by steam injection, about 100,000 by CO_2 injection, and the remainder by chemical and polymer flooding. Steam injection accounts for 99 of 196 EOR projects, 72 of which are in Kern County, California. By 1990, steam injection is expected to produce 450,000 bbl/d, and CO_2 injection is expected to produce 400,000 bbl/d. Although CO_2 will have the greater rate of increase, steam injection provides greater data availability and concentration of projects, and longer period of operation.

Both steam-soak and steam-drive processes are widely used. In the steam-soak process, large quantities of steam are injected into a producing well and allowed to soak into the formation. The heated oil, having more mobility, is then allowed to flow into the well. In the steam-drive process, separate wells are used for steam injection and oil production.

Tar sands and heavy oil. Heavy oil is defined as any oil having an API gravity of less than 20°, and these sour bitumen materials are found in tar sands. The United States appears to have about 30 billion barrels of heavy oil reserves, although estimates range from 10 to 175 billion barrels. These reserves have been found mainly in California and Utah. The Energy Security Act calls for accelerated production of heavy oil through the Synthetic Fuels Corporation to about 500,000 bbl/d (crude oil equivalent) by 1992.

Oil shale. Oil shale is fine-grained marlstone sediment rich in hydrocarbon derivatives. This hydrocarbon material, kerogen, produces a synthetic oil or gas upon pyrolysis.

The richest oil shale reserves in the United States are located in the Green River formation of Colorado, Utah, and Wyoming. The U.S. Geological Survey has identified shale oil resources at over 2 x 10^{12} bbl, of which 90% is in the Green River formation.

The current DOE program includes shale oil production research on true in situ methods, modified in situ methods, above-ground methods, and supporting research for oil shale processing and control technology. The DOE policy is that the technology for surface retorting is ready for commercialization. An assessment of information available to date on all methods has, however, identified specific uncertainties and concerns that affect the future environmental acceptability of commercial development. These concerns deal with air quality, water availability and quality, land disturbance, ecological effects, human health, occupational health and safety, transport and end use, socioeconomics, and compliance with applicable emission limitations.[1]

1.2.4 Coal liquefaction

The development of environmentally acceptable commercial coal liquefaction processes will provide a route to increased domestic production of clean fossil fuels and feedstocks. Synthetic fuels derived from coal liquefaction processes can replace refined petroleum products most effectively in two distinct markets. One market uses low-ash, low-sulfur boiler fuels suitable for clean generation of electric power and industrial steam. The other market uses high-grade fuels such as jet and diesel fuel, gasoline, heating oil, and chemical feedstocks.

1.2.4.1 Goals and objectives of DOE's coal liquefaction activities

The overall goal of DOE's coal liquefaction activities is the initiation of an environmentally acceptable synthetic liquid fuel industry. The specific objectives are to

- develop the technical capability to commercially produce clean liquid and solid fuels from coal,
- develop improved indirect liquefaction processes to produce liquid fuels from synthesis gas made from coal by the late 1980s,
- provide incentives for commercialization of those technologies that are currently ready for development such as indirect liquefaction, and
- promote the development of more advanced third-generation coal liquefaction processes that can be demonstrated to be commercially viable in the 1990-2000 time frame.

1.2.4.2 Indirect liquefaction

In indirect liquefaction, the coal is initially gasified to produce a synthesis gas (hydrogen and carbon monoxide) which is then catalytically converted to liquid fuels. There are commercially available technologies for converting synthesis gas to methanol and Fischer-Tropsch liquids. Currently, methanol is synthesized by steam reforming of methane. The other commercially available technology, Fischer-Tropsch, converts synthesis gas to a variety of hydrocarbon and oxygenated products. This process has been used commercially for over 25 years in South Africa for liquid fuel production. Since the indirect liquefaction technology already has reached a commercial stage, there are no planned demonstration programs in this area. This technology has been demonstrated outside the United States. In addition, domestically, Mobil Oil Co. has developed a coal-to-gasoline process which may be commercially viable. In fact, the

U.S. General Accounting Office has stated that indirect liquefaction may be a near-term assist to the nation's energy goals largely because Lurgi gasification, the gasification step currently used in indirect liquefaction, is commercially available.

The thermal efficiency of indirect liquefaction is approximately 45 to 55%. Liquid yields are in the range of 1.6 to 1.7 bbl of fuel oil equivalent per ton of coal for Fischer-Tropsch and 2.2 to 2.5 for methanol.

Some of the environmental impacts associated with commercial indirect liquefaction plants will be similar to those of direct liquefaction. Land disturbed for the plant, coal mining, solid waste disposal, socioeconomic effects, air and water quality, and water availability impacts will be for the most part similar. If high-temperature gasification processes are used, wastewater treatment will be less extensive than direct liquefaction because the organic loading will be significantly reduced. As a result of the indirect process, converting coal first to synthesis gas and then catalytically producing the liquid fuel product, few if any potentially biologically active hydrocarbons are produced and potential health impacts are correspondingly reduced.

Government support would be provided for preconstruction activities of a limited number of commercial indirect liquefaction facilities and will include site selection, environmental licensing, and preliminary and detailed design. The objective of this program is to assure the earliest possible construction and operation of coal liquefaction plants and to obtain sufficient technical, environmental, and economic information to provide a foundation for future decisions by both the private sector and the government. These preconstruction activities are being accomplished through feasibility studies and cooperative agreements with industry.[10,11]

1.2.4.3 Direct liquefaction

In direct liquefaction, coal is slurried in a process-derived solvent and reacted in a hydrogen atmosphere under high temperature and pressure. A feature of this method is a necessary solid-liquid separation step after the hydrogenation reactor to remove unreacted coal and ash. The unreacted coal is gasified in a manner similar to the indirect liquefaction route to provide the required hydrogen. Direct liquefaction processes typically have thermal efficiencies of 65 to 75% and yields of 2.5 to 3.0 bbl of product per ton of coal.

The primary emphasis of the direct liquefaction activities is to further the development of improved coal liquefaction processes that appear to be closest to commercial readiness. The selection of a particular process is based upon its economics, product slate value and potential applications, process efficiency, environmental impacts, and its amenability to accept a broad range of U.S. coals. Emphasis is placed on processes capable of producing liquids and solids for applications unsuitable for direct coal combustion. These applications include transportation, commercial/residential heating, and industrial and utility boilers.

In direct liquefaction processes, sulfur and nitrogen removal are not as thorough as in the indirect liquefaction route. At this stage of development, the greater thermal efficiencies and yields of the direct hydrogenation processes are expected to generate products that are less expensive than those from indirect processes.

To cover the goals and objectives adequately, to minimize risks, and to provide the private sector with sufficient options for commercialization, four processes — SRC-I, SRC-II, H-Coal, and EDS — have been chosen for primary emphasis. All four of these processes appear to be commercially viable and represent the most advanced processes under study.

SRC-I and SRC-II

Two demonstration plants based upon differing versions of solvent refined coal direct liquefaction technology were proposed for design, construction, and operation. Each demonstration plant would consist of one module of a full-sized commercial plant and would produce fuels suitable for use in boilers or as feedstocks for refineries. Two pilot plants are initiating operations for the other direct liquefaction technologies, EDS and H-Coal. The SRC-I and SRC-II processes were considered for demonstration because they were in a more advanced stage of development than EDS and H-Coal.

The SRC demonstration plants would

- provide an accurate basis for determining investment and operational costs for commercial-sized applications of the technology,
- demonstrate the environmental acceptability of the fuel product,
- allow assessment of the marketability of a range of fuel products obtainable from the process,
- demonstrate the technical viability of the process steps, as well as increase industry's confidence in the improved materials, design, and fabrication technologies that are needed for commercial-scale applications,
- provide technical and economic data that can be transferred to other coal liquefaction technologies, and
- provide a sufficient environmental, health, and safety data base necessary to allow DOE to recommend commercialization of the processes.

These demonstration plants would also support the H-Coal and EDS processes by providing data on those operations common to all processes. Such operations include coal handling, gasification of the unreacted coal matter, and product fractionation. The environmental, health, and safety aspects of these two processes are similar to those of the SRC processes, and information in these areas also would be applicable.

H-Coal

The H-Coal process is a catalytic hydroliquefaction process that converts high-sulfur coal to either a boiler fuel that will meet sulfur emission regulations or to a refinery synthetic crude oil. The process is based on a unique reactor concept which has substantial scale-up background in commercial petroleum processing. Construction of the 600-tons/d pilot plant at Catlettsburg, Kentucky, started in January 1977. Construction has been completed, and the plant is in the initial stage of operation.

An industry consortium sponsoring the H-Coal project is presently composed of the Electric Power Research Institute, Ashland Oil, Standard Oil of Indiana, Conoco Coal Development Co., Mobil Oil, and the Commonwealth of Kentucky. This project is co-funded with industry, with 87% of the current estimated total cost provided by DOE. The H-Coal plant will be operated in two modes to produce either synthetic crude oil or heavy fuel oil. Successful plant operation will accelerate commercial development of this technology by providing data for the design of a commercial-scale facility. Supporting laboratory-scale and process development with experimentation will continue.

EDS

The EDS process liquefies coal through the use of a recycled hydrogen donor solvent obtained from a coal-derived distillate. The donor solvent process transfers hydrogen to the coal, thus promoting liquefaction of the coal. Following solid-liquid product separation by distillation, the solid residue (bottoms) can be sent to a flexicoker to produce additional liquids and low-Btu gas for in-plant fuel. Hydrogen is provided by steam reforming of gases and recycled to the liquefaction and solvent hydrogenation sections. Another design option is to gasify the solid residue to produce hydrogen. The process is sufficiently flexible to allow for different coal feed and to produce a variety of liquid products to meet market demand. A 250-ton/d pilot plant is being operated by Exxon at Baytown, Texas.

1.2.4.4 Advanced liquefaction development research

In the United States, government involvement in research and development has generally been justified when one of the following criteria apply

- the costs and benefits to individual elements of the private sector are not commensurate with the costs and benefits of the nation as a whole,

- the funds required to bring research and development to a successful conclusion are too great or the risks so high that only the largest firms are capable of undertaking the task and, as a result, the competitive position of smaller firms within an industry may be damaged and adoption of the technology retarded, or

- information is required for such government functions as planning, formulating policy, and establishing regulations and incentives.

Following these criteria, a Federal role in synthetic fuels research has been developed. The uncertain nature of future energy prices, high development costs, and technical risks associated with the development of new synthetic fuel technologies have justified Federal support. Finally, research and development of environmental control technologies have been supported since such activities provide information needed to formulate environmental regulations.

Significant effort is devoted to engineering studies and analyses that are required to guide and evaluate process development work. Two major problem areas common to most liquefaction processes are under study: utilization of bottoms containing ash and unreacted coal for hydrogen production and durability of auxiliary equipment. Other supporting research consists of developing improved catalysts and techniques for refining of coal liquids.

1.2.5 Need for environmental, health, and safety information

The development of environmental, health, and safety information is one of the objectives of DOE's coal liquefaction activities. Process development priorities are safety, environment, operability, flexibility, yields and efficiencies, reduction of technical risk, schedule, cost, and economics.[12]

Handling and transportation of vast quantities of petroleum products is practiced daily by the petroleum industry. While there are hazards associated with these activities, when the quantities of materials involved are considered, the accidents that do occur are infrequent. In physical characteristics relevant to handling and transporting, coal-derived liquids appear to be no different from petroleum products. However, the toxicological properties are expected to be different from petroleum (Sect. 4.1).

The Fort Lewis SRC pilot plant operation includes both onsite and offsite environmental monitoring programs to document the quality of the working and neighboring plant environment. In addition, the toxicology characteristics of process liquids and solids are being studied, as discussed in Sect. 4.1. A coordinated SRC biomedical testing program has been initiated. Similar studies are under way for upgraded coal liquids in support of commercialization plans. Environmental studies are under way to assess state-of-the-art and advanced environmental control technologies for liquefaction process applications.

A similar toxicology program is being prepared for H-Coal and EDS products and for upgraded coal liquids. Environmental studies also are under way to assess state-of-the-art and advanced environmental control technologies for these liquefaction process applications.

Congress has passed many environmental laws in the past several years. Coal liquefaction processes with their concomitant gaseous, liquid, and solid discharges must meet the requirements of, among others, the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, and the Toxic Substances Control Act. Many emissions from coal liquefaction plants are identical to those from gasification and, to a large extent, combustion systems. However, DOE has identified three major issues of concern to liquefaction:

- development of particular industrial hygiene programs to ensure worker safety in liquefaction plants,

- identification of the sources of potentially carcinogenic, mutagenic, teratogenic, and toxic compounds in order to control normal operational emissions as well as accidental leaks and spills, and

- treatment of wastewater containing phenols and final disposal of sludges and solid wastes.

1.2.5.1 Health risk assessment methodology

The major components of a technology health risk analysis are represented schematically in Fig. 1.1. Risk assessments may be discussed using the generic framework of Fig. 1.1 with the components defined as follows:

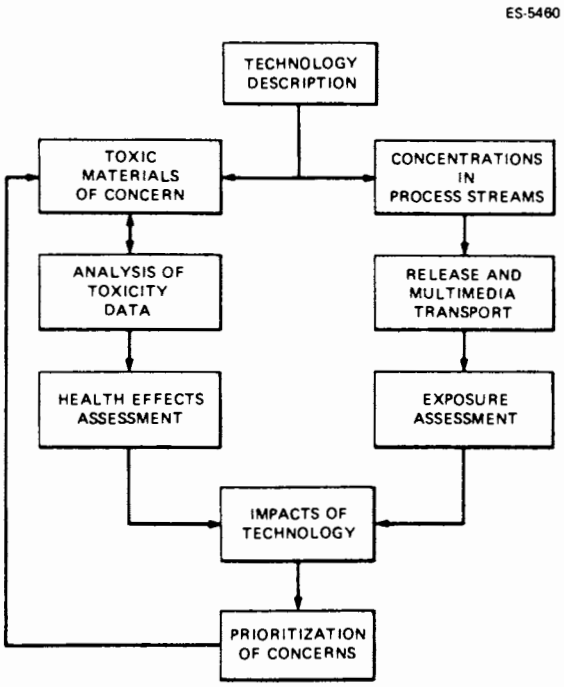


Fig. 1.1. Scheme for technology assessment.

Technology description

Technology descriptions of process designs for fuel cycles or components of fuel cycles include input, intermediate, and product streams and environmental control technology. Process descriptions include sufficient detail to identify potential releases that may affect occupational or public health. During development of the technology description, a list of materials (e.g., phenols and PNAs) of potential concern is developed. The list of materials of concern for synfuel technologies is based on information from related processes and on biological, chemical, and physical measurements for bench-, pilot-, or demonstration-scale experiments in support of the development of commercial-scale synfuel facilities. The biological data base for selection of materials of concern is discussed further under health effects assessments.

Exposure assessment

Exposure assessment is defined as an evaluation of the concentrations of toxic materials in space and time at their interface with target populations. Referring to Fig. 1.1, the inputs to an exposure assessment are as follows:

- Source term. Concentrations of toxic materials in process streams, including chemical and physical characterization and profiles of classes of compounds. Process streams include effluent, emission, and product streams. Mass flow rates of toxic material will be essential.

- Multimedia transport. Atmospheric and aquatic transformation and/or transport resulting in dermal absorption or food chain contamination. Outputs of multimedia transport models would have to include consideration of soil and sediment fate. Multimedia transport includes consideration of media interaction and direct exposure.

- Chemical and physical properties. Chemical and physical characterization of toxic materials in air, food, and water at their interface with target populations.

- Population exposure assessment. Identification of populations at risk. Life style, demographic patterns, living habits can dramatically influence populations at risk.

Health effects assessment

Ideally, the output of a health effects assessment shows risk as related to exposure or dose. Risk refers to mortality or morbidity in humans. Health effects assessment involves extrapolation of toxicity data from every level of biological organization to provide human health risk data. The process is represented schematically in Fig. 1.2. Generically, the process involves identification of concerns, data procurement, information retrieval, and analysis. The major types of currently available biological data at the various levels of biological organization are

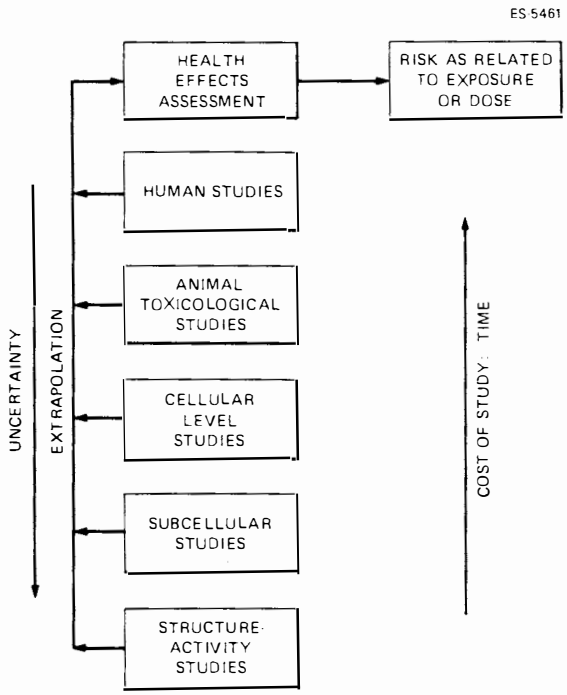


Fig. 1.2. Health risk analysis.

- Human studies. Medical surveillance and epidemiological studies on occupational or public groups exposed to materials of concern for coal liquefaction and oil shale technologies under consideration.

- Animal toxicological studies. Dose-response relationships for carcinogencity, life-span, reproduction, teratogenicity, and mutagenicity for materials of concern. Major parameters to be considered are exposure route, exposure rate, interspecies comparisons, mechanistic and metabolic factors, dose distribution, and predictive value for organ damage or

neurotoxicity. Mathematical/theoretical models of dose-response and relevant extrapolations will be useful in description applications.

- Cellular-level studies. Existing data from cellular-level studies will be useful for comparing mutagenesis/toxicology of synfuels versus that of natural petroleum. These data can also be useful for screening complex mixtures as well as pure compounds in elucidating in vitro/in vivo cytogenetics and in elucidating somatic cell transformation (Figs. 1.1 and 1.2); the data are also useful as potential bioassay systems for human exposure. Further discussion of the predictive power of cellular- level studies is given under major data needs.

- Subcellular studies. Studies at the subcellular level provide information on metabolism, repair processes, complex mixture synergisms or antagonisms, and laboratory data on chemical, physical, or biological modifications that may occur between source and receiver.

- Structure activity studies. The chemical structure and physical properties of a material can cause it to be suspect because of similarities to known toxic materials. As indicated in Fig. 1.2, the amount of uncertainty would be large in extrapolating such information to provide a human health effects assessment.

Health risk asessment

Health risk assessment consists of two main components: exposure assessment and health effects assessment (as described above). These essential inputs are combined to describe the estimated impacts on human health of the materials of concern that are associated with the given technology. Initially, the list of materials of concern may be a long one and may necessitate several successively more rigorous applications of the entire risk assessment process in order to rank the materials of concern on the basis of potential human health impacts. Worst-case assumptions regarding multimedia transport leading to exposure assessments and extrapolation of toxicity data leading to health effects assessment can be used in first application. Materials judged to be of minimal impact under such assumptions can be eliminated from further consideration. The remaining materials of concern can then be evaluated under more realistic assumptions, and data needs can be identified both for more quantitative exposure assessments and for more health effects assessments. The setting of priorities for data needs with respect to reduction of uncertainties can be attempted. Feedback of concerns will allow for more effective technology control modifications focused on occupational and public health concerns.

Health risk analysis is a complex activity that involves (1) extrapolation of toxicity data from high-level exposures or doses and (2) extrapolation from one biological system to another. Controversy still exists among scientists about how to extrapolate this knowledge to estimate the dose-response rate for humans. Health effects assessment must consider biological mechanisms and effects data at every level of biological organization and several dose levels in attempting to arrive at best possible estimates of human health risk as a function of exposure or dose. For example, certain trace elements are essential to the metabolic processes but at very high doses become toxic, and the dose response becomes "U-shaped" as is found with ordinary table salt (NaCl). Generally, ideal estimates are not achievable because of the lack of knowledge of the biological, chemical, and physical mechanisms of disease processes. Risk is discussed in relative or comparative terms, and dose-response models are wholly descriptive. Modelers in the descriptive sense and those who have attempted mechanistic models find that available biological effects data are not collected to test any particular holistic model and, furthermore, available data can be "fitted" by using several models. Often, experiments become "servants" of other experiments, and not enough attention is given to the hybridization of biological experimentation and model or concept-hypothesis testing. If "fitted" models diverge by orders of magnitude at low-level doses, little will be learned from their use. Clearly, health effects assessment requires a strong element of professional judgment across many disciplines, and mechanistic models should apply reasonably well at low dose and low-dose rates provided all appropriate mechanisms have been considered.

The assessment methodology illustrated in Figs. 1.1 and 1.2 provides the framework for coal conversion assessments. Several areas needing study are already apparent, especially as they relate to guidance for the estimation of health risks. Guidance must be derived on the basis of existing epidemiological, toxicological, and theoretical data, supplemented by short-term toxicity testing data. Such supplemental data are of particular importance for the coal conversion program because, in many cases, process samples will be complex mixtures of compounds

for which little or no toxicological data will be available. Currently we can state only that toxicological data should be obtained in such a way that toxicity of a complex mixture can be bracketed by the better-known toxicities of individual compounds.

1.2.6 Liquid alternatives and environmental impacts

In examining alternatives to coal liquefaction, one assumption is that the oil that would have been supplied as a consequence of DOE's coal liquefaction activities would be replaced by one or more of the alternatives. Of the alternatives to coal liquefaction, no single technology is expected to be capable of making up the amount of oil projected from coal-derived liquids, in the event the liquefaction activities were terminated. It is possible that a combination of alternative sources could produce fuel equal in amount to that expected from liquefaction. However, production of fuel at greater levels than the national goals in any one area would risk disrupting other sectors of the program.

The alternative sources of liquid fuels include

- increased domestic oil production,
- oil shale development,
- enhanced oil recovery,
- outer continental shelf petroleum,
- tar sands and heavy oil,
- biomass/alcohol,
- imported oil, and
- coal-oil mixture.

In addition to these alternatives to liquid fuels, there is the alternative of increased use of coal through direct combustion. Two of these are

- conventional coal-fired power plants and
- atmospheric fluidized-bed combustion.

Developing any of the liquid alternatives listed in Sect. 1.2.6 will have adverse effects on the local environment where such development occurs. The degree of impact will depend on factors such as emission rates, water requirements, successful use of mitigating measures, and on the ability of the environment to accommodate the residual factors. In the following discussion, an overview of the major potential environmental impacts of the liquid fuels alternatives is presented. Greater detail of the environmental impacts is provided in the *Final Environmental Impact Statement – Alternative Fuels Demonstration Program*, Vols. I and II, Report ERDA-1547. In addition, the environmental impacts of selected liquid alternatives are graphically compared in Figs. 1.3 and 1.4. The potential for water quality degradation and health and safety hazards for several liquid technologies are compared in Fig. 1.5.

1.2.6.1 Increased domestic oil production

Increased oil production would likely occur both onshore and offshore in Alaska and the continental 48 states. The environmental impacts resulting from refining and consumption of petroleum would be similar for both synthetic and natural fuels; however, the refining technology would be more extensive for synthetic fuels. Similar to increased production of syncrudes, increased production of petroleum would result in conjunctive developments, such as construction of pipelines and roads, and transportation of crude oil by tanker. These environmental impacts, and others, such as effects on the physical (air, water, topography), biological, and socioeconomic environment, are not expected to be disruptive.

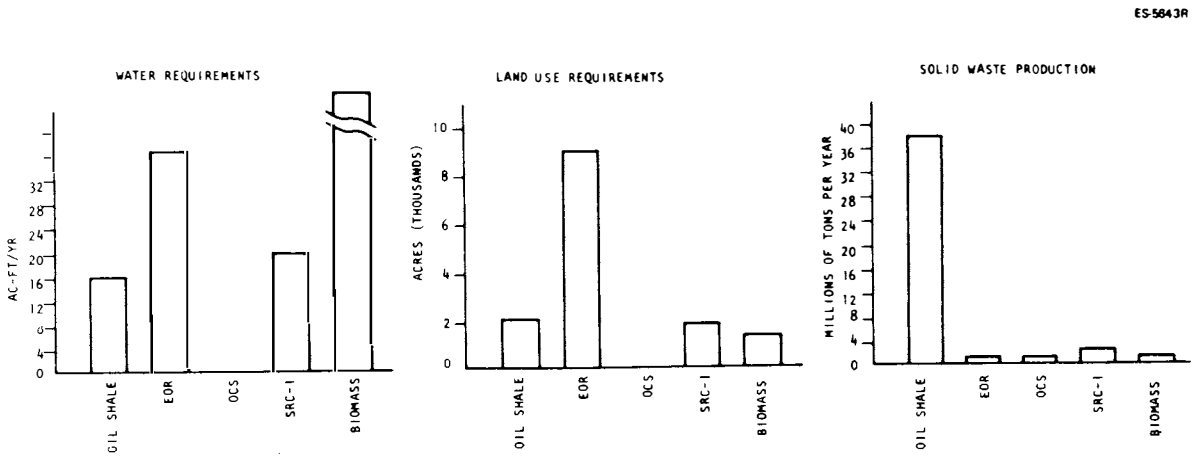


Fig. 1.3. Water requirements, land use, and solid waste production comparisons for 100,000 bbl/d energy alternatives. Sources: SRC-I values from Appendix C; other data from *Draft Environmental Impact Statement, Development Policy Options for the Naval Oil Shale Reserves in Colorado*, vol. 1, August 1980.

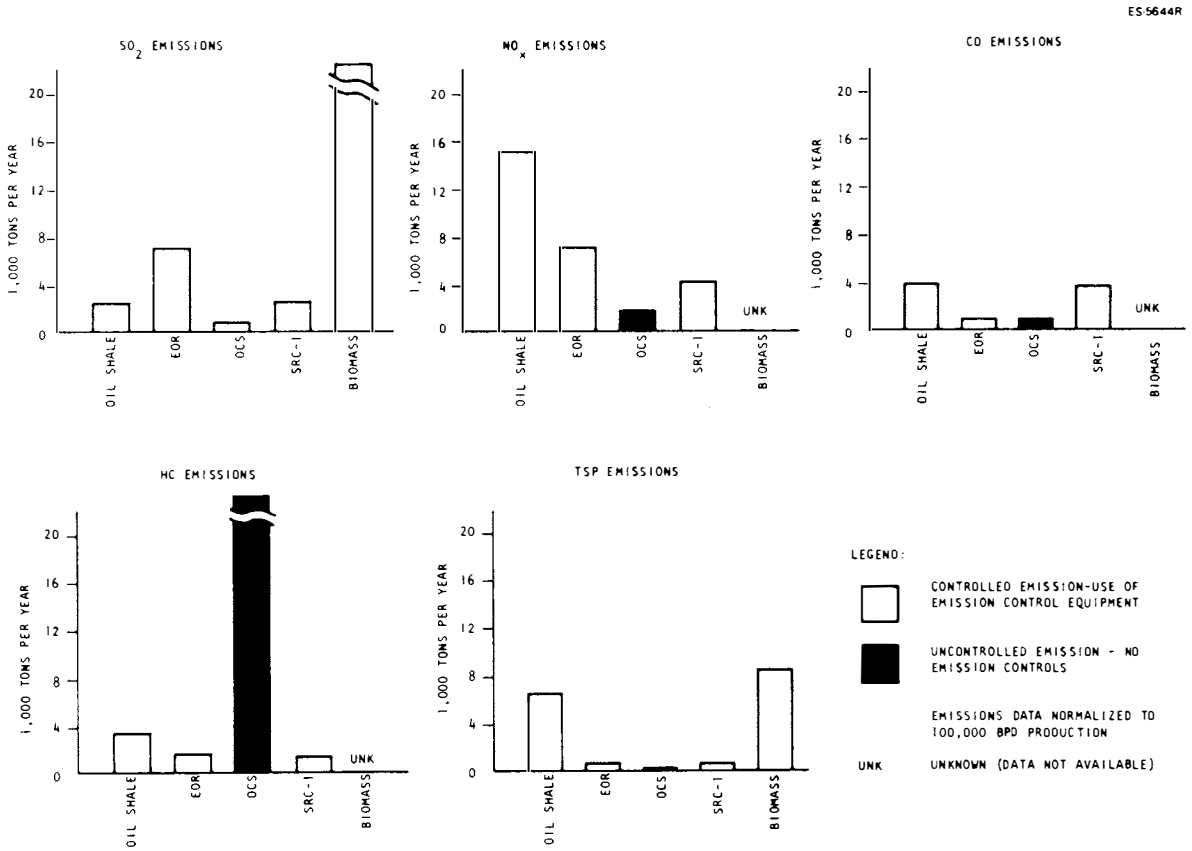


Fig. 1.4. Air pollutant emissions normalized to 100,000 bbl/d production level. Sources: SRC-I values from Appendix C; other data from *Draft Environmental Impact Statement, Development Policy Options for the Naval Oil Shale Reserves in Colorado*, vol. 1, August 1980.

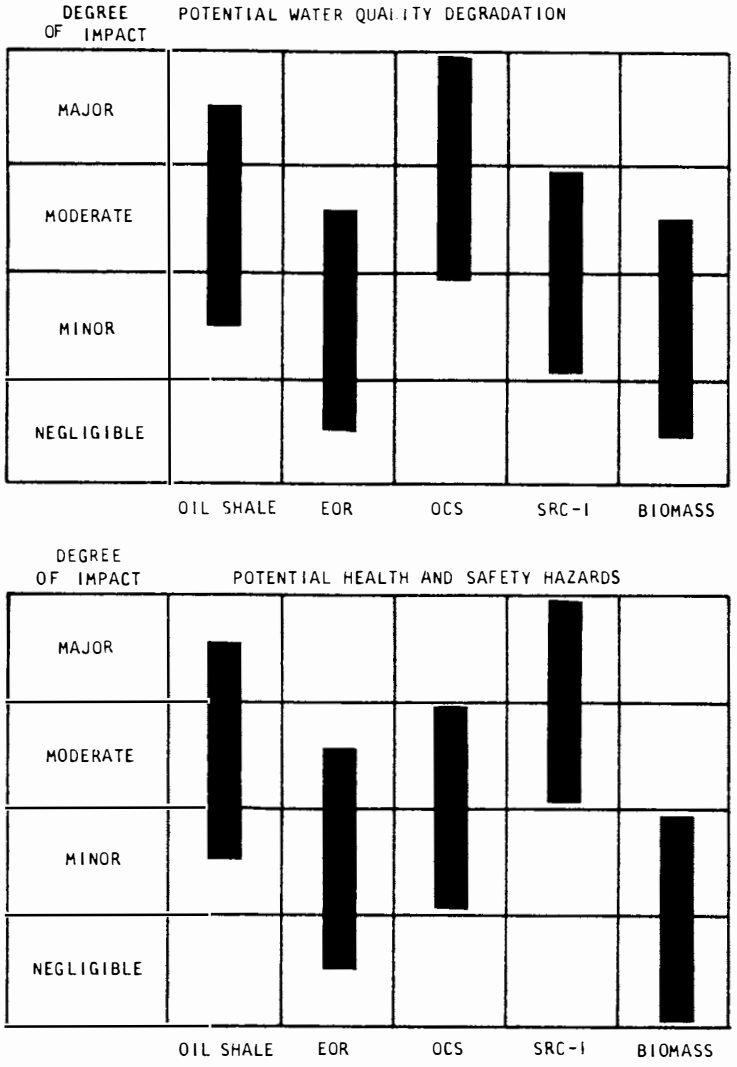


Fig. 1.5. Qualitative and subjective comparative assessment of the potential for water quality degradation (based on worst case, not assuming zero discharge) and health safety hazards. Sources: SRC-I values from Appendix C; other data from *Draft Environmental Impact Statement, Development Policy Options for the Naval Oil Shale Reserves in Colorado*, vol. 1, August 1980.

1.2.6.2 Oil shale development

Air quality concerns associated with oil shale relate to (1) the production of both criteria pollutants (e.g., carbon monoxide, sulfur dioxide, nitrogen oxides) and noncriteria pollutants from surface and in situ retorting and (2) particulate matter and noncriteria pollutants associated with dusts from mining and crushing of raw shale and resuspension of disposed spent shale.

Water resource impacts encompass effluent control and water supply. In the semiarid Piceance and Uinta geological basins in Colorado and Utah, where most of the high-quality oil shale is found, water pumped from mines or drawn for process use is expected to be recycled or consumed. Effluent problems are focused on potential contamination of aquifers and surface waters by

leaching from spent shale piles, by evaporative and lagoon concentrates, or from burned-out in situ retorts, rather than direct emissions. Problems with in situ processes caused by backflood water and fugitive gas emissions may result in contamination of groundwater aquifers. Groundwater supplies and surface water supplies fed by groundwater aquifers might be affected for very long periods of time, thereby creating difficulties in securing adequate water supplies for retort operations, as well as for any other uses of the aquifer.

Stabilization and management of spent shale and other wastes from surface retorting processes will require additional research, development, and demonstration before the leaching concerns are resolved. For surface operations, long-term information is lacking on stabilization of shale piles, leachate rates, and retort and other wastewaters as they may affect surface water and groundwater. There is a lack of knowledge about the changes in form and toxicity of inorganic and organic residuals that may occur by microbial or chemical reaction.

The effects of in situ processes on groundwater and the relationships between groundwater and surface water impacts are poorly understood. The variables that affect the quantity and quality of retort water are also poorly understood. Means have not been developed for preventing contamination of groundwater aquifers by backflood water for in situ operations.

Major uncertainties exist with surface retorting concerning the large volumes of spent shale for disposal. Disposal of spent shale and storage of raw shale could create land disturbances of large magnitude, potential accumulation of toxic substances in vegetation, and contamination of groundwaters and surface waters from runoff.[13]

1.2.6.3 Enhanced oil recovery

Steam flooding, the thermal method selected for the reference case, utilizes separate injection and production wells. Injecting steam enhances the recovery of heavy oils by expanding the oil and reducing its viscosity, by pushing the oil toward the recovery well, and by steam distillation.

Air emissions from the steam injection process result chiefly from the coal- or oil-fired boilers necessary for steam production. Hydrocarbon emissions may be released if the storage tanks and production wells are not equipped with vapor recovery systems. Hydrocarbon emissions would result from oil spills or other accidents.

Steam flooding is a water-consumptive process. The production of 100,000 bbl of oil per day would require approximately 38,000 acre-ft of water per year.

Contamination of groundwater sources through leaks in well casings generally is a concern in pressurized injection operations and in oil production in general. Spills of oil or produced brine could occur as the result of accidents at the wellhead, storage facilities, or along the transportation route.

Because oil produced by steam flooding does not require upgrading before transportation, the most significant source of solid waste is the sludge resulting from pollution control equipment necessary for controlling emissions from boilers. Other solid wastes generated by steam flooding operations include drilling muds and fines and wastes from site preparation. Drilling muds and scrubber sludge may contain toxic substances which could potentially degrade water quality. However, solid wastes generated by this alternative are generally less hazardous and of much smaller volume than those produced by the oil-shale alternative.[14]

1.2.6.4 Outer continental shelf petroleum

Air emissions result primarily from fuel combustion for power generation, and oil storage and processing. Additional emissions may result from well fires or oil spills. If a gas blowout were to occur, methane and other light hydrocarbons would be released, as well as hydrogen sulfide.

Water impacts may result from oil spills, which can introduce large quantitites of organic compounds into the water column. If the oil is spilled beneath the surface from a ruptured pipeline, much of the oil would be taken into the water column. If oil is spilled at the surface, it may form slicks which cover a considerable surface area. The rate of discharge and

duration of the spill also determine the types of effects the spill will have. Spill transport depends upon such factors as location, meteorological conditions, currents, and tides. These factors, as well as the location of vulnerable resources, will determine how much damage is caused by the spill.

Water quality will be affected by increased turbidity resulting from the disposal of solid wastes such as drilling muds and cuttings. Large quantities of sediment also are suspended during pipeline placement and burial.[14]

1.2.6.5 Tar sands and heavy oil

The environmental effects and resulting problems associated with the development of a tar sand production industry are expected to be generally similar to those of other extractive industries, especially oil-shale operations using open pit mining and above-ground or in situ retorting. These impacts are discussed in Sect. 1.2.6.2.

1.2.6.6 Biomass/alcohol

When corn starch is converted to alcohol by means of hydrolysis and fermentation, approximately equal weights of ethanol and carbon dioxide are formed in the processes. This CO_2 is usually vented to the atmosphere. Little information exists regarding the specific nature of the hydrocarbons associated with this exit gas. Some writers have suggested an arbitrary 1% loss of product (ethanol). Odor is occasionally mentioned as an environmental problem in residential areas but can be avoided by use of modern closed fermenters with well-designed and properly maintained equipment.

Aside from the studied emissions of any power plant used to supply process heat, the largest emission of particulates from ethanol production occurs in the front and back ends of the plant, that is, from grain elevators, screening and grinding of corn in the beginning, and during the drying and handling of spent distillers' grains in the by-product area. Emissions are generally controlled by gas cyclones followed by fabric-bag filters.

Estimates of residuals have been made for a 20-million-gal-per-year ethanol plant. The amount of raw waste might range from approximately 12 to 55 gal per gal of product. The waste may contain contaminants equivalent to 0.12 to 0.17 lb of BOD_5 (five-day biological oxygen demand) per gal of ethanol product.

The main source of solid waste is biological growth associated with secondary treatment of the liquid waste previously mentioned. Approximately 0.5 lb of excess activated sludge can be expected for each pound of BOD_5 removed. Assuming that the raw waste contains 0.17 lb of BOD_5 per gal of product ethanol, 95% removal corresponds to 961 tons of BOD_5 removed per 10^{12} Btu produced. Excess waste, then, will amount to 480 tons per 10^{12} Btu.

Solid wastes from biomass farms for methanol production should be minimal, because optimum use of the yield should be the prime goal of biomass technology. However, sediment loading of waterways will result from conventional logging techniques. For a 170,000 gal/d methanol plant with activated sludge treatment, it has been estimated that 0.64 ton/d of BOD_5 would be produced along with 6 tons/d of waste activated solids and 25 tons/d of ash and unburned carbon.[13]

1.2.6.7 Coal-oil mixture technology

Increased environmental effects resulting from converting from oil to coal-oil mixture (COM) boiler and furnace firing would be caused mainly by combustion differences. Environmental impacts expected in COM preparation operations parallel those experienced with coal-fired power plants. The mixing would occur in a closed system and requires no water, and land use would consist of the standard coal-fired power plant coal storage pile, plus a relatively small area for COM mixing and short-term storage.

The combustion efficiency of COM firing — about 98% — approaches that of oil firing, and the environmental impacts lie between coal- and oil-fired systems.

Sulfur, nitrogen, and mineral matter content all will be increased over that of oil alone. Typically, fuel oils contain mineral matter at levels ranging from trace quantities to not over

0.1% while some coals have over 30% mineral matter. Thus, at a 30% coal loading in COM the mineral matter could be increased to 9% from 0.1%. Emissions of sulfur dioxide, nitrogen oxides, and particulates will be increased, perhaps to the point of requiring control system modification or retrofit. In addition, unburned hydrocarbon emissions including polynuclear aromatics may occur. Thus, the environmental controls required for combustion would consist of those, albeit to a lesser degree, which are employed in coal-fired power plants.

Likewise, wastewater streams and treatment (boiler and cooling tower blowdown, floor and equipment drains, etc.) would be similar to those in coal-fired power plants. Due to the inherently erosive nature of COM mixing and pumping operations, pump and valve leaks and spills could be expected. This is the single operation that may set COM technology apart from coal- and oil-fired systems. Thus, backup systems, soil-surface treatment, and component location should be considered in developing COM technology.

1.2.6.8 Imported oil

The option of increasing imports of petroleum creates other problems, most importantly, the question of national security and the effect on the nation's balance of payments. The potential environmental impacts resulting from increased oil imports would result from tanker operations, oil handling and transfer operations, refining operations, and construction activities, such as deep-water ports. The major impact to the human environment from increased imports is economic. In addition, an increased dependence on foreign sources for oil supplies would increase the potential impacts associated with a disruption of these imports. Detailed discussion of the impacts resulting from increased imports is presented in ref. 1.

1.2.6.9 Direct coal combustion

The flexibility of the SRC-I process to produce a mixture of solid and liquid products is discussed in Sect. 1.3. Other options for supplying domestic petroleum and their comparative environmental effects are discussed earlier in this section. In addition to these options, there are certain direct coal combustion options that could be utilized to displace foreign oil in some markets anticipated to be served by SRC-I solids. These options include direct coal combustion with scrubbers and precipitators, or atmospheric fluidized bed combustion, with appropriate controls.

Environmental impacts for these two options are provided in Tables 1.2 and 1.3. Comparative environmental estimates for SRC solids are provided in Table 1.4. The estimates in each table are based on an equivalent energy output of 100,000 bbl/d of No. 6 fuel oil to facilitate comparisons. In addition, effects are traced back to the mining steps to account for differing efficiencies of conversion/processing. Underlying assumptions are listed in the respective tables. It should be noted that combustion impacts of utilizing SRC-I solids are uncertain due to the limited test burn data available.

Although these tables are useful for overall comparative purposes, it should be remembered that emissions from the various processing/combustion steps differ substantially for the SRC-I process, as compared with the other two operations, and will likely occur at different locations rendering direct comparisons difficult.

1.2.7 Coal liquefaction programmatic alternatives and environmental impacts

The three coal liquefaction programmatic alternatives include:

- no action
- limited-involvement, long-term research and development
- extensive-involvement research, development, and demonstration.

1.2.7.1 No action

The government could elect to take no action regarding synthetic fuels development. Under this alternative, development of direct liquefaction technology would be left entirely to the private

Table 1.2. Environmental impacts associated with a coal-fired power plant equipped with wet scrubbers and electrostatic precipitator

Combustion impacts	
Air emissions, tons per year[a,b,c]	
SO_2	5.5×10^4
NO_x	5.5×10^4
TSP	2.7×10^3
Nonmethane HC	1.2×10^3
CO	3.9×10^3
Water requirements, gal/year	
Power plant makeup water	1.2×10^{10}
Environmental cleaning makeup water	1.7×10^8
Total	1.22×10^{10}
Land requirements, acres per year[d]	
Land for power plant and environmental solid waste disposal	66.4
Solid waste, tons per year	
Bottom ash from boiler (dry)	1.35×10^5
Collected fly ash (dry) from precipitator	5.4×10^5
Total ash	6.75×10^5
Limestone scrubber sludge (dry)	1.0×10^6
Coal preparation impacts	
Air emissions, tons per year	
Fugitive emissions	Not quantifiable
Particulate emissions with control	367[e]
Water requirements, gal/year	
Coal preparation makeup water	$1.0-2.43 \times 10^8$
Land requirements, acres per year	
Land for coal preparation solid waste storage	86.4[f]
Solid waste, tons per year	
Solid waste from coal preparation to storage	2.8×10^6
Transportation impacts, tons per year	
Fugitive coal particulate emissions	1.1×10^5[g]
Diesel emissions[h,i]	
CO	363
Particulate	129
SO_2	336
HC	258
NO_x	390
Water impacts	Negligible
Land impacts from construction of roads and railways	Not quantifiable
Mining impacts	
Air emissions from surface mining, tons per year[j,k,l]	
Particulate	29
SO_2	27
NO_x	378
CO	230
Organics	42
Water requirements for surface mining (dust control and revegetation) acre-ft/year[m]	255
Land disturbed by surface mining, acres per year[l,n,o,p]	432
Solid waste from underground mining, tons per year[q,r]	1.2×10^5

Table 1.2 (continued)

Assumptions
Eastern bituminous coal
Heating value = 10,800 Btu/lb
Coal feed to boiler = 7.7×10^6 tons per year
Overall plant efficiency = 35%
Plant lifetime = 30 years
100,000 bbl/d of No. 6 fuel oil at 6.3×10^6 Btu/bbl = 630×10^9 Btu/d
Plant located in Kentucky
All coal mined in Kentucky
Zero aqueous discharge

[a] Electrostatic precipitator for particulate control.
[b] Wet lime/limestone scrubber for SO_2 control.
[c] High sulfur coal = 3.3% S.
[d] Depth of landfill = 30 ft.
[e] Assume 0.075 lb/ton of coal processed using cyclone followed by wet scrubbing.
[f] Assume depth of landfill = 30 ft.
[g] 1% blown away during transport if not wetted.
[h] Assume average 300-mile trip all by rail.
[i] Diesel fuel consumption rate = 1 gal per 200 ton-miles.
[j] Emissions from underground mining are minor.
[k] Emission factors taken from Table BB.2.
[l] 54% of coal delivered is strip mined.
[m] Surface mining only.
[n] Land disturbed by underground mining is minimal.
[o] Density of coal seam is 1750 tons per acre-ft.
[p] Average seam thickness = 5.5 ft.
[q] Solid waste from underground mining = 3% of coal extracted.
[r] 46% of coal delivered is mined underground.

Sources:

Energy and the Environment, Council of Environmental Quality, 1973.

SRC-I DEIS, Appendix BB.

U.S. Department of Energy, *Technology Characterizations Environmental Information Handbook*, Report DOE/EV-0072, June 1980.

Table 1.3. Environmental impacts associated with a coal-fired power plant utilizing an atmospheric fluidized bed and appropriate environmental controls

Combustion impacts	
Air emissions, tons per year[a,b,c,d]	
SO_2	7.2×10^4
NO_x	1.83×10^4
TSP	6.9×10^3
HC	7.5×10^2
CO	2.8×10^3
Water requirements, gal/year	
Total	1.1×10^{10}
Land requirements, acres per year	
Main plant site	18
Disposal area	20.8
Solid waste, tons per year	
Total, dry weight	1.6×10^6
Coal preparation impacts	
Air emissions, tons per year	
Fugitive emissions	Not quantifiable
Particulate emissions with control	367[e]
Water requirements, gal/year	$1.0-2.43 \times 10^8$
Land requirements, acres per year	86.4
Solid waste, tons/year	
Solid waste from coal preparation to storage	2.8×10^6

Table 1.3 (continued)

Transportation impacts, tons per year	
Fugitive coal particulate emissions	1.1×10^5 [f]
Diesel emissions[g,h]	
CO	363
Particulate	129
SO_2	336
HC	258
NO_x	390
Water impacts	Negligible
Land impacts	
Land impacts from construction of roads and railways	Not quantifiable
Mining impacts[i,j,k]	
Air emissions from surface mining, tons per year	
Particulate	29
SO_2	27
NO_x	378
CO	230
Organics	42
Water requirements for surface mining (dust control and revegetation), acre-ft/year	255[l]
Land disturbed by surface mining, acres per year	432[k,m,n,o]
Solid waste from underground mining, tons per year	1.2×10^5 [p,q]
Assumptions	
Eastern bituminous coal	
Heating value = 10,780 Btu/lb	
All coal mined in Kentucky	
Plant located in Kentucky	
65% capacity factor	
Power plant efficiency = 35.8%	
Coal feed to boiler 7.7×10^6 tons per year	
Zero aqueous discharge	

[a] 83–85% removal efficiency.
[b] Ash content coal = 9.6% by weight.
[c] Sulfur content = 3.9% by weight.
[d] Fabric filter or electrostatic precipitator.
[e] Assume .075 lb per ton of coal processed using cyclone followed by wet scrubbing.
[f] 1% blown away during transport if not wetted.
[g] Assume average 300-mile trip, all by rail.
[h] Diesel fuel consumption rate = 1 gal per 200 ton-miles.
[i] Emissions from underground mining are minor.
[j] Emission factors taken from Table BB.2.
[k] 54% of coal delivered is strip mined.
[l] Surface mining only.
[m] Land disturbed by underground mining is minimal.
[n] Density of coal seam is 1750 tons/acre-ft.
[o] Average seam thickness = 5.5 ft.
[p] Solid waste from underground mining = 3% of coal extracted.
[q] 46% of coal delivered is mined underground.

Sources:

Energy and the Environment, Council of Environmental Quality, 1973.

SRC-I.

U.S. Department of Energy, *Technology Characterizations Environmental Information Handbook,* Report DOE/EV-0072, June 1980.

Table 1.4. Environmental impacts associated with a power plant utilizing SRC-I solid fuel

Combustion impacts	
Air emissions, tons per year[a,b]	
SO_2	9.2×10^4
NO_x	1.5×10^5
Water requirements[c]	
Similar to those of atmospheric fluidized bed	
Land requirements[d]	
Less than atmospheric fluidized bed and coal-fired power plant with scrubbers and electrostatic precipitator	
Solid waste, tons per year[e]	
Total ash	7.7×10^3
Coal preparation impacts at SRC-I solid fuel power plant	
Solid waste and water requirements for the SRC-I solid handling[f]	Negligible
Land requirements and air emissions for SRC-I solid handling	g
Conversion impacts	
Air emissions, tons per year	
Particulate	340
SO_2	150
NO_x	5300
CO	3600
HC	40
Water requirements, gal/year	
Total	6.7×10^9
Land requirements, acres	
Maximum	1300
Solid wastes, tons per year	
Total	1.36×10^6
Coal preparation impacts at conversion facility	
Not available	
Transportation impacts, tons per year	
Fugitive coal particle emissions from mine to conversion facility	1.4×10^5[h]
Fugitive emissions from SRC-I solid from conversion facility to power plant	7.7×10^4[h]
Diesel emissions[i,j]	
From mine to conversion facility	
CO	253
Particulate	86
SO_2	223
HC	171
NO_x	259
From conversion facility to power plant	
CO	133
Particulate	47
SO_2	123
HC	94
NO_x	142
Mining impacts	
Air emissions from surface mining, tons per year[k,l,m]	
Particulate	39
SO_2	35
NO_x	481
CO	300
Organics	54
Water requirements for surface mining (dust control and revegetation), acre-ft/year	270[n]
Land disturbed by surface mining, acres per year	626[o,p,q]
Solid waste from underground mining, tons per year	1.5×10^5[r]

Table 1.4 (continued)

Assumptions
Coal mined in Kentucky
Heating value of solid fuel = 15,000 Btu/lb
Zero aqueous discharge
Conversion of coal to SRC-I solid has a thermal efficiency of 70%
The power plant burning SRC-I solid has a thermal efficiency of 35%
Assume that only SRC-I solid is produced at conversion facility

[a] SRC-I product contains 0.8% sulfur.

[b] SRC-I product contains 0.7% nitrogen.

[c] No scrubber required for SO_2 control.

[d] No scrubber sludge produced, no sorbent needed.

[e] SRC-I product contains 0.1% ash.

[f] SRC-I product will not require extensive preparation as for coal.

[g] Less than those required for the atmospheric fluidized bed and the coal-fired power plant with scrubbers and electrostatic precipitator coal preparation areas because there will not be extensive wastes from coal preparation.

[h] Assuming 1% loss during transport.

[i] Assuming 150-mile trip carrying 1.4×10^7 tons.

[j] Assuming 150-mile trip carrying 7.7×10^6 tons.

[k] Emissions from underground mining are minor.

[l] Emission factors taken from Table BB.2.

[m] 54% of coal delivered is strip mined.

[n] Surface mining only.

[o] Land disturbed by underground mining is minimal.

[p] Density of coal seam is 1750 tons/acre-ft.

[q] Average seam thickness = 5.5 ft.

[r] Solid waste from underground mining = 3% of coal extracted.

Sources:

Energy and the Environment, Council of Environmental Quality, 1973.

SRC-I DEIS, Appendix BB.

U.S. Department of Energy, *Technology Characterizations Environmental Information Handbook,* Report DOE/EV-0072, June 1980.

sector of the economy. Since there are technical and economic risks associated with any new venture, technology development would occur later in time, further delaying the deployment of commercial facilities. This in turn would continue our heavy dependence on imported oil. In addition, private sector development without DOE involvement may not emphasize environmental research at an early date. It is possible that environmental impacts could be more severe under the no-action alternative than with government support or that more delay in commercialization would be experienced in order to develop the necessary environmental technology.

1.2.7.2 Limited-involvement, long-term research and development

Future DOE synfuels activities would be limited to long-term, high-risk endeavors. Once proof-of-concept has been attained, it would be private industry's responsibility to continue development and application of the technology. An example of this approach is reflected in the Exxon Catalytic Gasification Process, a "third-generation" technique. DOE, in conjunction with Exxon, proved the process viability at a 1-ton/d process development unit. The Exxon Corporation is funding a $350 to $500 million pilot plant, and if this plant proves successful, it is anticipated that the process would be scaled to either demonstration or commercial scale with private funding.

A key facet of a Federal R&D policy oriented solely to high-risk technology is that it removes the Government from the position of having to choose between these potentially competing technologies for scale-up. Private firms, each reading the signals of the marketplace, would be responsible for making these choices knowing that they would not have to compete against a similar Government-subsidized effort. Adopting the limited-involvement, long-term research and

development alternative may result in delaying the deployment of commercial facilities and therefore could have impacts similar to those discussed in Sect. 1.2.7.1.

1.2.7.3 Extensive-involvement research, development, and demonstration

The demonstration of synfuels technologies is the intermediate step between the research and development process and commercial deployment. Following several years of development, first at the laboratory and bench scale and subsequently through process development unit and pilot plant testing, the more promising technologies which had been receiving support by the Government would move into the demonstration phase.

The demonstration plant is typically a modular unit. If it succeeds in validating the economic, environmental, and productive capabilities of the technology, the next step, for most projects, would be to replicate the modules to gain the economies-of-scale needed to produce a commercial product.

The environmental impacts expected from this alternative would be similar to those described in Sect. 1.4.

1.3 PURPOSE AND NEED FOR THE PROPOSED ACTION

1.3.1 Summary

The SRC-I demonstration plant process configuration consists of the basic SRC-I liquefaction step followed by de-ashing and a subsequent catalytic hydrocracking step. This overall processing configuration is referred to as the two-stage liquefaction (TSL) process. The degree of conversion of dissolved coal to liquids in each step can be adjusted to tailor product slate to satisfy market needs prevailing at the time of production. This processing flexibility is unique to the SRC-I process, and is achieved while also maintaining optimum process efficiency which in turn acts to minimize product cost.

Demonstration of the flexible TSL process will enable design and construction of multiple commercial plants, responding to different markets, from the basis of a single demonstrated design. Obsolescence is not a risk here. The basic SRC-I liquefaction step uses no catalyst and consequently does not carry the operability uncertainties associated with catalytic systems. The SRC-I process is not as sensitive to coal source as other processes and so commercial plants may be widely deployed.

The liquefied coal from the TSL process, when separated into product fractions and cooled to ambient temperatures, yields both solid and liquid products. Marketing analyses indicate SRC-I solid applications in

- oil-fired non-coal capable utility and industrial boilers,
- oil-fired coal capable utility boilers,
- new intermediate load utility boilers,
- new industrial boilers, and
- industrial furnaces and kilns.

Several electric utilities and industrial firms anticipating significant domestic needs for synfuel energy supplies in the 1990s have agreed to purchase and demonstrate the use of the SRC-I solid, as well as liquid, products for testing in their own boilers or industrial processes.

1.3.2 Purpose

The purpose of the proposed action is to demonstrate that that SRC-I process is a viable and competitive solution to meeting the national need for alternative energy sources. The SRC-I process is the most mature of all direct coal liquefaction approaches, having been the most

extensively tested process at the pilot plant scale. Operation of the demonstration plant using this technology will provide the information required to minimize technical and economic risk and confirm the effectiveness of environmental control systems as a timely basis for moving forward with commercialization.

The technical feasibility of the SRC process has been proven by the operation of both bench- and pilot-scale facilities, including 6 and 50 tons/d facilities at Wilsonville, Alabama, and Fort Lewis, Washington, respectively. As a result of these activities, it has been shown that the SRC-I process offers simplicity and ease of operability. This judgment is based on the inherent nature of the SRC-I process: noncatalytic coal reactions, reduced sensitivity to coal sources, operations at lower temperatures and pressures, lower hydrogen consumption, and higher energy efficiency. However, there are still a number of areas of technical uncertainty associated with construction of a commercial facility. These areas of uncertainty cannot be fully resolved by the operation of pilot-scale facilities. Since many of the equipment items of greatest concern would be replicated in a commercial-size facility, adequate information can be obtained from operation of a facility using the commercial-scale equipment but having a significantly smaller overall capacity than a commercial production plant. Operation of the fully integrated process (i.e., liquefaction, de-ashing, hydrocracking, product separation, solidification, gasification, hydrogen production, and environmental monitoring and control equipment) will be demonstrated for the first time. Also, by providing an opportunity for design of the commercial-sized equipment based on monitoring of pollution control equipment performance during its operation, the demonstration plant can confirm that plants can be operated in an environmentally safe manner.

Pursuing the SRC-I process through the operation of a demonstration plant would not foreclose alternative methods of direct coal liquefaction. The government is testing other direct liquefaction processes, and the success of an SRC-I demonstration plant will provide useful information for the development of those processes.

1.3.2.1 Demonstration plant objectives

SRC-I demonstration plant project objectives are to

- provide an accurate basis for determining investment and operating costs for commercial application of this technology, including required environmental control equipment and operating procedures,
- demonstrate the technical feasibility of certain process steps at commercial capacity, and provide other technical information on process integration, materials of construction, equipment design, and fabrication techniques needed for commercial operation,
- provide adequate supplies of SRC-I fuel products for long-term commercial-scale combustion tests necessary to demonstrate product use in existing and new electric utility and industrial applications,
- provide adequate supplies of SRC-I liquid fuel products for gasoline blend stock, and for turbine and distillate fuel oils,
- provide adequate supplies of SRC-I fuel products for long-term emission testing necessary to demonstrate the environmental acceptability of the fuels for direct use, and to characterize the control equipment or modifications necessary for compliance with applicable emission limitations,
- provide adequate supplies of SRC-I solid and liquid fuel products for large-scale testing of potential upgrading techniques to determine the effectiveness and economic viability of using SRC-derived products as feedstocks to petrochemical industries and raw materials for aluminum and steel industries,
- monitor plant emissions and evaluate environmental control and mitigation measures,
- allow assessment of the marketability of the range of products obtainable from a given coal,
- expedite commercial application of the SRC-I process by providing a site for the demonstration plant that is suitable for expansion to the first commercial facility,

- provide, through successful operation, significant technology advances that would not otherwise occur, which will also be used to optimize the use of other coal liquefaction technologies in such areas as mineral ash separation and hydrogen generation, and

- incorporate the SRC-I process with a unique second liquefaction stage, hydrocracking, that results in a more flexible product slate of both solids and liquids.

1.3.3 Need

The large size and diversity of U.S. demands for hydrocarbon fuels and uncertainty about product slate makes it prudent to demonstrate processes that are sufficiently flexible to shift with the market.

The SRC-I process followed by hydrocracking, referred to as two-stage liquefaction, provides the flexibility to vary product mix and the ability to efficiently convert a variety of coals, including some of the nation's worst ash- and sulfur-laden coals. The products by themselves, or when subjected to further refining as with any coal liquid, are acceptable for a wide range of uses — from boiler fuels to fuels for transportation.

The flexibility of the product types, quantities, and quality combined with the process features of efficient use of hydrogen and high energy yield is an advantage of SRC-I that is extremely important to future investors in commercial plants who will represent a wide range of interests. The production ratio of solids and liquids can be varied from as much as 85% solids with 15% liquids to as little as 10% solids with 90% liquids all involving minimal wasteful gas production.

1.3.3.1 Process features

The initial SRC-I liquefaction step does not require addition of a catalyst to accelerate the basic hydrogenation reactions which separate sulfur, oxygen, and nitrogen and release ash from the coal. The result is a less complicated flow scheme and greater accuracy in computing material and energy balances for the purpose of design and economic projections. Variations in process operation and in composition of feed coal are not likely to cause upsets and major breakdowns as may occur with the catalytic processes during these same variations.

Domestic coal has an intrinsic catalytic activity which varies from source to source. Some processes are sensitive to this variation which limits plant deployment and restricts the sources for acceptable feed coal. The SRC-I process is not dependent on this activity to provide economic product yields. The process has been tested in pilot plants on both Eastern high-sulfur bituminous coals and Western subbituminous coals. In all cases, the process successfully removed sulfur and ash pollutants and produced remarkably consistent marketable products.

The fundamental and original reason for interest in SRC-I is that the degree of conversion (hydrogenation) was to be just sufficient to enable ash removal and lowering sulfur content so that the product could serve as an environmentally clean fuel not requiring the use of scrubbers. This minimum conversion also results in the product being predominantly solid upon cooling of the de-ashed, desulfurized product stream. Operation at low temperature, pressure, and hydrogen consumption rates has the net result of lowering product cost. This is offset to some extent by the fact that solvent de-ashing methods are required for ash removal when conversion is minimum (i.e., the product is heavier). Solvent de-ashing is more costly than vacuum distillation which is used to remove solids in processes where conversion is higher (i.e., product is lighter and predominantly liquid). Coupling of the basic SRC-I liquefaction process with hydrocracking (TSL) allows overall process tuning so that the original feature of low-cost conversion is preserved while the ability to adapt the mix of solids and liquids to market demands is gained. The resulting overall efficiency is in the 65-75% range depending on the mix chosen. Stated differently, more usable fuel products will be produced from each ton of coal by this method than by any comparable method.

The hydrocracking step which is added to provide two-stage liquefaction is an extension of the well-known ebullated-bed hydrotreating process currently employed in petroleum refineries to upgrade sour and heavy crude oils or refining fractions. It is believed that the two-stage approach can be further optimized in terms of high liquid yields, low gas yields, and economics.

There are environmental benefits resulting from the SRC-I approach to coal liquefaction. Coal liquefaction by itself constitutes an action to remove pollutants from coal. Identification and control of pollutants (ash and sulfur) at one location is easier than when the pollutants are distributed through shipment of coal to many end-use sites. Additionally, due to the energy efficiency of SRC-I, less coal has to be processed to make a barrel of fuel. This corresponds to reduced emission potential throughout the coal handling, process, and product distribution spectrum.

1.3.3.2 Solids

Regardless of the mode in which the SRC-I plant is operated, substantial quantities of solids are produced. Two solid fuels are produced when SRC-I is coupled with hydrocracking to operate as two-stage liquefaction. Both steps produce liquids and solids. The TSL step greatly increases the overall liquid yields but conversion is only partial so some solid remains, which is called "TSL solid," to distinguish it from basic SRC solid because the sulfur and ash contents are different as follows:

- SRC solid is low in sulfur ($\sim$0.8%) and low in ash ($\sim$0.1%) and can serve as an environmentally acceptable, cost-effective boiler and furnace fuel which can displace oil.

- TSL solid is a very-low-sulfur (0.15-0.3%), low-ash (0.2-0.7%) solid boiler and furnace fuel that can displace low-sulfur oil.

The low sulfur content of SRC solid fuel results in compliance with sulfur emission standards without flue gas desulfurization. This product can be transported by rail in a manner similar to that for coal.

The SRC solid product has different properties from coal and as a consequence it can be used in place of petroleum in applications where coal could not be substituted. The solid can be used as low-sulfur boiler and furnace fuel, used to displace petroleum residual as a source for anode coke for aluminum manufacture, and used as a relatively pure feed to catalytic hydroprocessing to produce very low sulfur solid fuel (TSL solid) and middle distillate and naphtha.

In addition to low sulfur content, SRC-I solid is low in ash, has a low melting temperature, and is easily pulverized (very high Hardgrove grindability index) which enables its use in three firing modes that are applicable to oil-designed as well as coal-designed boilers and furnaces. These are finely pulverized feed, melted and atomized like oil, and mixed with the SRC liquids to provide a pumpable, sprayable slurry.

All three forms of firing SRC-I solid may be viewed as a means to directly backout No. 6 fuel oil use.

SRC-I solid combustion and fuel handling tests have been successfully conducted in these modes in an oil-designed boiler at the DOE Pittsburgh Energy Technology Center and in a coal-designed boiler at the Georgia Power Company's Plant Mitchell Generating Station.

A recent analysis based on the combustion test and evaluation of technical and economic feasibility indicates that SRC-I solids are a viable fuel for the 1990s in the following markets: (1) oil-fired, non-coal-capable utility and industrial boilers; (2) oil-fired, coal-capable utility boilers with technological, environmental, or economic conversion problems; (3) industrial furnaces and kilns; (4) new intermediate-load utility boilers; and (5) new industrial boilers. Several electric utility and industrial firms have agreed to purchase and demonstrate SRC-I solids product use in thermal boilers and process units to displace their current use of oil. Examples of these companies and the market segments they represent are:

- Existing oil-fired, non-coal-capable utility and industrial boilers. This market segment includes utility and industrial boilers originally designed to fire oil that cannot be converted to fire coal. By the year 2000, the energy requirement of this market segment is forecast to be 1.2 million barrels of oil equivalent per day. As demonstrated by the recent combustion tests at PETC, SRC-I solids can be used in oil-designed boilers. Since electric utility boilers are much larger than industrial boilers, the initial demonstration efforts have focused on the utility boiler market.

- Existing oil-fired, coal-capable utility boilers with technological, environmental, or economic conversion problems. This segment includes utility boilers that can no longer burn coal because of technical, environmental, or economic limitations. By the year 2000, the energy requirement of this segment is projected to be 200,000 barrels of crude oil equivalent per day. SRC-I solids, with their low ash and sulfur content, could accommodate some of the conversion limitations of boilers in this segment, thus offering a viable alternative to continued oil use.

- Industrial furnaces and kilns. Included in this segment are new and existing process heaters and furnaces such as heating furnaces, melting furnaces, shaft furnaces, tubestill heaters, and kilns. The estimated size of this market segment by the year 2000 is 1.4 million barrels of oil equivalent per day.

  - Existing units in this segment are almost universally designed for oil and/or gas and cannot fire coal. In light of anticipated economic and regulatory measures, new units will probably be designed to use coal where possible. However, where some process requirements prevent the use of coal, the unique characteristics of SRC-I solids make it a viable fuel option.

- New intermediate-load utility boilers. This segment includes only those new utility boilers which are expected to operate at less than 60% capacity factor. By the year 2000, the energy requirement of this market segment is forecast to be 400,000 barrels of oil equivalent per day. For the intermediate-load-range utility boilers, economics favor SRC-I firing over coal with a flue gas desulfurization system. Thus, SRC-I solids provide a viable fuel alternative which facilitates the enforcement of legislation limiting oil use in new utility capacity. Orders for new SRC-I designed boilers will probably be placed only after full-scale and extended use of SRC-I solids in utility boiler applications is demonstrated and after commercial production is established.

- New industrial boilers. Included in this segment are new industrial boilers built after 1990. The Powerplant and Industrial Fuel Use Act regulations prohibit oil use in larger boilers. By the year 2000, the energy required by this segment is expected to be 2.3 million barrels of oil equivalent per day.

In these applications, as in others, SRC-I solids can provide an economic alternative to oil or gas firing or to coal use with expensive emission control systems. SRC-I solids also offer a viable alternative for smaller boilers if local emission standards require coal scrubbing or oil use. New boiler orders will probably be placed after industrial use of SRC-I solids in existing boilers has been demonstrated and after commercial production is established.

Analysis of a commercial SRC-I plant yields a 1990 average Btu cost of all SRC-I products of $6.20 per million Btu (expressed in 1980 dollars), which is equivalent to approximately $37 per barrel of crude oil. The SRC-I liquid products — naphtha and middle and heavy distillates — would have an average cost of $8.18 per million Btu (1980 dollars), if they are valued at corresponding petroleum product prices projected by DOE-EIA for 1990. Subtracting the liquid products market value from the annual production cost yields a residual product cost for SRC-I solids of $3.25 per million Btu, delivered to user.

The cost-based price projection of SRC-I solids depends on many factors which require both verification by operation of the demonstration plant and commercial demonstration of its products. The prices presented here are based on a 30,000-ton/d coal feed commercial plant product mix of 60% liquids and 40% solids, a 65:35 debt/equity ratio, and a 15% after tax discounted cash flow return of equity.

The total energy demand by the year 2000, in the markets for which SRC-I solids are applicable, is projected to be approximately 1 million ton/d of SRC-I solids, which is equivalent to 5.5 million bbl/d of crude oil. During the next two to three decades, a combination of rising world oil prices and concern about insecurity of imports will lead to a demand for clean-burning synthetic fuels which will far outstrip the capacity that the new synfuel industry will be able to construct. Supplying just 5% of the projected demand would require the solids output of seven SRC-I commercial plants by the year 2000.

1.3.3.3 Anode coke

Petroleum residual from refineries currently is used to make high-quality calcined coke for manufacture of carbon anodes for aluminum smelting. Availability of low-sulfur crude oil and low-sulfur residual oil required for anode coke production is declining and necessitates development of alternate sources of calcined coke.

The United States is the largest producer of calcined coke and supplies nearly one-half of the free world demand. By 2000, total demand in the free world is projected to reach 17 million tons, with annual exports values at over $1 billion. New sources of calcined coke then are also required to maintain this nation's position in the market. It is apparent that anode coke production is linked to the general problem of petroleum availability.

The SRC-I solid can be used to produce high-quality calcined coke to make carbon anodes for aluminum production. Approximately one-third of the SRC-I solids produced in the demonstration plant will be calcined and sold to aluminum producers to demonstrate use in their application.

1.3.3.4 Liquids

Liquids from the process may be substituted directly for petroleum-derived fuels or further treated and refined as desired into an array of products including gasoline blending stock and distillate fuel oils.

The C_5-400°F naphtha fraction can be converted into high-octane gasoline blendstock. Preliminary tests with similar coal-derived naphthas show that hydrotreating can be used to prepare SRC naphtha for catalytic reforming, which then produces unleaded gasoline blendstock of about 100 research octane number.

The SRC-I plant middle distillate and heavy oil can substitute for No. 2 and No. 6 fuel oils. The middle distillate can displace No. 2 fuel oil in boilers and furnaces and may be used as stationary turbine fuel. The heavy oil fraction can be used directly or blended with pulverized solids as a substitute for No. 6 fuel oil. The sulfur content of SRC-I medium to heavy oils is considerably lower than that of comparable petroleum-derived fuel oils.

Further market potential for liquids produced from the SRC-I demonstration plant is expected to exist in the following areas: the SRC-I naphtha as a catalytic reforming feedstock to produce benzene, toluene, and xylene for the petrochemical industry; the middle distillate (400-650°F fraction) as a hydrocracker feedstock due to its low API gravity and relatively high aromatics content to produce more gasoline, stationary diesel fuel, and turbine fuel; and the heavy oil (650-850°F fraction) as a carbon black feedstock due to its high aromatics content and relatively low API gravity.

1.4 POTENTIAL FOR COMMERCIALIZATION AND CUMULATIVE IMPACTS

It is foreseeable that the private sector or the Synthetic Fuels Corporation, or both, will continue current efforts and develop a mature commercial coal liquefaction industry, which will result in regional impacts on air quality, water quality and availability, solid waste disposal, socioeconomics, and land use. Although DOE has no current plans to assist further demonstration or commercialization of a coal liquefaction industry, it has generically examined regional impacts to provide estimates of the cumulative effect of commercialization that could ensue. To aid in this examination, a hypothetical scenario was developed, which postulates the number of plants and general candidate locations for the plants in the 1992 time frame.

Commercialization will most likely occur in regions having access to coal fields and an adequate water supply. Once the hypothetical locations were selected, the aggregate regional environmental impacts were estimated, based on algorithms that translated the input and output characteristics of a unit liquefaction plant into characteristics of the regionally located plants.

The analysis indicated that plants similar in design and size to the unit liquefaction plant could be located in the regions considered with little environmental degradation occurring if certain siting precepts were considered. With reasonable care in selecting sites for commercial facilities and with proper engineering design, cumulative impacts would not create significant changes in regional environmental conditions such as air and water quality, solid waste disposal,

land use, or in community facilities and services. The exact magnitude of such impacts would depend on the eventual site selection process and on the specific location of individual liquefaction plants.

1.4.1 Unit plant emissions

Potential environmental impacts due to commercialization will originate principally from four major areas of plant operation: by-products and solid wastes, environmental control technology limitations, wastewater discharges, and fugitive emissions.

In addition, momentary releases of pollutants may occur during startup and shutdown operations and under emergency conditions. In the SRC-I process, steps are being taken to avoid such releases by routing emergency blowdown of reactors to holding tanks.

For purposes of this analysis, the unit plant emissions have been estimated from conceptual design of an SRC-I commercial plant. In the absence of final plant designs, it is difficult to estimate accurately the total emissions arising from a commercial coal liquefaction facility. Existing emissions data are highly conceptual. Atmospheric emissions and wastewater effluents for the unit plant are presented in Tables 1.5 and 1.6, respectively.

Table 1.5. Atmospheric emissions, direct coal liquefaction processes, SRC-I unit plant for point sources

(100,000 bbl/d oil equivalent)

Emissions	Average tons/year	
	Maximum	Expected
Particulates	500[a]	350[b]
SO2	184	184
NOx	4,150	3,320
CO	3,705	1,852
Hydrocarbons	350[a]	40[b]
Trace metals		Tons/year
As		1.7
Cd		160.0
Hg		51.0
Zn		1170.0
Cr		2480.0
Ni		550.0
Pb		580.0

[a]Point sources and fugitive emissions.
[b]Point sources.

A scenario involving six liquefaction plants has been used to illustrate a coal liquefaction industry. Six plants have been chosen as a reasonable estimate of the number of commercial direct liquefaction plants that may be operating in 1992. These are plants having a product output of 100,000 bbl/d (oil equivalent). Each of these consumes 30,000 tons/d of coal. Location, coal type, and relevant coal analysis are shown in Table 1.7. Of the four major areas of plant operation which produce discharges, estimates of fugitive emissions present the greatest uncertainty, while by-products and certain solid wastes can be estimated on the basis of the coal analyses.

1.4.2 Description of existing environment

The coal conversion facilities under consideration are proposed to be sited in Illinois, Kentucky, and West Virginia. Since the coal type to be used at each facility can be estimated, it is possible to broadly describe the existing environment based on coal seam locations.

Table 1.6. Worst-case, treated wastewater discharges from SRC-I coal liquefaction plant[a]

(100,000 bbl/d oil equivalent)

Parameters	Average concentrations (mg/liter)	Maximum concentrations (mg/liter)	Average discharge rate (tons per year)	Maximum discharge (tons per year)
BOD	20.0	40.0	457.0	914.0
COD	50.0	100.0	1142.0	2284.0
TSS	20.0	35.0	457.0	800.0
Oil and grease	10.0	20.0	228.0	456.0
NH_3 (as N)	5.0	20.0	114.0	456.0
Phenols	0.1	0.6	2.3	14.0
H_2S	0.04	0.09	0.9	2.0

[a]Normal case is zero wastewater discharge.
Source: Appendix C.

Table 1.7. Coal liquefaction commercialization scenario

State	Illinois	Kentucky	West Virginia
No. of plants	Two	Two	Two
Coal	Illinois No. 6	Kentucky No. 9	Pittsburgh No. 8
Nitrogen, %	1.3	1.4	1.2
Sulfur, %	3.4	3.4	3.6
Mineral matter, %	10.8	10.4	8.9

Sources:

1. *Process Engineering Evaluation of Alternative Coal Liquefaction Concepts*, Vol. 1, Final Report, EPRI AF-741, Project 411-1, April 1978.
2. *SRC-I: Summary of Preliminary Demonstration Plant Design Cost Estimates and Long Lead Procurement Plan* (Draft), Vol. 1, Air Products & Chemicals, Inc., and Wheelabrator-Frye, Inc.
3. *Assessment, Selection and Development of Procedures for Determining the Environmental Acceptability of Synthetic Fuel Plants Based on Coal*, Basic Report and Appendix 1, FE-1795-3 (Pt. 1), May 1977.

For example, Pittsburgh coal may be used to fuel the West Virginia facilities. However, since details of the environment will depend upon the specific sites selected, the following description of water availability, socioeconomics, air quality, coal supplies, and transportation systems is very general in nature.

1.4.2.1 Water availability

The six coal conversion facilities being proposed will each require substantial amounts of water, thus it is imperative that they be located in areas where there is a dependable supply of water. If the facilities should be constructed in the Ohio River Basin, the water supply should be adequate. An extensive network of tributaries exists in this basin which can supply a substantial volume of water. The region also has a mean annual precipitation of over 40 in. of rain. Average annual runoff ranges from over 10 in. in Illinois to more than 25 in. in West Virginia. Consequently, for these facilities, there should be adequate surface water. However, should this area receive more coal conversion facilities in the future, water availability could become a possible constraint.

Because of the large water requirements of each facility and the existing water requirements, competition for water use may develop. The navigable waterways cannot afford to have their flow significantly reduced if this would affect navigation.

1.4.2.2 Socioeconomics

The six coal conversion facilities are assumed to be located in relatively rural areas, but the distance from each project site to the nearest urban centers, the primary sources of construction and operation labor forces, will vary. Where the distance between the project site and the nearest urban centers is great, significant numbers of workers are likely to move to the small communities in the vicinity of the site, thereby creating socioeconomic impacts related to population dislocations.

In potential areas for SRC-I facilities, unemployment in July 1980 ranged from 6 to 12% in Kentucky, 12 to 18% in Illinois, and 5 to 12% in West Virginia. Since construction of commercial facilities will not begin for several years, no firm prediction can be made as to the level of unemployment which will exist at that time. Many of the unemployed are miners, and, according to the Bureau of Labor statistics, coal mining employment has declined sharply in areas where the coal contains high amounts of sulfur. However, since the coal conversion facilities may be located in high-sulfur-content coal regions, mines will be reopened to supply feed coal to the facilities. Many of the unemployed workers may be skilled coal miners who will be reemployed as the mines open, but it is likely that some of the remaining unemployed will be hired to work on the construction of the facilities. The local labor force is not likely to be adequate to supply all the highly specialized workers needed for plant construction. The labor force at the peak of construction of a commercial-scale unit plant will be between 5000 and 10,000.

1.4.2.3 Coal supplies

Bituminous coals with high volatile matter and sulfur contents, suitable for utilization in liquefaction facilities, are abundant in the proposed areas. The large Pittsburgh coal seam in West Virginia and Pennsylvania is the most important of all West Virginia coals. The Kentucky coals are generally ranked as high-volatile B to high-volatile A bituminous coals. Most of these coals are below 3% sulfur. The Illinois No. 6 coal, which would probably be used at the Illinois facilities, constitutes over 40% of the total coal resources in the state. The sulfur content is relatively low for Illinois, ranging from 0.5% to 2.5% and averaging around 1.5%. The volatile matter of this No. 6 coal is high, averaging over 30%.

1.4.2.4 Air quality

Air pollution legislation is based on the goal of protecting and enhancing public health and welfare, regardless of location. The Clean Air Act of 1970 and its 1977 amendments authorize two programs to meet this goal.

In highly polluted areas, regulations have been set to improve air quality through the National Ambient Air Quality Standards (NAAQS). In order for a coal conversion facility to locate in an area which is nonattainment for any criteria pollutants, several stringent requirements have to be met. These include emission offsets and lowest achievable emission rates.

Kentucky has several primary nonattainment areas for SO_2 and TSP. Facilities locating in these areas would have to meet more stringent requirements than if they located elsewhere in Kentucky. Small portions of the upper neck of West Virginia are primary nonattainment areas for SO_2, and the entire area is primary nonattainment for TSP. Illinois similarly has primary nonattainment areas for SO_2 and TSP.[13]

In relatively clean air areas, a program has been established to prevent significant air quality deterioration. All other areas in these three regions are classified as Prevention of Significant Deterioration (PSD) Class II areas. The PSD program is aimed at preserving clean air resources and preventing the development of new air quality problem areas. PSD Class II areas are those areas which are in attainment, but which allow for increments of air degradation. National parks, wildernesses, etc., are classified as PSD Class I areas. In these areas, only small amounts of degradation of ambient air quality are allowable. Any facility locating in a Class II area, adjacent to a Class I area would have to ensure that ambient air quality in the nearby Class I area is not degraded by more than the allowable amount. Evaluation of the impact of SRC-I commercialization on Class I areas in the three states will require site-specific studies prior to final site selection.

1.4.2.5 Transportation systems

The coal conversion facilities are expected to be located close to existing highways, railroads, and navigable waterways. Accessibility to these transportation networks will be advantageous during the construction phase for moving materials to the facility site and for transporting product fuels from the site. It is likely, however, that existing roads will not be adequate in many cases, particularly in rural areas, to handle the large number of commuting construction workers without road improvements or other mitigation measures.

Coal transport to the facility will be by rail, truck, or barge, depending upon the specific locations of the mine and the plant. The transportation of solid fuels from the facilities to the markets also will be via rail, truck, or barge. Illinois is much less mountainous than Kentucky and West Virginia and has the most extensive rail and highway network. Although the other regions are characterized by a more rugged terrain, they also have highways, railroads, and rivers which pass through the coal regions.

Although oil and natural gas pipelines pass through each of the regions, the liquid fuel produced at the conversion facilities may be too viscous, corrosive, or otherwise incompatible for injection into these existing systems. Insulated pipelines (similar to the Alaska Pipeline) may be constructed to transport the fuel to refineries, utilities, and/or other markets, or heatable tank cars may be used to transport the liquid product by rail.

Further assessment is needed to determine the compatibility of syncrude with materials used for petroleum transportation.[15] Railroads, trucks, and tankers are more hazardous modes of transportation than pipelines.[16] Due to their poor condition, the nation's railroads may transport the least amount of synfuels products. In addition to transportation risks, exposure to the synfuels products may occur in loading and unloading trucks at storage terminals and service stations.

Equally important with the environmental advantages of using pipelines are the economic considerations. It is expected that it will be cheaper to transport coal liquids to existing refineries through a pipeline than to build new refineries. Pipelines are expected to be the most efficient and economic transporters of coal liquefaction and gasification products from synfuels plants to users in large cities across the country.

1.4.3 Cumulative environmental consequences

1.4.3.1 Approach

In Sect. 1.4.1, six liquefaction plants were hypothetically sited in Illinois, Kentucky, and West Virginia. While it can generally be assumed that liquefaction plants would be located with respect to mine-mouth locations, it is not practical at this time to select specific sites for analyses. Consequently, a regionalized or state-level environmental assessment has been developed in the following section based upon two unit liquefaction plants located within each state and the coal mining requirements necessary to supply these plants when intrastate coal is available for use. As the synthetic fuels program evolves and grows, specific sites would be chosen by industry and NEPA reviews would be conducted where DOE or other Federal agencies are participants.

State-level environmental loadings associated with coal mining requirements and the construction and operation of plants located within a state are estimated on the basis of algorithms presented in Appendix BB. Where possible, the relative importance of these loadings is established by comparison with projected state-level loadings (i.e., net residuals) for energy production, processing, and end use as reported in runs of the Strategic Environmental Assessment System (SEAS).

A macroeconomic simulation model, SEAS calculates pollutant loads based on economic growth and energy supply patterns. The national energy production and consumption levels used as inputs to the SEAS model were projected by the FOSSIL2 model and reflect the energy initiatives as incorporated under the Second National Energy Plan. The estimates of the aggregated regional loadings from the commercial liquefaction plants and those state-level loadings projected by the SEAS model are not precise enough to represent anything more than a framework for a general comparison and to put the comparison in the proper context.

The cumulative loadings from the liquefaction plants should not be considered increases over those estimated by the SEAS model. Since the energy being produced by the liquefaction plants is already being produced in some form and way in the SEAS model, the net increase or decrease cannot be estimated.

1.4.3.2 Air quality

The U.S. Environmental Protection Agency has promulgated Primary NAAQS (health-based) and Secondary NAAQS (welfare-based) for seven criteria air pollutants. Table 1.8 displays the current standards. Areas having air quality exceeding these levels are termed Nonattainment Areas. A clean air area is one whose air quality is purer than that required by an NAAQS. Significant deterioration is said to occur when the amount of new air pollution exceeds a fixed maximum allowable increase. The reference point for determining air quality deterioration is the baseline concentration, which is the ambient concentration existing at the time of the first PSD permit application submittal in the area. To date, only PSD increments for SO_2 and TSP have been established. Increments are currently under investigation for the other five criteria air pollutants. Table 1.9 provides the current increments for SO_2 and TSP.

Table 1.8. The national ambient air quality standards

	Time period	Units	Primary	Secondary
SO_2	3 h[a]	$\mu g/m^3$		1300
	24 h[a]	$\mu g/m^3$	365	
	Annual	$\mu g/m^3$	80	
NO_2	Annual	$\mu g/m^3$	100	100
TSP	24 h[a]	$\mu g/m^3$	260	150
	Annual	$\mu g/m^3$	75	60
CO	1 h[a]	mg/m^3	40	40
	8 h[a]	mg/m^3	10	10
Pb	3-month average	$\mu g/m^3$	1.5	1.5
Hydrocarbons (nonmethane)[b]	3 h[a]	$\mu g/m^3$	160	160
Ozone	1 h[a]	ppm	0.12	0.12

[a]Levels not to be exceeded more than once per year. Annual standards are not to be exceeded.

[b]For use as a guide in devising plans to achieve the ozone standard.

Source: U.S. Environmental Protection Agency, "National Primary and Secondary Ambient Air Quality Standards," 40 CFR Part 50.4 et seq. (1980).

States are required to develop State Implementation Plans (SIPs) to properly develop or implement air pollution control plans. One principal regulatory mechanism of an SIP is the New Source Review (NSR) process. Among other things, NSR requires that major emitting sources be examined by a reviewing authority to ensure that they incorporate prescribed emission limitations [i.e., New Source Performance Standards (NSPS)]. A major emitting source is one that has the potential to emit, after control, 100 to 250 tons per year (the amount depending on the source category) of any criteria air pollutant. There are 28 source categories (including steam generators and coal preparation plants) currently having an NSPS and affected by the 100 ton-per-year rule. Liquefaction plants include both steam generators (boilers) and coal preparation plants which will be subject to NSPS review. The 1977 Amendments to the CAA directed EPA to accelerate the NSPS program so that standards will be periodically issued for most other major source categories (possibly synthetic fuel production plants).

The emissions of the major criteria air pollutants from plant operation and coal mining have been estimated for the liquefaction scenario. It is not possible, however, to estimate the effects that these emissions may have on air quality for every plant and mine since predicting air quality requires knowledge of local meteorological conditions. Table 1.10 provides the projected state emission inventory for plant operation and mining in 1995. (See Table 1.5 in Sect. 1.4 for atmospheric emissions in tons per year per unit plant.) Table 1.11 compares these emissions with those from the energy production, processing, and end-use sectors in each state,

Table 1.9. PSD increments ($\mu g/m^3$)[a]

	Class I	Class II	Class III
Total suspended particulates			
Annual geometric means	5	19	37
24-h maximum	10	37	75
Sulfur dioxide			
Annual arithmetic mean	2	20	40
24-h maximum	5	19	182
3-h maximum	25	512	700

[a]Congress established an area classification scheme to be applied in all PSD areas. The basic idea was to allow a moderate amount of industrial development but not enough to degrade air quality to the point at which it barely complied with standards. In addition, states were allowed to designate certain areas where pristine air quality was especially desirable. PSD areas can be categorized as Class I, Class II, or Class III. Class I represents pristine areas subject to tightest control; Class II, areas of moderate industrial growth; and Class III, areas of major industrialization. Under EPA regulations, all areas were initially categorized as Class II. States were authorized to reclassify specified areas as Class I or Class III. There are 58 mandatory Federal Class I areas that include major national preserves.

Source: U.S. Environmental Protection Agency, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans," 40 CFR Part 51.24 (1980).

Table 1.10. Air pollutant emission inventory from coal liquefaction[a]

State	Particulates			Sulfur oxides			Nitrogen oxides			Carbon monoxide			Hydrocarbons		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Illinois	1,000	99	1,099	308	90	458	8,300	1,238	9,538	7,410	752	8,162	700	139	839
Kentucky	1,000	99	1,099	368	90	458	8,300	1,238	9,538	7,410	752	8,162	700	139	839
West Virginia	1,000	30	1,030	368	60	428	8,300	900	9,200	7,410	554	7,764	700	80	780

[a]Numbers represent net emissions, in tons per year, by state, assuming two plants in each state; A = plant operation, B = mining, and C = total.

Table 1.11. Air emissions from liquefaction commercialization compared with energy sector and state total[a]

State	Particulates			Sulfur dioxides			Nitrogen oxides			Carbon monoxide			Hydrocarbons		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Illinois	1,099	0.8	0.32	458	0.04	0.04	9,538	1.2	1.2	8,162	0.81	0.35	839	0.30	0.25
Kentucky	1,099	0.8	0.32	458	0.04	0.04	9,538	1.6	1.6	8,162	1.5	0.81	839	1.0	1.0
West Virginia	1,030	1.1	0.83	458	0.09	0.09	9,200	1.2	1.2	7,964	0.80	1.36	839	1.8	1.8

[a]State net emission figures for energy sector and total are from the NEI 80 High Scenario and are based on 1995 projected emissions; A = emissions (tons/year), B = percent of state energy sector, and C = percent of state total

and the total emissions in each state. In all states, the emissions from the liquefaction plants will be a minor component of the total emissions from industrial combustion. Nevertheless, plants sited in all states will be required to undergo NSR for NA and PSD permit rules because their air emissions for sulfur oxides and nitrogen oxides would exceed 250 tons per year.

1.4.3.3 Water availability

About 16,500 gal/min of water will be withdrawn* to operate the unit plant. (Actual consumption is 11,808 gal/min.) For two plants in each of the three states, the water requirements would exceed 38,000 acre-ft per year, as is shown in Table 1.12.

Table 1.12. Aggregate water use requirements

State	Water withdrawal (acre-ft/year)			Total state water consumption in 1975 (%)
	Liquefaction plants	Coal mining	Total	
Illinois	38,054	1,034	39,088	17.4
Kentucky	38,054	1,015	39,069	19.3
West Virginia	38,054	1,099	39,153	53.0

In addition to the water needs of the liquefaction facilities, water will be required for the supporting coal mine operation. Principal categories that consume water in coal mining are dust control for roads, mines, and embankments, and revegetation of reclaimed areas. However, the mine location and type of mine will strongly influence the quantity of water consumed. Water sprayed for dust control in the mine and on the road is based on the area disturbed, evaporation rate, rainfall rate, and wetted area rate. The derivation of water use requirements is presented in Appendix BB. Total water requirements amount to approximately 39,000 acre-ft per year in each of the three states when mining use is added to that required for facility operation as shown in Table 1.12.

In order to provide some perspective on the impact of water requirements values, Table 1.12 also shows the combined water requirements of liquefaction facilities and associated coal mining as a percentage of total state water consumption in 1975. Project water withdrawal in West Virginia amounts to about 53.0% of total 1975 water consumption. Comparable data for Illinois and Kentucky reflect percentages of 17.4 and 19.3, respectively. Though these data must be assessed on a site-specific basis to determine the impact on water systems, they appear to represent a considerable amount of total water use.

There are several considerations that must be taken into account in assessing water availability. Groundwater overdraft is a severe problem in many parts of the country. One of the problems associated with groundwater overdraft is that continuing current trends may result in a sharp decline in the availability of groundwater for uses such as irrigation and domestic water systems. In addition to total availability, water quality must be considered. For example, in West Virginia, problems have arisen from salt water intrusion and contamination that were caused by exposure of groundwater to iron and sulfur deposits encountered during well drilling. Also, the effects of flooding in Kentucky are accentuated by the widespread occurrence of limestone deposits, allowing for increased exposure of groundwater aquifers to contamination by seepage.

*The reader should distinguish between the concepts of withdrawal and consumption. Water consumed is that which is chemically or physically altered during the process and is not released in the liquid phase. Water withdrawn is the total volume associated with the process. All consumed water is withdrawn, but not all withdrawn water is consumed.

It is not possible, when assessing potential cumulative impacts, to predict the ability of specific water systems to satisfy the requirements of synthetic fuels development. Such determinations must be made on the basis of site-specific considerations. However, neither the liquefaction facilities postulated nor any other synthetic fuel facilities will be constructed if sufficient water supplies are not available.

Two final considerations are worthy of note regarding water availability. It is possible that appropriate design changes could be made for specific regional siting, to allow complete water recirculation or zero discharge of wastewater. This would reduce both the overall facility water requirement and the ultimate amount of plant effluents.

1.4.3.4 Water quality

Impacts to water quality will depend upon the characteristics of wastewater discharge from the liquefaction facilities and the ambient conditions of the receiving waters. For commercial liquefaction plants, it is expected that most facilities would employ zero discharge; therefore, no impact on water quality will occur. However, for the worst-case analysis, treated wastewater discharge is assumed. In some cases, several of the components are of particular concern since the ambient levels of these components in the receiving water may exceed current criteria. Concentrations and discharge quantities for several selected wastewater parameters are shown in Table 1.6 to provide a general estimate of the levels anticipated. It is important to emphasize, however, that the environmental impacts of liquid effluents from liquefaction facilities will be highly site-specific. A major factor is the size and flow rate of the receiving waters which affects the capacity of the waters to disperse or dilute the pollutant streams. In addition to the characteristics of wastewater discharge, ambient water quality is also an important factor. Over the past decade, primarily in response to Federal and state legislation, the quality of surface water in the United States has shown signs of improvement. However, river basins in almost the entire eastern half of the country are still affected by industrial waste discharges. If the surface water quality is to continue to improve, discharges from synthetic fuels and other industrial developments must be kept to an absolute minimum.

One impact of improving surface water quality has been the gradual deterioration of groundwater supplies. This has resulted from greatly increased disposal of solid and liquid wastes in surface containments which allow waste constituents to leach into groundwater supplies. Because the exact nature of wastes from the various liquefaction processes are not yet known, particular care must be taken in their disposal.

Facilities that are ultimately constructed will require National Pollutant Discharge Elimination System (NPDES) permits prior to operation in the event wastewater is discharged. It can be assumed, then, that facilities granted these permits will be able to demonstrate compliance with applicable Federal standards. Depending on the specific site, similar or more stringent permit requirements may be necessary for certification by states. In addition to being required to meet current Federal and state standards to operate, it should also be noted that during the time frame under consideration in this statement, control equipment development should continue so that plants will be able to achieve zero-discharge levels.

One of the primary problems in predicting water quality impacts is that the impacts of individual effluent components are not yet fully understood. This problem is greatly aggravated at the programmatic level of consideration because of the chemical variation in the effluent receiving media and differences in coal feed characteristics. Continuing research and development efforts are being conducted by both DOE and the Environmental Protection Agency to (1) improve waste stream characterization from synthetic fuels facilities; (2) increase understanding of the potential environmental effects of the individual waste stream components; (3) increase understanding of the synergistic relationships between these components; and (4) develop improved methods of controlling the amounts of liquid effluents and specific components of liquid effluents.

One significant outgrowth of these efforts is the increasing interest in designing conversion facilities with essentially zero liquid discharge. This can be achieved theoretically by improving the recycle capabilities of plant water systems. By conducting a periodic purge of the water system to prevent contaminant buildup, potentially harmful wastes can be removed in a more easily contained solid form. Such systems could also prove extremely valuable in areas with poor or questionable water availability.

In the commercialization scenario developed in this report, liquefaction facilities in Illinois, Kentucky, and West Virginia, when not operating in a zero-discharge mode, would release effluents into receiving waters that ultimately join the Mississippi River. Although each of the plants in these states may meet applicable standards at the time of construction, their combined effluents could well produce effects downstream that have not yet been foreseen.

1.4.3.5 Land disturbed

Land will be disturbed as a result of the preparation of plant sites, the mining of coal, and, in some cases, the construction of transportation corridors. Each plant site is expected to require 1880 total acres (including offsite solid waste storage) for the life of the liquefaction facilities in each state. In addition, the remainder of the site area will be unavailable for other uses. Estimates of total land disturbed are presented in Table 1.13.

Table 1.13. Land disturbed

State	Plant facility (acres)	State surface mining (total acres, 1976)	Mining for liquefaction	
			Acres/year	Percentage of state
Illinois	3760	2580	838	32
Kentucky	3760	4770	1131	24
West Virginia	3760	2060	453	22

Additional acres will be disturbed by surface mining of coal to support the facilities. The number of acres in each state will vary, however, depending on the amount of coal required, the seam thickness of coal beds, and the type of mining. For example, acres disturbed from mining range from 453 acres in West Virginia to 1131 acres in Kentucky. The relatively low figure in West Virginia results primarily from a larger proportion of coal being supplied from underground mines.

One way to provide an indication of the relative impact of land disturbed is to relate the acres disturbed by the project to a common base. In this case, project-related acres disturbed per year have been compared to total acres disturbed by all surface mining in each state. This base has been calculated from 1976 surface mine productivity data using average seam thickness for each state. This provides an index for comparing project-related land disturbed to existing mining activity as shown in Table 1.13. For example, Illinois reflects a relatively high index of 32. This is higher than the Kentucky index of 24 even though the total acres disturbed by mining in that state is greater than in Illinois. The lowest index appears in West Virginia at 22 with 453 acres disturbed. Although surface mining creates the greatest land disturbance in some cases, the acreage shown in Table 1.13 will not all be disturbed at the same time. Typical surface mining operations involve simultaneous activities of surface clearing, topsoil removal, coal removal, backfilling, and revegetation. As a result, the amount of land being disturbed at any one time will be considerably less than the total acres indicated. The 1880 acres in each state removed from use by each plant facility and off-site solid waste storage, however, will all be disturbed for the life of the plant.

Land could also be disturbed as a result of transportation of construction materials by truck and coal by railroads. All of the plants, however, are located in the east where an extensive network of highways and railways exist. This system should be capable of accommodating transportation requirements. In areas where access roads are needed to reach the plant site, about 9 acres of land per mile of road will be disturbed if a 75-ft right-of-way (ROW) is built.[17] Approximately 32 acres per mile of railroad will be disturbed if new spur lines are required, assuming a 260-ft ROW.[17] The amount of time it will take to restore land to a usable state will vary from region to region. In West Virginia, for example, natural succession and recovery of hardwood vegetation could take 100 years. Natural hardwood disturbed in Illinois would require 150 to 200 years to reestablish.

1.4.3.6 Solid waste

The principal sources of solid waste associated with coal liquefaction are mining wastes, slag and fly dust from the gasifiers, auxiliary boiler ash, and secondary wastes (i.e., sludges) from pollution control equipment. Solid waste from underground coal mining is estimated at approximately 3% of the coal extracted.[17] Solid wastes which are generated from surface mining are returned to the mining site and, thus, do not constitute a disposal problem. Inspection of Table 1.14 shows that total solid waste from liquefaction would result in a 17 to 35% increase in estimated industrial solid waste generation on a state basis. This increase could be problematic in areas or states where disposal capacity is limited. Coal liquefaction wastes are under review but are not currently classified as hazardous under the Resource Conservation and Recovery Act (RCRA) regulations and, as shown in Appendix C, are not hazardous under EPA tests and thus are not subject to stringently regulated disposal practices. In the demonstration program, solid waste from the gasifier, which is over 95% of the total solid waste, is to be studied to confirm its nonhazardous characteristics, and a process will be devised for its ultimate disposal as road aggregate material or other construction aggregate.

Table 1.14. Solid waste generation by state (10^3 t/year)

	Coal mining waste[a]	Plant solid wastes (dry weight)	Total liquefaction wastes	Total solid wastes—1995[b] (dry weight)	Percentage of total wastes that are total liquefaction wastes
Illinois	327	2,400	2,727	15,881	17.2
Kentucky	267	2,400	2,667	13,489	19.8
West Virginia	463	2,400	2,863	8,110	35.3

[a]Coal mining wastes are based on underground coal mined for two liquefaction plants. Total solid wastes by state include pollution controlled ash and dust; sludge from SO2 removal, sludge from industrial wastewater treatment, other industrial sludges, and bottom ash process solid waste.

[b]State total for all solid wastes as projected by the SEAS Model.

1.4.3.7 Socioeconomic

Socioeconomic impact is determined to a large extent by the size of the project population and its relationship to existing community facilities and services. In general, metropolitan areas can accommodate larger population increases than rural areas and experience less impact. Metropolitan areas also provide larger labor forces and thereby reduce the need to import workers and their families. It is unknown at this time, however, where the other five facilities postulated for this scenario will locate in relation to metropolitan areas. Assumptions for such parameters as migration rates, family size and employment have therefore been based on calculations derived from the SRC-I case. The potential for variation from these basic assumptions is discussed in the following sections.

Employment

Direct and indirect employment for construction, operation, and mining are presented in Table 1.15. These data have been derived using the assumptions stated in Appendix BB.

These data must be interpreted in the context of time and space. In the case of direct construction workers, for example, the 10,000- to 20,000-man peak assumes that both plants in each state are constructed at the same time. In the ideal situation, the facilities would be built in series thereby reducing considerably the number of workers required at any one time. On the other hand, all plants will be operating at the same time once they have been completed. This results in a total operational force of 4400 workers for each of the three states. In addition, coal miners required to support the facilities during operation range from approximately 4300 in West Virginia to about 5600 in Illinois. It should also be noted that the impact from these work forces will be reduced to the extent that the six plants are dispersed throughout the three state areas and by their proximity to metropolitan areas within the states.

Table 1.15. Project-related employment

State	Construction			Operation			Mining		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Illinois	10,000-20,000	7,500-15,000	17,500-35,000	4,400		4,400	5,623	4,217	9,840
Kentucky	10,000-20,000	7,500-15,000	17,500-35,000	4,400		4,400	4,840	3,630	8,470
West Virginia	10,000-20,000	7,500-15,000	17,500-35,000	4,400		4,400	4,329	3,247	7,576

Although indirect population increases can be calculated for operation of the liquefaction plants, such a calculation would not be meaningful in this instance. The indirect employment generated during construction should be adequate for the operational labor force. Therefore, no additional indirect employees would be generated.

One of the major concerns related to construction employment is the availability of skilled labor. A potential shortage could develop if the plants are located close to other large construction projects that might compete for labor. On the other hand, if construction schedules are spaced as in the ideal situation mentioned earlier and the plants are dispersed throughout the three state areas, the demand for labor would be reduced considerably. The magnitude of impact will therefore depend on the siting and timing of plant construction. This also applies, to some extent, to design engineers and operational employees. An adequate supply would be more readily available if plants are dispersed among labor markets of large metropolitan areas. Also, any potential shortages could be ameliorated if plants are constructed in series thereby providing sufficient lead time to initiate training programs in areas of skilled labor shortages.

Mining manpower must also be considered. Demand for miners is estimated to range from approximately 4300 in West Virginia to 5600 in Illinois. While the demand is relatively similar in the three states in terms of absolute number of mines, the incremental increase is quite different. For example, the 4300 figure in West Virginia represents about 8.0% of the average number of miners working daily in that state in 1976.[18] In Illinois, however, the project-related demand amounts to approximately 42.4% of 1976 mine workers. Again, impact will depend on the siting of facilities and local supply of labor rather than overall impact on the coal mining industry manpower.

Population

Project-related population in relationship to community facilities and services is generally indicative of a wide range of socioeconomic impact. Population data related to construction, operation, and mining are therefore presented in Table 1.16. They have been derived using the assumptions outlined in Appendix BB.

Table 1.16. Increase in local population related to project

State	Construction	Operation	Mining	Total	1990 state total	Project percentage of state
Illinois	10,500-21,000	1,360	3,400	15,260-25,760	11,665,000	0.13-0.22
Kentucky	10,500-21,000	1,360	2,923	14,780-25,280	3,953,000	0.37-0.64
West Virginia	10,500-21,000	1,360	2,611	14,470-24,970	1,973,000	0.73-1.27

It is impossible to quantify the magnitude of socioeconomic impact of these data without knowing the baseline characteristics of community facilities and services. It is possible, however, to identify relative indices by comparing project-related population to a common base. In this case, project-related population has been compared to the official U.S. Census Bureau population projections for 1990 in each state.[19] These values are shown in Table 1.16 and range from 0.13 to 0.22 in Illinois to 0.73 to 1.27 in West Virginia.

It is important to emphasize that these data are not measures of socioeconomic impact. Construction timing and siting will ultimately determine the impact and must be assessed at the individual community level. Proximity to urban centers will have a significant influence on the magnitude of impact for two reasons. First, location within daily commuting distance of metropolitan areas will provide a greater supply of labor and thereby reduce the need to import workers and their families. This would result in lower estimates of project-related population than has been postulated in this scenario. Secondly, proximity to urban areas generally assures an adequate supply of the variety of community facilities and services required to support any influx of population. These include such things as housing, markets, school facilities, health care delivery systems, and public safety personnel and equipment. Impacts on these variables must, however, be addressed on a site-specific basis.

1.4.3.8 Occupational safety and health

Physical hazards

The most common causes of injuries occurring in virtually all industrial workplaces are falling from heights, slipping on wet floors, being struck by falling objects, and accidental contact with machinery. In many instances, these injuries result from human carelessness, malfunctioning equipment, or poor design. Other potential physical hazards to the well-being of workers in a coal conversion or combustion plant, which should be readily controllable or preventable, include excessive noise and heat and improper lighting. Control or prevention of these problems must be considered during plant design and modifications. The levels of noise, heat, and illumination may vary on a plant-specific basis depending on utilizing engineering techniques, and would have to be ascertained for each plant. The degree of danger would be determined by the safety attitude of the employees and is not expected to be any more significant for liquefaction facilities than for other production and manufacturing facilities.

Dust hazards

Coal dust in the liquefaction facility must be controlled. Lung damage has been observed in coal miners suffering advanced stages of coal workers pneumoconosis, initiated by an accumulation of coal dust in the lungs and the resultant lung tissue reactions. The most likely location that may present a problem would be the coal crushing and grinding facility, although any unloading or transfer point may be a point of exposure. If this operation is automated and individual workers are not exposed, no health hazard should exist. Other dust exposure that may be considered a potential hazard originates in the insulation materials: fibrous glass and mineral wool. The principal consequence of inhalation of the particulate forms (0.5 to 5.0 microns) of these materials is pulmonary fibrosis. The level of exposure encountered in individual facilities will determine the extent of the hazard and, if necessary, properly fitted respiratory protectors can be used to reduce worker exposure on an interim basis when engineering controls are not effective.

Chemical hazards

The assessment of fugitive emissions from commercial-state, liquefaction facilities must be inferred from emissions of related industries, since little published information exists and no commercial-scale plant has been built. Related industries in the United States which involve thermal and catalytic processing of fossil fuels (e.g., the petrochemical processing and utilization industry) are known to generate in-products and emissions containing substances that are potentially hazardous to human health. Liquefaction products, by-products, and process stream releases may pose a unique set of public health risks and environmental impacts during their production, transport, and use. Health risks may also result from chemical/biological transformations mediated by environmental factors. Potential carcinogenic polynuclear aromatic and heterocyclic hydrocarbons have been identified on coal combustion fine particulates and in

various syncrude products.[20] Programs are under way to address these potential hazards, and mitigating measures will be undertaken in the demonstration plant and will be further developed prior to commercialization.

Transportation

As discussed in Sect. 1.4.2.5, the facilities are expected to be located close to existing highways, railroads, and/or navigable waterways. The primary means of coal transport are rail and barge. In addition, for distances of up to 50 to 75 miles, truck transport is an option and for distances of several hundred miles or more, coal-slurry piplines may be considered.[20] Impacts associated with coal transport by these modes include: transportation system capacity impact, energy consumption, air pollution, noise pollution, right-of-way acquisition, and safety.

Based upon the assumption that the average daily coal input to a unit plant would be 30,000 tons, the daily coal input for the six plants in the commercialization scenario would be approximately 180,000 tons/d. In terms of transportation system requirements, moving this amount of coal would require use of over 1800 rail cars at 100 tons per car, or 120 barge loads at 1500 tons per barge. In terms of truck transport, 180,000 tons of coal would be equivalent to 9000 loads at 20 tons per load. The above figures represent approximately 9% of present rail car capacity when calculated on an annual capacity basis of 840 million tons or 4% of barges currently estimated to be handling coal.[21] The size of the coal truck fleet is not currently known and, thus, comparable percentages for truck transport cannot be calculated. Energy consumption and air pollution impacts related to transportation would be dependent upon the transportation mode used and the distance traveled. Noise pollution impacts would depend upon the transportation mode utilized and the proximity of sensitive receptors. The issue of safety is mode dependent and a function of the distance traveled.

1.4.4 Unavoidable adverse impacts

The environmental impacts of a commercial synthetic fuels industry are discussed in ref. 7. Regardless of control technologies and impact mitigation techniques utilized, commercialization of the SRC-I process by the private sector will result in some unavoidable adverse effects.

1.4.4.1 Air

Localized degradation of air quality would unavoidably occur as a result of coal mining and conversion. Some increase in sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, trace elements, hydrocarbons, and respirable particulates would occur in the vicinity of liquefaction facilities even though emission controls were employed.

1.4.4.2 Water

The water-related impacts of increased coal mining (i.e., aquifer disruption, acid mine drainage, etc.) are well documented in the literature. Some degree of impact will unavoidably occur in meeting coal requirements of the coal conversion program. Because these facilities are intended to be one component of a projected commercial plant which will ultimately be three to five times larger than the demonstration plants, water requirements will increase significantly in the future. However, impacts to water supplies and quality resulting from program-related mining increases should be minimal.

There may be some localized degradation of water quality as a result of coal conversion; however, "zero wastewater discharge" plant designs are being developed which will contain all water effluents. The SRC-I process is such a design. It should be noted that the exact constituent makeup of plant effluent streams is not known. Although liquefaction facilities will be designed to meet existing effluent limitation standards, some water quality deterioration will be unavoidable. Effluents from all facilities may ultimately reach major water courses with large capacities for pollutant dispersion and dilution.

1.4.4.3 Soils

Soil fertility may be unavoidably decreased in many areas as a result of activities associated with coal conversion facilities. However, this will be dependent on the type of reclamation practices being followed. Surface mining, facility construction, and solid waste disposal would all result in disturbance of topsoil. Even reclamation activities following surface mining will result in soil compaction and perhaps the burying of fertile soils. Toxic materials present in lower soil levels would be brought to the surface or mixed with the soils.

The disposal of ash from the facilities and mining wastes could cover large areas of topsoil making these areas permanently useless for productive purposes. Leaching from disposal sites could also adversely affect soil productivity.

1.4.4.4 Topography

Topography would be unavoidably altered by construction and mining activities. Actual plant locations would be marked generally by a leveling of all topographic features. Major changes in topography would accompany surface mining of coal, depending on the degree of reclamation. Similarly, underground mined areas could be adversely affected by ground subsidence and the creation of spoil piles.

1.4.4.5 Flora and fauna

The diversity, density, and composition of plant and animal species would be unavoidably altered in areas of mining and construction of the coal conversion facilities. Locations of the facilities would have to be selected keeping in mind the protection of endangered plant and animal species. It is anticipated that all native species will be removed from the actual facility sites; however, the area of construction will be relatively small, and a number of animal species may be able to relocate in adjacent areas. Ponds and streams that are removed or altered by mining and construction activities will unavoidably experience some or total species loss. In addition, noise from coal mining activities as well as construction and operation of the facilities could adversely affect local species' behavior, particularly reproduction and migration functions.

1.4.4.6 Socioeconomic values

Increased coal mining and construction activities associated with the facilities will result in moderate to substantial changes in population, depending on the size of the preexisting labor pools. A large increase in population would, to some degree, change living patterns in impacted communities and could result in aggravation of social and economic problems. The potential impacts would depend upon the relative size of the existing communities, the rate of growth, the existing infrastructure, and the adequacy of advanced planning for the growth.

Land use patterns would be unavoidably altered because of the land requirements for plant sites, mining sites, waste disposal sites, roads, railroads, utility and pipeline corridors, and associated services. Some of this change would be permanent. Agriculture, grazing forest, and recreational lands would be removed from their existing uses.

REFERENCES FOR SECTION 1

1. Energy Research and Development Administration, *Final Environmental Impact Statement — Alternative Fuels Demonstration Program*, Vols. I and II, Report ERDA-1547, September 1977.

2. Office of Emergency Preparedness, *The Potential for Energy Conservation*, U.S. Government Printing Office, Washington, D.C., 1972.

3. *Transportation Energy Conservation Data Book.* Ed. 3, ORNL 5493, 1979.

4. Kyosti J. Sarkanen and David A. Tillman, Eds., *Progress in Biomass Conversion*, Vol. 1, Academic Press, New York, 1979.

5. *The Report of the Alcohol Fuels Policy Review*, Report DOE/PE-0012, June 1979.

6. U.S. Department of Energy, "Fossil Energy Policy and Strategy, FY 1982-1985 (Draft)," Office of Assistant Secretary for Fossil Energy, Washington, D.C., July 30, 1980.

7. U.S. Department of Energy, *Final Environmental Impact Statement — Memphis Light, Gas and Water Division, Industrial Fuel Gas Demonstration Project*, DOE/EIS-0071, May 1981.

8. U.S. Department of Energy, Energy Information Administration, *Annual Report to Congress, 1979, Volume 3*, Washington, D.C., 1980.

9. U.S. Department of Energy, *Enhanced Oil Recovery of Improved Drilling Technology*, DOE Progress Review 23, Report DOE/BETC-80/3, October 1980.

10. *Program Solicitation for Proposals for Cooperative Agreement — Alternative Fuels Production*, U.S. Department of Energy, Procurement and Contracts Management Directorate, Office of Procurement Operations, Solicitation No. DE-PS01-80RA-50413, Washington, D.C., Aug. 1, 1980.

11. *Feasibility Studies for Alternative Fuels Production*, U.S. Department of Energy, Procurement and Contracts Management Directorate, Office of Procurement Operations, Solicitation No. DE-PS01-80RA-50412, Washington, D.C., Aug. 1, 1980.

12. H.D. Cochran, *SRC-I and SRC-II Demonstration Plant Projects — Technical Status Report*, Seventh Annual International Conference on Coal Gasification, Liquefaction, and Conversion to Electricity, Pittsburgh, Pa, August 1980.

13. U.S. Department of Energy, Assistant Secretary for the Environment, *Synthetic Fuels and the Environment: An Environmental and Regulatory Impacts Analysis*, Report DOE/EV-0087, Washington, D.C., June 1980.

14. *Draft Environmental Impact Statement, Development Policy Options for the Naval Oil Shale Reserves in Colorado*, Vol. 1, August 1980.

15. W. Wakamiya, A.B., Selbelien, and M.A. Parkhurst, *Assessment of Synfuels Transportation to Year 2000*, DOE Contract EY-76-C-06-1830, Pacific Northwest Laboratory, Richland, Washington, March 1979.

16. E.N. Bohn et al., *Utilizaton of Synthetic Fuels: An Environmental Perspective*, TRW Energy Systems Planning Division, August 1980.

17. U.S. Department of Interior, *Final Environmental Statement, Federal Coal Management Program*, Bureau of Land Management, Washington, D.C., April 1979.

18. U.S. Department of Energy, *Coal — Bituminous and Lignite in 1976*, Energy Data Report, Washington, D.C., 1978.

19. Bureau of the Census, U.S. Department of Commerce, "Projections of the Population of the United States: 1977-2050, Population Estimates and Projections." Current Population Reports, Series S-25, No. 704, Washington, D.C., July 1977.

20. Council on Environmental Quality, *Environmental Quality – 1979*, Tenth Annual Report, December 1979.

21. Energy Research and Development Administration, *Draft Coal Research, Development, and Demonstration Program Environmental Impact Statement*, Report ERDA-1557D, June 1977.

2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

2.1 INTRODUCTION

2.1.1 Background

The proposed action will lead to the construction and short-term operation, on a cost-shared basis with the International Coal Refining Company (ICRC), a general partnership of Air Products Coal Refinery, Inc., and Wheelabrator Coal Refinery, Inc., of a facility to demonstrate the operability of the SRC-I solvent refined coal process at near-commercial scale with the potential to expand to commercial scale at this site, if successful. Information obtained by environmental monitoring and effluent and control equipment testing during demonstration operations should reduce the environmental risks associated with the first commercial plant.

The contract between DOE and the industrial participant directed ICRC to propose a site-specific design for a 6000 tons per stream day (tpsd) plant. The site should be suitable for construction of a commercial facility having a capacity of approximately 30,000 tpsd. The demonstration plant design must be capable of complying with all applicable environmental requirements.

Although compliance with current and projected standards will require application of state-of-the-art control technology, standards do not yet exist for most of the chemical entities found in SRC materials or in many other chemical process operations. For this reason, the plant has been designed to incorporate measures to mitigate the hazards associated with releasing harmful chemicals. The proposed New Source Performance Standards for the Synthetic Organic Chemical Manufacturing Industry (SOCMI) was used as the basis for the design of controls, emission estimates and necessary control efficiencies for fugitive volatile organic compounds. These design features are discussed in Sects. 2.2.1, 4.1, and Appendix C.

2.1.2 Alternative actions available to DOE

The proposed action will lead to the construction and operation of a demonstration plant in accordance with the proposed process design evaluated in this EIS. This design is described in the Phase Zero conceptual design report with the modifications indicated on the first page of Appendix C and is specific for the proposed site near Newman, Kentucky.

The environmental impacts of the proposed action are evaluated in comparison with the impacts of the alternative actions that may be taken by DOE:

- Select an alternative site, design, or plant layout to further reduce environmental impacts and proceed with construction,
- No action, and
- Delay the action.

The proposed action is described in detail in Sect. 2.2 and the resulting environmental impacts are summarized in Sect. 2.3.1 and discussed in detail in Sect. 4. The impacts of alternatives are compared to those of the proposed action in Sects. 2.3.2, 2.3.3, and 2.3.4.

2.1.3 Summary comparison of alternatives

Twelve major process areas and control options and an alternative plant layout were evaluated to identify environmentally preferable alternatives and, where possible, to determine the potential for reducing impacts through selection of each alternative. The following areas were evaluated (Sect. 2.3.2 and Appendix C):

- separation of mineral residue,
- disposition of mineral residue,
- hydrogen production,
- gasification processes,
- sulfur recovery and emission control,
- process hydrocarbon emission control,
- waste heat rejection,
- wastewater treatment,
- plant fuels,
- particulate emission control,
- product solidification, and
- slag/flydust disposal.

The evaluations indicate that the proposed design includes the environmentally preferable alternative for (1) separation and disposition of mineral residue; (2) hydrogen production; (3) sulfur recovery; (4) particulate emission control for process emissions and the storage of coal, SRC solid product, coke, and sulfur; (5) wastewater treatment; and (6) plant fuels. The evaluation of alternatives for gasification processes did not identify significant differences in the potential environmental impacts of the technologically viable alternatives.

Evaluation of alternatives for heat rejection, process hydrocarbon emission control, plant fuels, product solidification, and sulfur emission control for the coker-calciner indicates that further study as detailed design information becomes available could reveal an alternative with less environmental impact than the proposed design. Alternatives being considered are described in Sect. 2.3.2.2.

Except for the plant layout, the design alternatives discussed in Sects. 2.2.1 and 2.3.2.2 are essentially independent of site considerations, as it may be reasonably assumed that the plant design and resultant emissions would be the same at either the proposed or alternative sites. However, the impacts of construction and operation of the demonstration plant depend on the environment of the site and physical conditions of the site.

In summary, the proposed site was selected by the industrial partner using the procedures and criteria described in Appendix B (Sect. B.2). Based on available information, none of the alternative sites are obviously environmentally superior to the proposed site (Sects. 2.3.2.1, 4.3, and 4.4).

Alternative site layouts were investigated to determine whether the plant could be located out of the flood-prone areas of the site. The proposed plant layout locates the process area on the portion of the site naturally above the 500-year flood elevation. Locating the storage tanks and ash ponds above this elevation by grading existing site soils is not practical. Hence, these areas will be diked to prevent inundation by a 500-year flood.

2.2 DESCRIPTION OF THE PROPOSED ACTION

2.2.1 Proposed plant design

This section describes the basic SRC-I process and the major features of the demonstration plant as currently proposed. The currently proposed design is described in the Phase Zero deliverables with the modifications noted on the first page of Appendix C. The proposed design is under continual evaluation by both DOE and the industrial participant and may be further modified. Alternative plant designs are discussed in Sect. 2.3.2.2 and Appendix C.

Detailed information on various sections of the plant design is given in Appendix C as follows:

- Additional description of the SRC process.
- Air emissions under normal, startup, shutdown, and emergency operating conditions; fugitive emissions; and alternative air pollution control schemes.

- Water treatment under normal, startup, shutdown, and emergency operating conditions; waste heat rejection; water balance; and alternative wastewater treatment schemes.
- Solid waste disposal information, including slag, coal, and SRC solid product leaching tests; slag disposal area design; water-soluble solid waste characteristics; and solid waste handling and disposal alternatives.
- Construction air emissions (including commuter and construction vehicle traffic) and water discharges.
- Plant resource requirements during the construction and operation phases.
- Results of SRC-I and SRC-II product combustion tests.
- Description of the expanded commercial plant, its pollution control strategy, and effluents.
- The effects of a flood on plant construction and operation.

2.2.1.1 Overall process description

The demonstration plant facilities have been designed to produce a primary product of low-sulfur, low-ash solid solvent refined coal from Western Kentucky No. 9 or equivalent coal. By-products will include anode coke, naphtha, fuel oil, and elemental sulfur. A process schematic of the preliminary design is presented in Figs. 2.1 and 2.2. A plant layout is shown in Fig. 2.3, and by-products from normal operations are reported in Table 2.1. Note that phenols and ammonia are destroyed within the plant and are not by-products.

Table 2.1. Products from SRC-I demonstration plant[a]

	Amount (tons/d)
Solid SRC	1050
Anode coke	588
Naphtha	585
Fuel oil	907
Elemental sulfur	188

[a] The product slate presented for the demonstration plant is based on the Phase Zero conceptual design with modifications as noted in the introduction to this appendix. The proposed design is currently under review by DOE and the industrial participant and may be further modified, resulting in changes to the product slate.

The design specifies that washed Kentucky No. 9 or equivalent coal will be delivered to the demonstration plant by train. A barge unloading facility is also included to supplement rail delivery in the event that the coal mine is not located in proximity to a rail line. (Appendix Y is devoted specifically to the environmental effects of the barge facility.) From the weighing and unloading area, the coal will be transported by semienclosed conveyors to the storage area. Coal will be reclaimed by a tunnel reclaiming system and transported by semi-enclosed conveyors to pulverizing-drying equipment for final size reduction and drying. The fine coal will then be transferred through surge bins to a slurry tank for mixing. Baghouses will be used to control the dust generated by coal pulverizing activities.

The demonstration facility will utilize a noncatalytic direct hydrogenation SRC-I process to convert 6000 tpsd of high-sulfur and high-ash coal to a solid product with a sulfur content of less than 1% and an ash content of 0.2% or less. The process encompasses the following steps.

The coal will be slurried in the process solvent and pumped to reaction pressure. Hydrogen recycle gas will be mixed with the slurry and heated to reaction temperature in a fired heater. At the exit of the fired heater, additional hot hydrogen recycle gas will be added to the slurry, and this mixture will flow to a dissolver for further hydrogenation and desulfurization.

The stream leaving the dissolver will be flashed from 2000 psia to 40 psia in multiple stages to recover hydrogen, process solvent, and liquid products and to remove water. The flash vapors from each stage will be partially condensed and the water decanted from the hydrocarbon liquids. The vapors will be combined and sent to the acid gas removal and hydrogen purification sections for further processing before recycle to the SRC area. The hydrocarbon liquids will be fractionated to yield liquid products and process solvent. The decanted water will be sent to the ammonia-sulfide stripper for further processing.

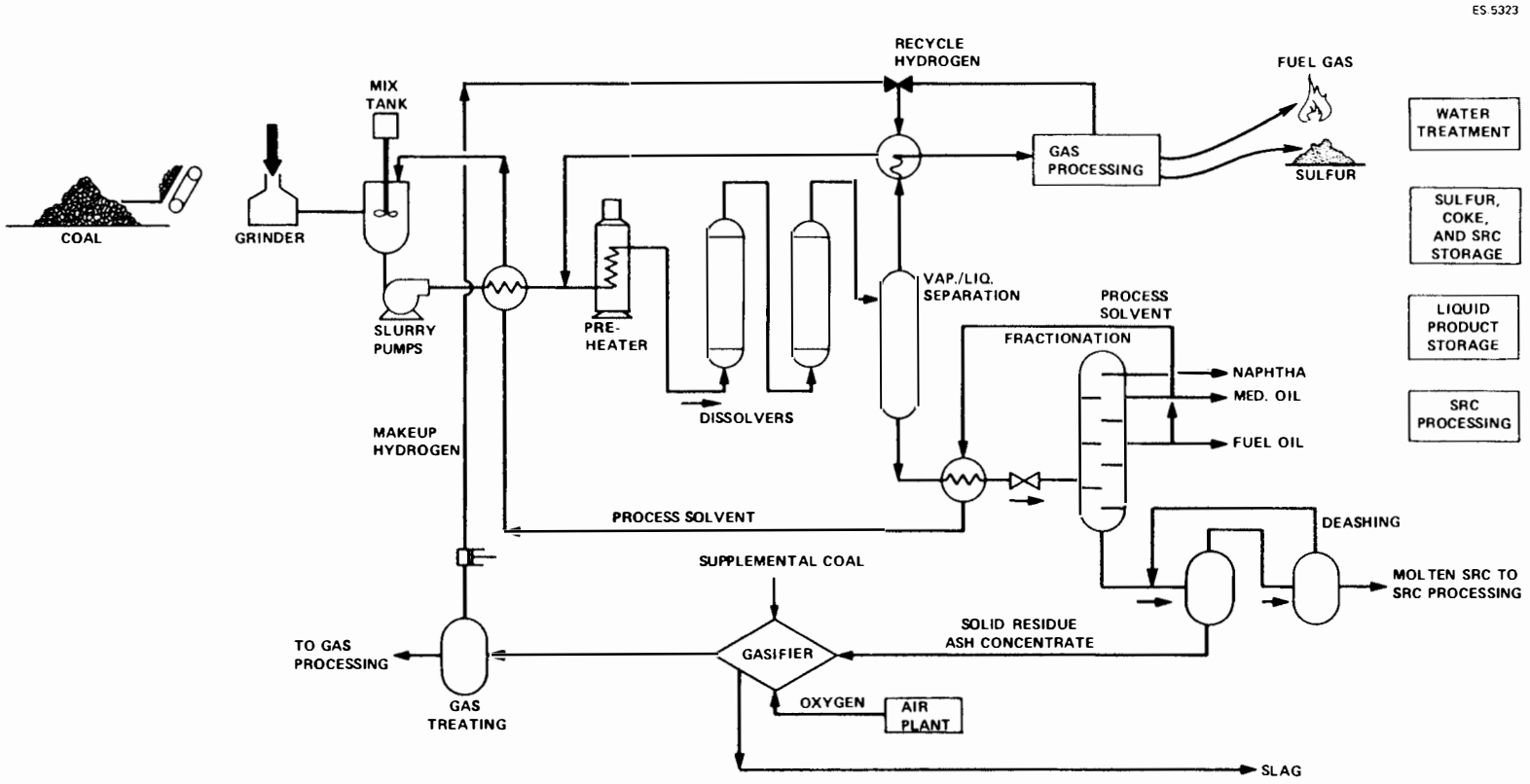


Fig. 2.1. Basic flow diagram for the proposed SRC-I demonstration plant. (For detailed diagrams of water treatment and SRC processing designs, see Figs. 2.4 and 2.2 respectively.)

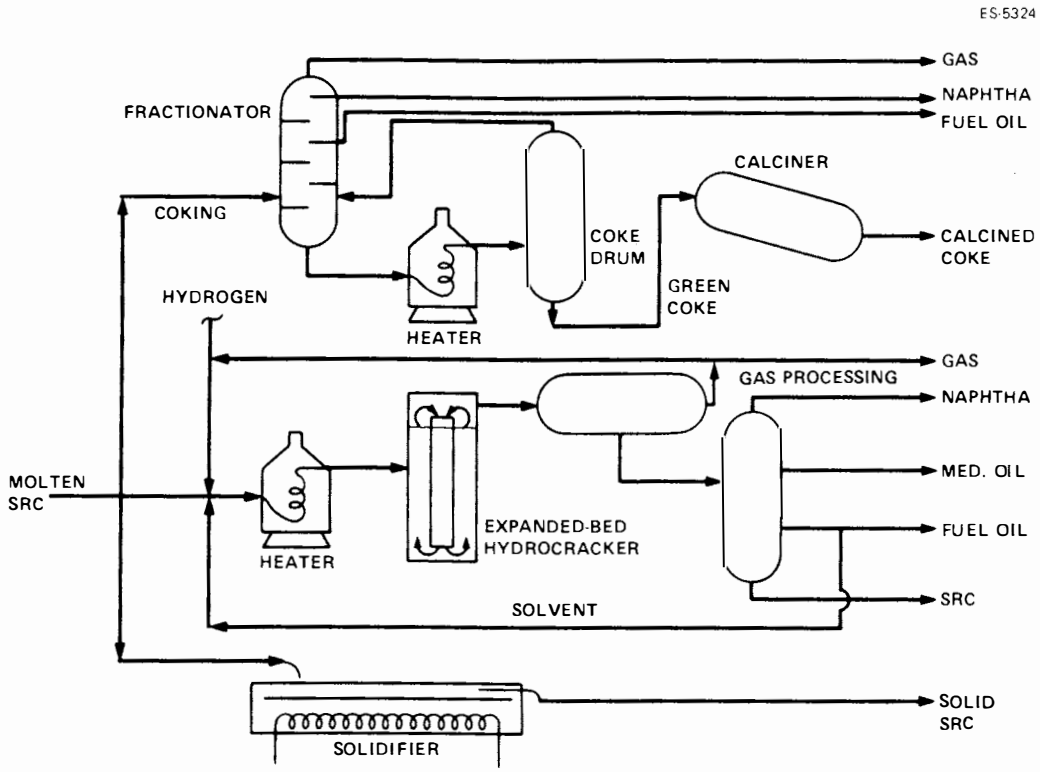


Fig. 2.2. Basic flow diagram for proposed SRC processing.

The low-pressure slurry containing process solvent, SRC product, unconverted coal, and mineral residue from the final separation stage will go directly to a vacuum column in the SRC product recovery area, where the process solvent and lighter components will be removed. The remaining SRC slurry will be sent to the Kerr-McGee Critical Solvent Deashing Unit, where it will be mixed with the deashing solvent and separated into the basic SRC product and ash concentrate.

One-third of the molten SRC product will be solidified into a solid SRC product. Another one-third will proceed to the coker/calciner area (see Fig. 2.2) where anode grade coke and light and medium oils will be produced. The remaining one-third of the molten SRC product, as presently proposed, will be fed into an expanded-bed hydrocracker for partial conversion to liquid distillates (see Fig. 2.2). In the hydrocracking process, SRC product will be combined with hydrogen and catalytically hydrogenated and hydrocracked. Product effluents of the hydrocracker will be cooled and flashed in a series of separators where light and heavy condensates are drawn off. All liquids will then be sent into a fractionator for separation into light, medium, and heavy oil cuts. Net products will include light (naphtha), medium, and heavy oils and a vacuum residue stream that solidifies upon cooling and is termed two-stage liquefaction (TSL) solids. These solids are similar to SRC solids but have an even lower sulfur content.

Sources of naphtha and fuel oils
(tons/d)

	SRC	Hydrocracker	Coker	Total
Naphtha	438	110	37	585
Middle distillate (400-650°F)	359	290	75	724
Heavy distillate (650-850°F)	83	100		183
Total				1492

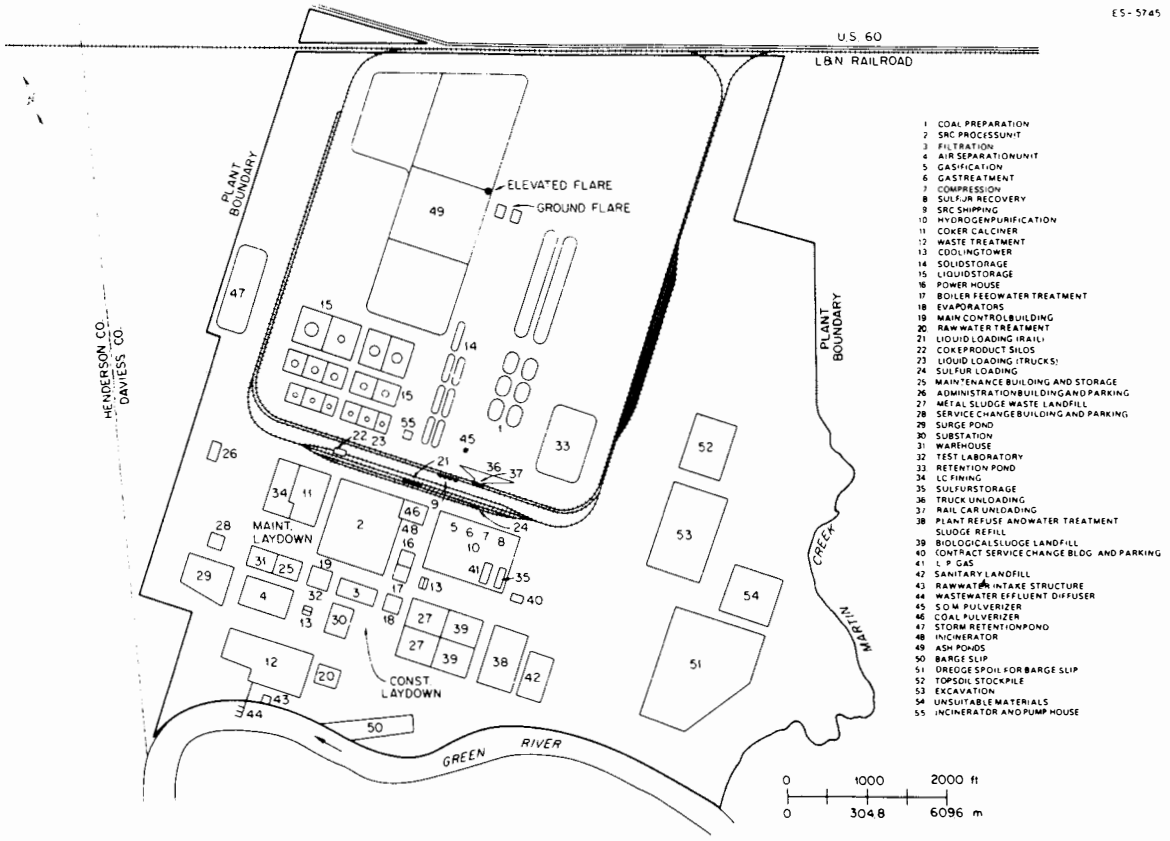


Fig. 2.3. Plant layout for the proposed SRC-I demonstration plant.

The ash concentrate recovered from the Kerr-McGee deashing area, containing mineral matter, unconverted coal, and some residual SRC product, will be sent to the gasification area. In the GKT gasifier, the carbonaceous material in the ash concentrate will be partially oxidized with steam and oxygen to produce a synthesis gas, primarily carbon monoxide and hydrogen. The synthesis gas will be reacted with additional steam to produce the hydrogen required by the process. In the gasification process, the mineral matter of the ash concentrate will be converted to a slag and a solid fly dust which will be the primary solid wastes generated by the process. Most of the sulfur in the residue will be converted to hydrogen sulfide, which will be removed from the product gas in a Selexol unit in the gas-treating area. The hydrogen, after acid-gas removal and compression, will be sent to the coal slurry area at the front of the plant. Hydrogen sulfide from the Selexol unit will be sent to a Claus plant for recovery of elemental sulfur.

2.2.1.2 Supporting facilities

In addition to the basic SRC process, the plant will include a number of supporting facilities similar to those used by the petroleum refinery and petrochemical industry. These facilities will provide required materials and utilities such as steam, electricity, process water, oxygen and nitrogen; treat products to market specifications; recover by-products; control fugitive emissions of volatile organic compounds for worker protection; and treat waste streams to remove pollutants and produce effluents suitable for emission or discharge, and to provide for the safe disposal of solid wastes. The major facilities that are of environmental importance are described briefly in the following sections.

Transmission lines

A power line will be required to serve the SRC-I facility. Information received by DOE in November 1980 indicates that the Big Rivers Electric Corporation has proposed construction of a 161-kV line to serve both the proposed SRC-I facility and an industrial facility proposed for construction at the Baskett site near Baskett, Kentucky. The line would be approximately 56 km (35 miles) long, with a 38-m (125-ft) wide right-of-way, occupying a total area of 213 ha (526 acres). The line would be placed on double wood pole structures with suspension insulators. One substation at the Baskett site and one at the Newman site would be required.

Approximately 4 ha (10 acres) of land would be purchased for each substation, allowing for later expansion. Initial substations at each site would actually occupy only about 0.4 ha (1 acre) of land.

The proposed route originates at the Henderson County Substation located off Kentucky Highway 1539 approximately 1 mile from its intersection with Tucker Road. It will parallel an existing line north for 1.1 miles crossing U.S. Highway 60, where it turns east-northeast for 3.2 miles to enter the proposed new Baskett Substation located off Tscharner Road 0.4 mile north of its intersection with Dr. Hughes Road. A specific route between the Baskett and Newman substations and a specific location for the Newman Substation have not yet been determined.

Near the SRC-I site, the proposed route must avoid two ecologically sensitive wildlife habitats. One is the Martin Creek forest where Indiana bats, an endangered species (Appendix K) have been found. The other is the Richland Slough, a wetland habitat used by waterfowl. DOE will work with the Big Rivers Electric Corporation to investigate the feasibility of slightly modifying the route to avoid these habitats. Current indications are that a route can be found to avoid these ecologically sensitive areas.

Gasification

From a process standpoint, the most important supporting operation is the gasifier. The SRC process consumes hydrogen in quantities too large to be economically procured off site. The required hydrogen may be most economically produced by a partial-oxidation gasifier. (Section 2.3.2.1 discusses alternatives to the proposed gasification system.) The GKT* gasifier reacts (burns) a carbon source with steam and a limited quantity of oxygen to produce hydrogen and carbon monoxide. The carbon monoxide is then reacted with steam over a shift conversion catalyst to produce hydrogen and carbon dioxide.

A variety of carbon sources including coal and oil could be utilized as gasifier feed. However, in the SRC process, the ash concentrate produced by the Kerr-McGee Critical Solvent Deashing Unit contains significant amounts of carbon and is used as the carbon source. Gasification of this material offers the dual advantages of recovering the carbon content of the ash concentrate for generation of makeup hydrogen and converting the ash concentrate into a slag and fly dust suitable for disposal. Alternatives for disposition of the ash concentrate and production of hydrogen are discussed in Sect. 2.3.2.1. To facilitate production of high-purity hydrogen for process use, oxygen will be supplied to the gasifier by cryogenic separation of air. During normal operations, there will be no emissions to the atmosphere from the gasification process. The gasification and shift-conversion processes are net consumers of water; however, a waste-water stream will be produced which is directed to the water-treatment facility. The slag and fly dust produced by the gasifier will be the major solid wastes produced by the process. Disposal of the slag and fly dust are discussed later in this section, in Appendix C, and in Sect. 4.2.2.2.

Acid-gas removal, sulfur recovery, and tail-gas treating

In the dissolver, hydrogen will react with both organic and inorganic sulfur to produce hydrogen sulfide and other reduced sulfur compounds (COS, CS_2). Most of the sulfur will be contained as hydrogen sulfide in the vapor stream; however, a significant amount of sulfur will remain with the products and the mineral residue; it will be partially liberated during subsequent processing steps. A sulfur balance for the plant is presented in Appendix C. The presence of hydrogen

*This gasifier technology was formerly identified generically as Koppers-Totzek.

sulfide is considered undesirable from a process standpoint, and gaseous streams containing excessive quantities will be directed to acid-gas (hydrogen sulfide) removal systems at various locations within the plant. In the SRC-I facility, the primary sources of acid gases will be the SRC process area, the gasification area, the coker/calciner area, and the expanded-bed hydrocracker areas. Acid-gas removal systems will use several commercial processes in which the hydrogen sulfide is absorbed into a scrubbing solution and then removed from the solution by physical processing, producing a concentrated hydrogen sulfide stream and a clean gas stream for further processing or use. The concentrated hydrogen sulfide streams will be collected from the various acid gas treating facilities and routed to the sulfur-recovery unit.

The systems specified for acid-gas removal include a Selexol unit and a diethanolamine (DEA) unit. The Selexol unit removes acid-gas from shifted syngas. The removed H_2S is then sent to the Claus unit for sulfur recovery. The effluent from the Selexol unit, which contains 80 vol % CO_2, 20 vol % N_2, with approximately 6 ppm H_2S and 140 ppm COS, will be heated to produce a bouyant plume then vented to the atmosphere. The DEA unit removes acid-gas from streams originating in the other areas of the plant (mentioned above) and sends the H_2S to the Claus unit. The sulfur recovery area will consist of two Claus units, one being a 100% spare, and a Beavon sulfur-removal unit. A three-stage, straight-through, ammonia-burning Claus unit will recover the bulk of the sulfur contained in the acid gases to produce elemental sulfur, which will be recovered for sale as a by-product.

The flue gas from the calciner, which contains SO_2 as well as particulates, will be incinerated and scrubbed. Two alternative scrubbing systems are being evaluated: the proposed wet soda-ash absorption and the alternative dry soda-ash absorption described in Sect. C.2.2.1. The scrubbed effluent will be vented to the atmosphere. The sulfite- and particulate-laden scrubbing stream will be either directed to the wastewater treatment facility or to the evaporator when the plant is operating in the zero wastewater discharge mode. The ultimate disposal mechanism depends on the choice of scrubbing technology. If dry scrubbing is used, the material may go directly to a landfill. The Beavon sulfur-removal unit will recover additional sulfur from the Claus tail-gas. The treated tail-gas will be vented to the atmosphere and will contain less than 4 ppmv hydrogen sulfide and less than 100 ppmv of combined hydrogen sulfide, carbonyl sulfide, and sulfur dioxide. Low-pressure raw fuel gas from the DEA unit will be treated for residual hydrogen sulfide removal by oxidation in the Stretford solution, where the hydrogen sulfide will be removed down to less than 5 ppmv and the clean fuel gas will be made available for in-plant fuel use. Treated tail-gas from the coker/calciner scrubber will constitute one of the major sulfur dioxide emission sources from the plant. The environmental impacts are evaluated in Sect. 4.2.3.1. Alternative sulfur control technologies are described in Sect. 2.3.2.1 and Appendix C.

Wastewater treatment

Major wastewater streams and contaminants. The expected types of wastewater flow generated in the demonstration plant are given below:

- process sour water
- cooling tower blowdown
- coal pile runoff
- SRC pile runoff
- process area runoff
- runoff from liquid storage and shipping areas
- metal-sludge landfill leachate
- leachate from slag disposal
- weak process wastes
- oily wastes
- sanitary wastes
- spent scrubber liquor from the coker/calciner scrubber
- wastewater from the gasifier

Appendix C describes the characteristics and compositions of these streams as presently known or estimated; Appendix P describes the composition of leachates from coal, solid SRC product, and gasifier slag. An extensive laboratory program is currently under way to characterize most of the wastewater streams expected at the demonstration plant (see Sect. 2.3.2.2). In addition to the major contaminants, the characterization will also determine trace elements and organic compounds, such as the EPA priority pollutants. About one-half of the total wastewater flow will be process sour water, the most heavily contaminated stream. Process sour water sources are from the SRC area, the coker, the expanded-bed hydrocracker, Beavon sulfur removal, and the DEA process. Hydrogen sulfide, ammonia, and phenolics should be the major contaminants in these streams, along with some cyanide, thiocyanate, and metals. Trace complex organics, such as polynuclear aromatic compounds, will probably be present in some of the streams, also.

About one-third of the wastewater flow will be the cooling tower blowdown. The most significant contaminant in this stream will be hexavalent chromium, which is added to the cooling system for corrosion control. (Alternatives to the use of chromate anticorrosion chemicals are described in Sects. 2.3.2.2 and C.3.4). The common inorganic constituents originating in the makeup water to the cooling system will be concentrated and present in the blowdown.

The remaining portion of the wastewater will come from various sources: GKT gasifier wastewater, runoffs from raw coal and SRC piles; runoffs from the diked areas where the process equipment, storage, and shipping areas will be located; sanitary waste; metal sludge and ash pond leachates; oil-bearing wastes; and such lightly contaminated waters as boiler blowdown and water-filter backwash.

The contaminants in the GKT wastewater will be primarily inorganics with low concentrations of organics and cyanides. The contaminants in the runoff from the coal piles should be mostly dissolved inorganic solids, including trace quantities of heavy metals. The process area runoff should be contaminated with process liquids, including certain high-boiling point hydrocarbons. The landfill leachate should contain the contaminants common to the coal pile runoff. The lightly contaminated wastewaters should contain chiefly inorganics and suspended solids.

Conceptual design of the wastewater-treatment system. The proposed wastewater-treatment system will be a zero-discharge system utilizing total recycle to the process but will have the flexibility to fully treat and discharge all wastewater in the event that process operating conditions do not permit total recycle. A laboratory program is currently under way to determine the treatability of the wastewater expected at the demonstration plant (see Sect. 2.3.2.2) and to support the design of the wastewater treatment systems. The goal of the wastewater treatment system is to operate primarily in the zero discharge mode. The conceptual design may have to be modified depending on the results of the treatability study. All wastewaters generated in the plant, as well as the contaminated runoff, will be sent to the wastewater-treatment facility. Sanitary waste will be combined with other plant wastewaters entering the biological system. Figures 2.4 and 2.5 are conceptual diagrams of the treatment facility. Figure 2.4 depicts the overall wastewater recycle scheme; Fig. 2.5 amplifies the primary, secondary and tertiary treatment of the wastewater. The treatment processes will include separation of oily wastes, precipitation and flocculation of toxic metals, pH adjustments, two-stage aerobic biological treatment followed by filtration, and final polishing of the effluent by activated carbon and disinfection. The system will provide equalization and retention basins to retain large wastewater flows during rain events (primarily runoff and leachates) and promote mixing, thereby preventing upset of the biological system due to shock by toxic components.

The equalization basin will receive all wastewaters requiring biological treatment, including weak process wastes, effluent from oil removal, effluent from metal precipitation, and the ammonia-sulfide water stripping (ASWS) bottoms. The equalization basin will be sized for a minimum of a 24-h retention time and will prevent shock organic, hydraulic, and temperature loads to the biological system. Two compartments in the equalization basin will be provided to permit solids removal and cleaning of the basin. Potential of solvent attack will be a consideration in selecting the materials of construction of the basin. An oil-skimming device will be provided to ensure that no oils enter the biological system. Provisions will also be made for addition of nutrients or defoamer to the equalization basin. A recycle stream from the biological-treatment effluent to the equalization basin will be provided to ensure sufficient water dilution in order to avoid inhibition and to further treat wastewater if the effluent composition is not within effluent limitations.

Rainwater runoff from the coal and SRC piles will enter a retention basin to control the flow of these waters to the treatment system. The basin will be constructed in such a manner to permit

ES-5331

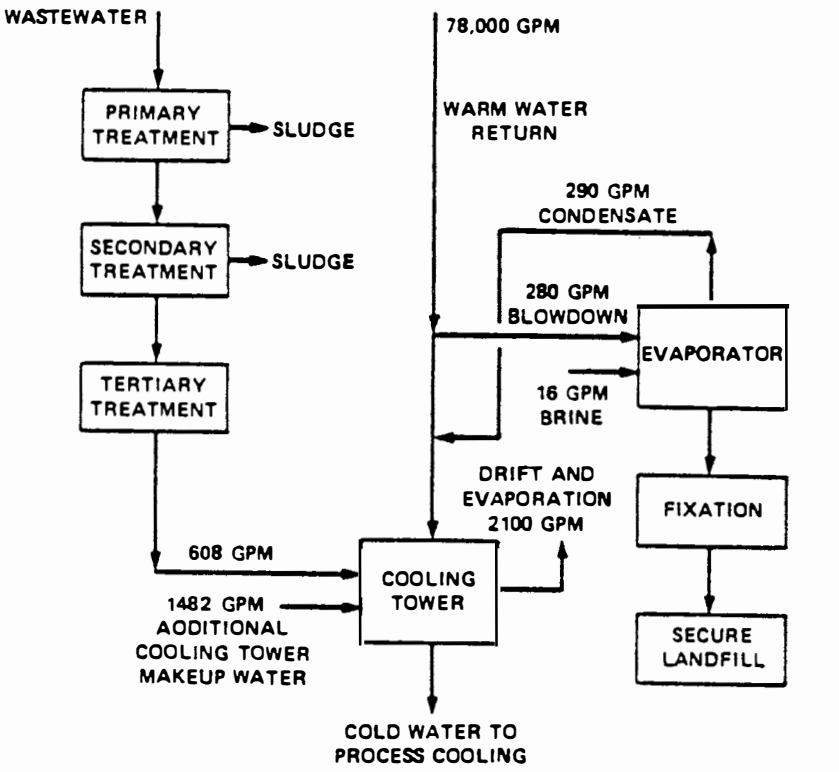


Fig. 2.4. Proposed zero wastewater discharge system.

access for cleaning solids that will accumulate in the basin. The basin will be lined with appropriate materials to prevent leaks. The lining materials will be selected in detailed engineering. Because of the acid nature of the coal pile runoff, the liner will be acid resistant. The capacity of retention basin will handle the rainwater of a 24-h, 10-year frequency storm. Effluent from the retention basin will then enter the metal precipitation system. The ability to bypass the metal precipitation system and permit water from the retention basin, after a prolonged storm, to enter the surge basin will also be available.

Rainwater runoff from the process area will be collected in a surge basin to control flow into the treatment system. Materials resistant to organic solvent attack will be used to line the basin. This basin will also be sized to handle rainwater runoff from a 24-h, 10-year frequency storm.

Effluent from the surge basin, along with other oily wastewaters generated in the plant, will enter an oil-removal system. The oil-removal system will have the ability to remove all floatable and emulsified oils. Depending on the carbon loading of the effluent leaving the oil-removal system, this stream may be bypassed around the equalization basin and biological treatment and permitted to enter the filtration system. Handling and disposal of slop oil from the oil-removal system are discussed in Sect. C.3.2.5.

Wastewater streams containing significant amounts of toxic metals will be treated in a metal-precipitation system. The GKT gasifier wastewater, coal and SRC runoffs, and landfill leachates will be in this category. If chromate is used as the corrosion inhibitor in the cooling system, blowdown from the cooling tower will also belong to this category. However, the cooling tower blowdown will enter a chromate-reduction unit in which Cr^{6+} is converted to Cr^{3+} before feeding into the metal-precipitation system. The metal-precipitation system consists of two separate stages: the pH of the first stage will be 11, and of the second, 8.5. Two-stage precipitation may be necessary because some metal hydroxides are amphoteric; the optimal pH for precipitating

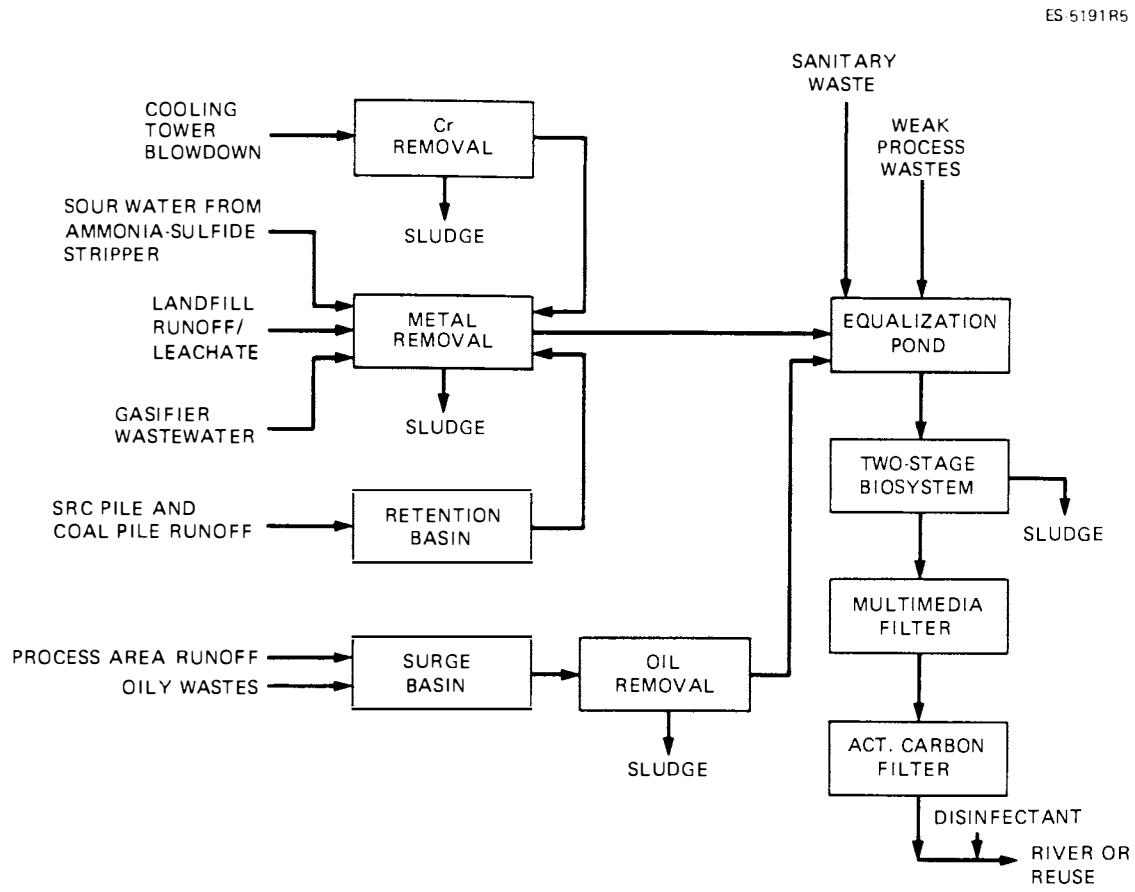


Fig. 2.5. Details of the proposed wastewater treatment system.

one metal may not be optimal for precipitating another. For example, the optimal pH for nickel is 11, considerably higher than the optimal pH (8.5) for many other metals. The final design of the metal-precipitation system will greatly depend on species of metals present in the waste streams. The metal precipitation will generate sludges; disposal of those sludges is discussed in Sects. C.2.3.2 and C.3.2.2.

The sour water streams will initially be steam stripped in the ammonia-sulfide water stripping (ASWS) unit to remove hydrogen sulfide and ammonia. The ammonia and hydrogen sulfide overhead stream will enter a Claus unit, where the ammonia will be converted to nitrogen and the hydrogen sulfide will be converted to elemental sulfur. The stripper bottom will contain a high level of phenolics and some other organics. The phenolics will be sent to biological treatment for removal. Depending on the amount of metals present in the ASWS bottoms, this stream will either pass through the metal precipitation system or enter the equalization basin directly.

The biological-treatment system will have two stages. The pH of the influent will be adjusted to achieve proper treatment in the biological system. Each stage system will contain an aeration basin and a clarifier to concentrate active biomass for recycle to the aeration basin. Concrete will be used as the material of construction in the aeration basins. Critical equipment items will have parallel units.

The purpose of the first-stage biological system will be to remove mostly phenolics and other easily biodegradable materials. Removal of ammonia and thiocyanates, as well as refractory organics, should occur principally in the second-stage biological system. Since the micro-

organisms in the second stage are usually more sensitive to environmental changes and more susceptible to inhibitions, the first stage should provide stability for the second stage. To further protect the biological system from potential inhibition and toxicity for major spills, provisions will be made for adding powdered activated carbon to the aeration basins. An alternative to the proposed design was considered: use of oxygen rather than air in the biological systems. Since pure oxygen is readily available in the plant, an oxygen system could be used instead of an air system (see Sect. 2.3.2.2).

A two-stage biological system similar to the biological system proposed for the demonstration plant is operating at the Wilsonville, Alabama, SRC-I pilot plant. Consistent operation of the biological system has been achieved at Wilsonville with phenol removal to less than 0.06 mg/liter during the period of January to August 1980, as documented in Wilsonville's monthly discharge monitoring report to the Alabama Water Improvement Commission. Phenol concentrations entering the biosystem in the demonstration plant will be higher than the influent feed at Wilsonville, but will be controlled to treatable levels by dilution. Additionally, tertiary treatment will be used in the demonstration plant as described below.

The effluent from the biological system will be further polished before discharge or reuse by filtration and activated-carbon adsorption. Filtration by multimedia filters will remove residual suspended solid; backwash water used to clean the filters will be sent to the equalization basin. Adsorption by GAC* will reduce trace organics, particularly polynuclear aromatics. Monitoring of the GAC bed effluent to detect organic breakthrough will determine when the spare GAC bed will be put on-line.

Effluent leaving the biological system will be ozonated either before or after multimedia filtration. Ozonation before multimedia filtration will prevent the development of microbial growth on the media in both filter bed systems. To prevent formation of chlorinated hydrocarbons, chlorination will not be practiced on this stream.

Because treated effluent will be discharged to the Green River on some occasions, a National Pollutant Discharge Elimination System (NPDES) permit will be required. The specific limitations for the treated wastewater discharge from the demonstration plant will be selected to ensure protection of the Green River's indigenous aquatic life and the designated uses for the stream established by the Kentucky Department for Natural Resources and Environmental Protection. The following procedures will be used to establish limitations for each conventional, nonconventional, priority, hazardous, and unlisted pollutant identified as being discharged from the plant.

Permissible amounts of pollutants in the effluent will be either water quality- or technology-limited. If there are no applicable water quality limits, the limit will be based on the best available treatment technology economically achievable or an appropriate New Source Performance Standard, whichever is more stringent. Where an appropriate water quality limitation exists, the effluent limitation will be chosen to ensure protection of that limit. The discharge will be credited for dilution only during the 10-year, 7-d low-river flow, rather than for any assimulative capacity of the river. Also, if current water quality is found to be out of compliance for a specific pollutant because of natural or background pollution sources, the associated discharge limit will be selected to prevent further significant degradation of stream quality.

When treated effluent is reused in the process, the treated effluent will be used as partial makeup water to the cooling tower. Before entering the cooling system this stream will be monitored so that water with excessive residual organic or inorganic contaminants can be diverted and kept out of the cooling system. The balance of makeup water will come from treated river water and possibly evaporator condensate. Blowdown from the cooling tower, after chromate removal if chromate inhibitor is used, will enter an evaporator system rather than the metal removal system. A small brine stream from the diethanolamine area and a small Stretford purge stream will also enter the evaporator system. The evaporator will concentrate the dissolved solids in the feed stream and will also produce a relatively solids-free condensate stream. The condensate will be used as makeup water in either the cooling tower or boiler. A granular activated carbon bed will be used to adsorb any small amounts of organics from the condensate stream if necessary. The solids stream leaving the evaporator will be further concentrated in a decanter and then will be disposed by one of several options described in Sect. C.3.2.1.

---

*Granular activated carbon dual-bed system.

Air pollution control

Emission inventory. The plant emission inventory is detailed in Appendix C. Table 2.2 compares the emission rates of the criteria pollutants from point sources in the SRC-I facility under normal operation (after control) with the emission rates of a nearby, 600-MWe power plant having approximately the same coal throughput. The power plant uses a low-sulfur coal without flue-gas desulfurization (FGD). As the table shows, the power plant emits significantly larger quantities of the pollutants than the SRC-I facility. This would still be true even if FGD were employed at the power plant. FGD could typically remove 90% of sulfur oxides and particulates and 20% of nitrogen oxides.

Table 2.2. Emission inventory of criteria pollutants from SRC-I point sources after control and nearby power plant

Contaminants	SRC-I		Nearby power plant	
	tons per year	metric tons per year	tons per year	metric tons per year
Sulfur oxides, as SO_2	92	84	125,600	114,150
Particulates	140	130	13,900	12,600
Hydrocarbons	7	7	no data	
Nitrogen oxides, as NO_2	830	750	73,240	66,590
Carbon monoxide	741	671	5,300	5,000

The pollution control technology employed is highlighted below for each pollutant: sulfur oxides, particulates, hydrocarbons, nitrogen oxides, and carbon monoxide (Appendix C).

Sulfur oxides control. Sulfur oxide control alternatives were considered for various parts of the plant and are discussed in Sect. 2.3.2.2 and Appendix C. Fired heaters could be potentially major sources of sulfur dioxide; however, the normal fuel utilized in the demonstration facility will be low-sulfur ($\sim$5 ppmv) process-generated gases.

Two parallel Claus units are incorporated in the plant design for sulfur recovery, the second unit being a full capacity spare. The cleanup of the Claus unit tail-gas is accomplished by a Beavon sulfur-removal unit (BSRU). The vented gases from the molten-sulfur storage and handling operations will be treated by small Stretford scrubbers to prevent release of sulfur compounds.

The flue gas from the calciner will be scrubbed with a wet soda ash system to minimize SO_2 and particulates. A dry particulate- and SO_2-removal system utilizing a sodium carbonate spray and fabric filters is under evaluation as an alternative.

Hydrocarbon control. All liquid storage tanks will have controls for vapor emissions. Most liquid storage tanks will be equipped with fixed roofs; any vapors evolved will be directed to a vapor-recovery system, where most of the vapor will be condensed and sent back to storage. All uncondensed vapors will be combusted in the enclosed thermal oxidizer of the controlled combustor/flare system as described in Appendix C, Sect. C.2.2.6. Some liquid storage tanks will be equipped with floating roofs; vapors will be purged from the space between double seals and combusted in the controlled combustor/flare system. Fugitive hydrocarbons will be minimized by providing liquid film seals; centrifugal compressors and centrifugal pumps handling light liquids and potentially hazardous liquids will be equipped respectively with liquid film seals and double mechanical seals with a barrier fluid interface, or equivalent systems. Sampling connections, drains, and sumps will be equipped with double valving or a valve and cap system and will drain into enclosed containers or the closed sewer system to minimize fugitive hydrocarbon emissions. Also, a directed monitoring, maintenance, and repair program (Appendix C, Sect. C.3.1.5) for valves, flanges, pumps, and compressors will be implemented at the plant.

During process upsets and emergencies, pressure relief streams containing hydrocarbons will be flared by the system described in Sects. C.2.2.6 and C.3.1.5. The hydrocarbons will be condensed as much as possible; the uncondensibles will be flared, and the condensibles will be fed to a holding tank that feeds the controlled combustor at a controlled rate. Some condensed hydrocarbons may be recycled to the process, depending on the upset situation. All hydrocarbons

should be combusted before release to the atmosphere. Entrainment of heavy hydrocarbons with the light gases to the ground flare field will be minimized by designing blowdown tanks to allow sufficient disengagement of vapor and liquid phases.

Hydrocarbons volatilized from the coal-drying operation will be vented to the atmosphere. The extent of volatilization will be minimized by controlling the drying temperature at less than 400°F and designing the pulverizer/drier to minimize the residence time. A study is under way to determine the amount of devolatilization and the contents of the volatilized matter at drier conditions.

Particulates control. At rail car unloading points and the transfer to the storage pile, water sprays will be used as required for dust suppression. Conveyors transferring coal to storage piles will be covered. Underground reclaim from the storage piles will be totally enclosed and ventilated through a baghouse. After reclaim, prior to pulverization, transfer points and conveyors will be totally enclosed to the extent possible. Any ventilation of these enclosures will be exhausted through a baghouse to the atmosphere. Provision will be made to install water spray at transfer points should monitoring during operation indicate this is necessary. After pulverization all conveyors, transfer points, and coal processing equipment will be totally enclosed and ventilated through baghouses. Fugitive emissions from the coal piles will be minimized by utilizing pre-washed coal and by spraying the piles with water, or in the case of the reserve piles, with a polymer crusting agent.

Vent gas from coal pulverizing/drying operations will also be filtered in a baghouse. Particulates will be removed from the calciner flue gas by the SO_2 scrubbing system described in Sect. C.2.2.1. The molten elemental sulfur from the sulfur-recovery area will be stored in a closed insulated tank to prevent emission of fugitive dust from open piles and solid sulfur handling. The anode coke from the calciner will be stored in silos, handled by a closed conveyor system with dust control, and transported in hopper cars. The SRC solid product conveying system will be totally enclosed. Section C.1.2.1 provides additional details on the proposed particulate control systems, and Sect. C.3.1.2 discusses alternative particulate control systems.

Nitrogen oxides control. The principal source of nitrogen oxide will be combustion of fuel in the process-fired heaters, the boiler, the calciner, and the controlled combustor. Process-derived fuel gas, containing minimal fuel-bound nitrogen, will be the fuel normally fired. Thus, by virtue of the clean fuel, fuel-NO_x formation will be eliminated.

Thermal NO_x formation will be controlled by utilizing low-NO_x burner design and combustion techniques, without compromising the fuel efficiency to the point where the amount of plant-derived gas would be insufficient to provide heat requirements. When plant gas is unavailable, the fired heaters will use plant-derived fuel oil.

All burners will be low-NO_x type, utilizing the concept of staged combustion, whereby combustion initially takes place in a fuel-rich region followed by complete combustion in a fuel-lean region. The staging effect is achieved by feeding the primary combustion air to the burner at a substoichiometric rate, thus creating a reducing atmosphere that inhibits NO_x formation. The remaining air requirement for complete combustion is then allowed to enter the burner flame zone slightly downstream from the reducing flame zone. The combustion is completed as the oxygen diffuses into the flame. Staged combustion results in low oxygen availability at the peak flame temperatures and lower temperatures in oxygen-rich zones, conditions that cause a reduction in the temperature-dependent NOx formation reaction.

The combustion air will probably be preheated, especially in the large fuel-consuming heaters, because the effect of preheating on increasing fuel efficiency outweighs its potential to produce NO_x.

The controlled combustor will be burning heavy hydrocarbon compounds that are potentially toxic and/or carcinogenic. To ensure complete combustion, the unit will be designed to operate at high flame temperatures and long residence times. This type of combustion favors NO_x formation. The normal combustion load on this combustor is low. Therefore, even though the NO_x evolution is high on a Btu basis, it is a small source of NO_x.

Controlled combustor/flare system. Under normal operating conditions, the primary emission sources are process heaters, dust collection systems, tail gas from sulfur recovery, the CO_2 vent stream from acid-gas removal, the coker/calciner scrubber, and the flare system. The

remaining process units are designed to operate without continuous atmospheric emissions except for the fugitive emissions of hydrocarbons and particulates, which are being minimized through design and maintenance.

Several combustible gases must be destroyed by combustion prior to release to the atmosphere. These gases arise from several sources within the demonstration plant. Some are continual emissions, others occur only under upset conditions, and still others only during emergency conditions. A few of the process areas have a single-purpose dedicated combustion system as part of the ordinary design of that process. Consideration of these combustors is not within the scope of this discussion.

Many pieces of process equipment handle hydrocarbon compounds (including carcinogens) which have the potential to cause health effects. Hydrocarbon emissions from these sources will be treated in a common combustion system designed to achieve high combustion efficiencies. The conceptual design of the proposed system is highlighted here. Additional detail along with a description of alternate control systems being evaluated may be found in Appendix C, Sects. C.2.2.6 and C.3.1.5.

Detailed description of the various hydrocarbon streams to be combusted cannot be made until detailed engineering design has been completed. It is however, possible to identify at this time types of hydrocarbon emissions by category and to estimate the magnitude of these emissions. On the basis of these preliminary estimates, a combustor system has been proposed and several alternates have been selected for evaluation. The emissions fall into five categories:

- continually occurring emissions at low concentrations and pressures (e.g., gases from storage tank venting, purge gases from process equipment, condenser vents, continuously collected fumes),
- emissions due to minor upsets in operating conditions on various pieces of process equipment (e.g., intermittent pressure relief from pressure vessels to maintain safe operating pressures),
- materials produced during start-up and shutdown which must be purged because the next stage of normal processing is not ready to handle them,
- materials which must be purged rapidly and in large quantities because of a major process emergency (e.g., dissolver blowdown due to line blockage), and
- liquids collected from the system which cannot be recycled for reprocessing, but which can be stored for combustion at whatever time and rate is appropriate (e.g., slop oils from wastewater treatment; liquids from the flare-system knockout drums).

The appropriate combustion requirements for these various streams differ, and consequently the combustion system proposed consists of a number of different components, as discussed in the following. There has been some confusion over the use of the term "controlled combustor." As used in this document "controlled combustor" is a combustion system for which the flow rate, combustion conditions, flame mixing conditions, and stoichiometry can be adjusted to maintain efficient combustion over a wide range of feed conditions. It will be composed of several individual equipment types. It is distinguished from the uncontrolled combustion conditions of an open elevated flare, which must handle a wide range of feed conditions and flow rates and which offers very little option for adjustments to maintain combustion conditions close to optimum.

Types of combustion equipment that have been evaluated for inclusion in the controlled combustor and flare system are described below. Standard nomenclature has not been established; however, to be consistent within the scope of this document, the equipment will be identified as:

- thermal oxidizer (noncatalytic),
- thermal oxidizer (catalytic),
- ground flare field,
- contained flare,
- elevated flare (smokeless), and
- elevated emergency flare.

The proposed design currently includes a ground flare field, a thermal oxidizer, and an elevated emergency flare. In addition to these combustion devices, three other critical system components must be evaluated:

- collection manifold systems,
- emissions pretreatment and liquid knockout systems, and
- turndown flow control systems.

The various elements and alternatives for all of these system components are described in Appendix C, Sects. C.2.2.6 and C.3.1.5.

Wastewater emission control. The wastewater streams that contain a significant quantity of H_2S and NH_3 are the sour water streams; these streams are sent to the ammonia-sulfide water stripper for H_2S and NH_3 removal. The emission of H_2S and NH_3 from the wastewater treatment facilities will be negligible. There will be little emission of H_2S and NH_3 from the open tanks and ponds because of the solubility of these compounds.

The NMHC emissions will also be small since the streams containing significant amounts of NHMC will also be treated in the ammonia-sulfide stripper, as well as passing through the covered API oil/water separators.

Solid waste disposal

Types, quantities, and classification. Five major types of solid waste resulting from the SRC-I process will be (1) slag and fly dust from the gasifier, (2) metal-bearing inorganic solids mainly from wastewater treatment processes, (3) biological solids, also from the wastewater treatment facility, (4) water-soluble solid wastes from the wastewater evaporators when the wastewater treatment system is operating in the zero-discharge mode, and (5) slop oil from the coker/calciner area, various plant wastewater streams, and the controlled combustor and flare systems. In addition, there will be minor quantities of other types of solid waste, including a water-soluble waste from the flue gas desulfurization system on the calciner, oily sludges, spent catalysts, spent activated carbon, and process area, coal pile, and SRC pile runoff solids. Appendix C provides additional discussion of solid waste characteristics.

The quantities and assumed Resource Conservation and Recovery Act (RCRA) classification of the solid waste are estimated in Table 2.3.

Disposal of the gasifier solid wastes (the largest waste stream) has been a key environmental issue facing the synfuel technologies. A sample of Kerr-McGee ash concentrate from a pilot-scale SRC-I plant was gasified in a pilot-scale GKT gasifier. The slag and fly dust from the gasifier were then sent to the Oak Ridge National Laboratory (ORNL) where the proposed RCRA leaching experiments were performed. The preliminary results reported in Appendixes P and C indicate that this slag is not hazardous under current RCRA regulations.

Leaching data for the metal-bearing sludges, the biological sludges, and the water-soluble solids from zero wastewater discharge operation are not available. The metal-bearing sludge will probably contain toxic metals and some heavy hydrocarbons. It is likely that these sludges will be hazardous and, for the purpose of design, they are assumed to be hazardous.

Methods of disposal. The disposal sites will be constructed and maintained in accordance with applicable Federal and state solid waste guidelines and regulations. Because these have not been finalized, the design discussed here will be subject to modification. The Environmental Protection Agency (EPA) and The Kentucky Department of Natural Resources and Environmental Protection will be consulted regularly during the course of detailed design. Guidance from these regulatory agencies is imperative because the final solid waste disposal regulations may not be promulgated before the detailed design phase. Even if the guidelines are issued, they may not provide specific design standards. Indications are that EPA will promulgate performance standards rather than design standards.

The hazardous waste landfills and the slag/ash ponds will have the capacity to store all solid wastes produced during a 5-y demonstration phase. The hazardous landfills will be used to store metal-bearing sludges, spent catalysts, activated carbon, equalization basin solids, zero-discharge solids, and process-area, coal-pile, and SRC-pile runoff solids. The ash ponds will be used to store gasifier wastes.

Table 2.3. Identification of potential hazardous and nonhazardous solid wastes

Type of waste	Quantity (dry metric t/y)	Wet volume (m^3/y)	Probable RCRA classification[a]	Moisture assumed (%)	Specific gravity
Gasifier slag and fly ash	209,520	285,200	Nonhazardous[b]	20 (50)[c]	1.6 (1.3)[c]
Water soluble solids[d]	10,430	25,730	Assumed hazardous	70	1
Metal Precipitation sludge	2,400	8,950	Assumed hazardous	80	1
River water treatment sludge	2,400	8,950	Nonhazardous	80	1
Slop oil	1,815	1,990	Assumed hazardous	15	
Spent activated carbon[e]	910	2,680	Assumed hazardous	17	0.4
Biological sludge	600	2,980	Assumed hazardous	80	1
SRC and coal pile runoff solids	135	150	Assumed hazardous	25	1.2
Equalization basin sludge	135	150	Assumed hazardous	40	1.5
Process area runoff solids	10	12	Assumed hazardous	50	1.6
Spent catalysts	1		Assumed hazardous		

[a]Resource Conservation and Recovery Act.
[b]See Appendix P for leaching test results.
[c]Values for fly ash.
[d]From zero-discharge evaporator system.
[e]From tertiary water treatment system.

The currently proposed design for the hazardous waste landfill is based on proposed RCRA design standards (published December 18, 1978), which specify that such a landfill should include the following features: double liners, leachate collection, leachate detection and monitoring, and prevention from flood inundation. The final standards may be different, in which case design would be modified accordingly.

The hazardous waste landfills will have a 0.9-m (3-ft) thick clay liner to provide primary containment of the waste and to protect a 20-mil- (0.020 in.-) thick synthetic liner located beneath it. The synthetic liner will contain any waste that migrates or leaks through the clay liner. Testing of compacted onsite clay indicates that its permeability is about 10^{-7} cm/s; because of this, it will be used extensively, providing it also passes other compatibility tests. Synthetic liners such as high-density polyethylene, reinforced hypalon, butyl rubber, and neoprene will be evaluated and tested using EPA guidelines.

A leachate collection and removal system on top of the clay liner will collect and remove leachate generated in the landfill, and a leachate detection and removal system will be located beneath the synthetic bottom liner. The bottom elevation for the landfill will be above the 100-y flood level and, if reproposed regulations from 1981 are promulgated, it will be 2 m above the historic high groundwater table.

In accordance with RCRA regulations, a groundwater monitoring system will include monitoring wells hydraulically downgradient and some distance upgradient from the facility (see Sect. 4.5). The landfill will be divided into several cells so that, should the liner leak, the faulty cell can be isolated. (See Appendix HH, Groundwater Contamination Contingency Plan).

The hazardous waste landfills will also have embankment dikes located above the 500-year flood level. These will be constructed using excavated materials from the plant process area.

The final design of the disposal facility for gasifier wastes has not been selected. Alternative designs are briefly discussed in Sect. 2.3.2.2 and are detailed in Appendix C, Sects. C.2.3 and C.3.2. Regardless of the alternative finally chosen, the slag/ash ponds will have the same key features as the hazardous waste landfill (i.e., double liners, leachate collection, leachate detection, and diking to prevent flood inundation). Gasifier wastes will be pumped to the

slag/ash ponds as a slurry. Supernatant will be drawn from the ponds and recycled to process areas. A blowdown stream will be directed to the wastewater treatment plant to control the buildup of dissolved solids.

Because of the location of the slag/ash ponds on the site, the base of the ponds will be below the elevation of a 100-year flood (see Figs. D.1 and C.14). In the event of a 100-year flood, groundwater levels could approach or attain surface-water levels, causing an uplifting force on the clay liner system. Such an event could cause a breach in the liner of the ash pond (it would not be a problem for the hazardous waste landfill whose base is above the 500-year flood elevation). Engineering provisions to avoid floating of the liner, such as placement of water barriers, are being evaluated (see Sect. 4.2.2.2). Regular tracking of groundwater levels will provide sufficient warning of high water table conditions. The use of construction methods specifically designed to avoid soil liquefaction problems will also be evaluated.

Solid waste handling alternatives are discussed in Appendix C, Sect. C.3.2.8, and the environmental effects of solid waste disposal are discussed in Sects. 4.2.1.2 and 4.2.2.2.

Process cooling

Control of process operations requires the removal of significant quantities of heat from process streams. Wherever economically feasible, heat will be recovered through transfer to other process streams, heat transfer fluids, or generation of steam to increase the overall thermal efficiency of the plant. The relatively small size of the demonstration plant limits the degree of heat recovery which can economically be employed. At a commercial scale, additional heat recovery would be economically feasible, and the overall thermal efficiency of a commercial plant would probably be higher. Assuming only heat recovery which is economically feasible at demonstration plant scale and utilization of cost effective direct air cooling, the demonstration plant will reject approximately 1.8×10^{12} J/h (1.7×10^{9} Btu/h) of waste heat. The currently proposed design will utilize a recirculating cooling water system with mechanical draft wet cooling towers for most process needs. To preclude the possibility of the release of complex hydrocarbons through the cooling system as a result of leakage in heat exchangers, aerial coolers and indirect cooling systems will be used for the dissolver, hydrogen recovery, liquid fractionation, separator, coking, hydrocracking, and recycle gas systems (the systems handling intermediate product hydrocarbons of greatest concern from a health and environmental standpoint). Appropriate monitoring equipment will be provided to detect significant leaks rapidly. Chromate emissions from the cooling tower through the 60 gpm drift loss are about 7 lb/d (see Table C.10). Section 2.3.2.2 and Appendix C, Sects. C.1.2.4 and C.3.3, discuss alternative waste-heat rejection systems. Section 4.2.3.1 and Appendix S present the environmental impact analysis for the cooling system.

Coal storage, preparation, and handling

The coal storage area will consist of eight piles: two 30-d reserve piles and six 5-d active piles. All coal used in the process will be directed to the six 5-d piles for short-term storage. Coal from these piles will be sampled, blended, and directed to process areas for use. The reserve piles will act as an emergency coal supply. Dust from loading onto piles, mechanical agitation and wind action, and rainwater runoff laden with dissolved and suspended solids will constitute the principal effluents from receiving, conveying, storing, and reclaiming activities (see Appendix P for analysis of coal pile leachates). To control fugitive dust, a water spray dust-suppression system will be utilized at the active storage piles, and polymer coating will be used at the reserve piles. The area surrounding the storage piles will be graded to direct uncontaminated surface runoff away from the piles, and the area under the active and long-term reserve coal piles will be contoured, lined with compacted clay or other suitable materials, and provided with a drainage collection system designed to minimize the infiltration of leachates. Collected leachates will be pumped at a controlled rate from the area retention basin to the wastewater treatment facility. Onsite soils were examined to determine their permeability characteristics. Permeability on compacted onsite clays is in the order of 10^{-7} cm/s. Consequently subject to other compatibility tests, onsite clays will be used extensively as a liner material. Synthetic liners will also be tested.

At rail car unloading points and the transfer to the storage pile, water sprays will be used as required for dust suppression. Conveyors transferring coal to storage piles will be covered. Underground reclaim from the storage piles will be totally enclosed and ventilated

through a baghouse. After reclaim, prior to pulverization, transfer points and conveyors will be totally enclosed to the extent possible. Any ventilation of these enclosures will be exhausted through a baghouse to the atmosphere. Provision will be made to install water spray at transfer points should monitoring during operation indicate this is necessary. After pulverization all conveyors, transfer points, and coal processing equipment will be totally enclosed and ventilated through baghouses. Fugitive emissions from the coal piles will be minimized by utilizing pre-washed coal and by spraying the piles with water, or in the case of the reserve piles, with a polymer crusting agent. Vent gas from coal pulverizing/drying operations will also be filtered in a baghouse. Particulates will be removed from the calciner flue gas by the SO_2 scrubbing system described in Sect. C.2.2.1.

See Appendix C, Sect. C.1.2.1 for additional information.

Other support facilities

Appendix C provides a discussion of other support facilities such as product storage and shipping, railroad, stockpiles, barge, electricity, water intake and discharge, and potable water supply.

2.2.2 Proposed site: Newman, Kentucky

The proposed site, which is 1 km (0.6 mile) south of Newman, Kentucky, encompasses 600 ha (1484 acres) on the Green River floodplain. Located in northwestern Daviess County, the site is bounded by the Green River to the south and Martin Creek to the east. Site topography is generally flat with elevations ranging from 113 to 119 m (370 to 390 ft) above mean sea level (MSL). The dominant land-use category at the site is agricultural, with a major portion of the site being cleared for agricultural use. The second largest land use is riparian forest and hardwood forest (Sect. 3.2.1.3). Though residential land use is minimal at the proposed SRC-I site, 24 families residing on the site will be displaced by the proposed project. Route 60, a two-lane highway provides access to the site. The L&N Railroad runs along the north boundary of the site.

The riparian hardwood forest represents very good habitat for a wide variety of species, while the agricultural land represents poor habitat for wildlife. The Indiana bat, a species listed as endangered by the U.S. Fish and Wildlife Service (USFWS), occurs on the site in the riparian forest along Martin Creek and may be affected (Sects. 3.2.1.3 and 4.2.1.3). However, the USFWS has determined that the proposed project will not jeopardize the continued existence of the Indiana bat. No other species classified as threatened or endangered by the USFWS either occur on the site or should be affected by the proposed project (Appendix I).

Soils in the area of the site are primarily alluvial deposits associated with the Green River floodplain. The U.S. Department of Agriculture (USDA) Soil Conservation Service estimates that over 90% of the site is "prime agricultural soil" (see Appendix X). At the site, the alluvial material is underlain by unconsolidated sand deposited by glacial outwash.

Water quality in the Green River adjacent to the proposed site is classified as "effluent limited" with respect to dissolved oxygen and conventional pollutants. Therefore, best available treatment technology economically achievable will be applied to wastewaters discharged into the river.

The proposed site is located in the Evansville-Henderson-Owensboro Interstate Air Quality Control Region (AQCR 77). Daviess County, in which the proposed site is located, is designated attainment for all air pollution categories. Henderson County, located just west of the proposed site, is also designated attainment for all categories.

Over half of the site is below the elevation of the 100-year floodplain, and over 75% of the site is below the elevation of the 500-year floodplain (Appendixes D and G).

Most of the labor required for construction of the SRC-I facility will likely come from Evansville, Indiana, and Owensboro and Henderson, Kentucky, with additional labor being imported from Paducah, Kentucky. Labor availability problems may be compounded by competition from the construction of proposed nearby facilities including the Rockport power plant and several proposed synthetic fuel plants in the area (Sect. 4.2.5).

See Sect. 3.2 for a more complete description of the proposed site.

2.3 COMPARISON OF ALTERNATIVES AVAILABLE TO DOE

As discussed in Sect. 2.1, three alternative actions may be taken by DOE:

- Proceed with the proposed action (Sect. 2.3.1).
- Select an alternative site or design or further reduce environmental impacts and proceed with construction (Sect. 2.3.2).
- No action (Sect. 2.3.3).
- Delay the action (Sect. 2.3.4).

The environmental impacts resulting from each of these alternatives are summarized and compared below.

2.3.1 Impacts resulting from the proposed action

2.3.1.1 Impacts during the demonstration

The currently proposed design is summarized in the preceding section and additional information is included in Appendix C. The environmental impacts resulting from construction and operation of the demonstration plant at the proposed Newman site in accordance with the currently proposed design are described in Sect. 4. Cumulative impacts will result from the proposed SRC-I facility and other projects proposed, planned, or under construction in the area (Sects. 2.3.1.3 and 4.2.5).

In summary, construction and operation of the plant in accordance with the proposed design and site are expected to result in the following impacts:

Health risks. Through chemical reactions involving coal, the SRC process will produce a broad range of material that contains carcinogenic and mutagenic organic compounds, including aromatic amines, aromatic and heterocyclic compounds, highly substituted phenols, and other compounds. The health risks of operating a plant of this nature have been recognized; therefore, the following actions are being taken: (1) engineering controls are being incorporated in the design with the philosophy that the risk should first be reduced by minimizing the exposure of workers, the public, and the environment (Sect. 4.1.3); (2) the design and implementation of mitigation measures will be responsive to exposure data from a monitoring program that will include point and fugitive emission sources, the site and surrounding environment, in-plant area monitors, and personnel monitors (Sect. 4.1.3); and (3) an industrial hygiene program will be instituted to further reduce worker risk through identification of hazardous materials and areas, a worker education program, protective clothing and equipment, carefully developed work practices and personal hygiene procedures, and medical monitoring (Sect. 4.1.3 and Appendix Z). The current research program sponsored by DOE may continue based on available funding (Appendix Z).

The sources of these hazardous substances to which the public could be exposed include fugitive hydrocarbon air emissions (leaks), emissions from the plant flare system, wastewater discharge to the Green River, and SRC liquid spills during product transport. Point source air emissions, onsite spills, and solid waste disposal are not significant sources. Fugitive hydrocarbon emissions will be reduced through the use of special mechanical design and equipment selection for potential leak points and a "directed maintenance" program. Emission of these hazardous substances from the flare system will be reduced through the use of a controlled combustion system. Discharge of these substances to the Green River will be reduced through the use of a tertiary wastewater treatment system with zero-discharge capability. Under some plant operating conditions, recycle of the entire treated effluent will not be possible, and treated wastewater will be discharged. The worst-case analysis of impacts (Sects. 4.2.2.3 and 4.2.2.4) assumes low river flow, high water discharge flow rate, and high concentration of pollutant in the discharge. Impacts from SRC liquid product spills will be reduced by handling and transporting the liquids in accordance with all regulations and safe practices used in the transport of other industrial products and materials such as chlorine, ammonia, gasoline, propane, and benzene. Careful selection of markets will also be a part of the program to reduce accidental spills and

human exposure. In addition, a plan will be developed for spill cleanup and countermeasures, and collaboration with the EPA and the Coast Guard in the event of a spill (Sect. 4.1.3 and Appendix C).

For workers involved in maintenance operations, skin contact and inhalation are of concern. For other categories of workers at the plant site, fugitive emissions to the atmosphere are expected to be the major exposure source and will be reduced by the measures discussed above. Highly detailed maintenance procedures will be developed based on experience at the SRC pilot plants and at other industries involved in handling materials that are hazardous if personal contamination occurs (Sect. 4.1.3).

The SRC pilot plants at Fort Lewis, Washington, and Wilsonville, Alabama, have operated since 1974 without any health effects unique to their operation. However, the size of the work force and study times are not adequate to draw conclusions concerning potential long-term effects in an epidemiologically significant manner. The Department of Energy and other agencies are sponsoring programs for characterizing and assessing the health risks of SRC processes before commercialization. Major long-term chemical, biological, and monitoring studies are under way to determine the specific characteristics of SRC materials and the effects of management and controls on them (Appendix Z). Results of programmatic efforts to date are encouraging. Industrial hygiene management within the SRC pilot plants appears to provide a sound basis for developing the program to be employed at the demonstration plant. Because no technological development is risk free, exposure monitoring for both the work force and public will be a major feature of the health protection program. Construction and operation of the plant in accordance with the proposed design and proposed monitoring and mitigation measures will ensure low exposures and thus low risk to the public, the work force, and the environment (Sect. 4.1).

Endangered species. The Indiana bat, a species listed as endangered by the U.S. Fish and Wildlife Service (USFWS) occurs on the site in the riparian forest along Martin Creek (Sects. 3.2.1.3 and 4.2.1.3 and Appendix K). No other species classified as threatened or endangered by the USFWS either occur on the site or should be affected by the project (Appendix I). Present layout plans indicate that no permanent facilities of the demonstration facility (except earth stockpiles) will be located within 305 m (1000 ft) of the Martin Creek Forest. A biological assessment was prepared for the USFWS (Appendix K.1). None of the Martin Creek Forest will be disturbed. However, noise and construction activities may have some impact on the bats. Direct and indirect impacts of construction and operation of the SRC-I demonstration facility should not jeopardize the continued existence of the species because no designated critical habitat will be affected. Indiana bats are widely dispersed in summer, and the proposed SRC-I site is apparently outside the main population centers of the bats. The USFWS concurs that the proposed facility will not jeopardize the continued existence of the bat (Sect. 4.2.1.3 and Appendix I). Information received by DOE in November 1980 indicates that a power line proposed by Big River Electric Company to serve the SRC-I plant may impact the Indiana bat (Sects. 2.2.1.2 and 4.2.1.3). However, a specific routing of the line and the location of the Newman Substation have not yet been determined. As long as DOE continues to participate in the project, DOE and Big River Electric Company will work to minimize adverse impacts on the Indiana bat.

Traffic. Increased traffic on U.S. Highway 60 could produce a major adverse impact if no mitigation measures are carried out. Increased delays to traffic between Henderson, Kentucky, and the SRC-I site during peak use periods could be expected to average between 1-1/4 and 2 h and to reach 4 h in extreme cases. Delays to traffic between Owensboro and the SRC-I site could be expected to average 40 min to 1-1/2 h and to go as high as 3 h.

Mitigation measures have been studied, a variety of which can reduce the potentially adverse impact of increased traffic on U.S. 60 (Sect. 4.2.4.1). Without effective mitigation, project-induced traffic would entail an unacceptable social impact to communities in the vicinity of the proposed SRC-I site.

DOE would take the following measures to ensure that acceptable levels of service will not be exceeded on U.S. 60: (1) construct a signalized intersection with turn lanes at the SRC-I plant entrance on U.S. 60; (2) encourage voluntary ridesharing, vanpooling, and bus riding, (3) utilize staggered workshifts or establish a second shift to reduce peak period traffic; and (4) establish a company-sponsored bus riding program if the preceding measures fail to ensure acceptable traffic conditions on U.S. 60 (Sect. 4.6.2.2).

In addition to the above actions, Federal, State, and local governments are studying the feasibility of the following mitigation measures to increase the effectiveness of those measures described above: (1) realignment of curves and improve railroad crossings on U.S. 60 at Stanley and Reed; (2) construction of temporary ramp from the Audubon Parkway to KY-1554 to accommodate traffic to and from the areas west of the SRC-I plant site; and (3) upgrading of Sauer Lane from KY-1554 to the plant site (a rear entrance will be constructed to allow access from Sauer Lane). If these measures are not undertaken, an increased degree of effectiveness will be required of the four DOE-sponsored measures described above. Specifically, a substantially larger number of company-sponsored buses is likely to be required, and worker participation in the bus-riding program will have to be correspondingly greater.

A detailed traffic mitigation plan that would elaborate on the above measures would be issued before major project construction by DOE in cooperation with KYDOT and the Green River Area Development District (GRADD) describing the costs of the measures to be taken and the institutional arrangements that would be necessary for their implementation.

Water quality. Although the goal of the wastewater treatment system is to operate primarily in the zero-discharge mode, discharge of treated water will be necessary under some conditions. Impacts to water quality will result during those occasions when wastewater is discharged from the SRC-I facility. Under normal flow conditions for the Green River, discharge from the SRC-I plant will cause only very minor changes in water quality. At present, the Green River's maximum concentrations of manganese, iron, cadmium, copper, mercury, silver, zinc, and probably phenol exceed the water quality standards or criteria (Sect. 3.2.2.3). A worst case would consist of discharge during a 7-day, 10-year low flow with the assumption that the ambient concentrations of all water quality constituents were at the maximum ever recorded. Under worst-case conditions, wastewater discharge is projected to cause small increases in the concentration of trace elements, heavy metals, cyanide, and phenol. In addition, the worst-case discharge scenario would cause violation of standards for cyanide and phenol. Because of their potential toxicity to humans and aquatic organisms, the worst-case discharge of cyanide, copper, cadmium, silver, and phenol are considered a significant degradation of water quality. The probability that wastewater discharge would be necessary during low-flow periods is uncertain but considered to be very small. However, if periods of low stream flow do coincide with periods when zero wastewater discharge cannot be achieved, plant shutdown or reduction of plant throughput might be required. During preliminary consultation in preparation of a National Pollutant Discharge Elimination System (NPDES) permit application, EPA and the State of Kentucky will jointly develop effluent limitations for the plant. When wastewater discharge is necessary, the plant and its wastewater treatment system will be operated in compliance with the discharge limitation stated in the NPDES permit.

Floodplain/wetlands. The development of the SRC-I demonstration plant at Newman, Kentucky, will necessitate encroachment on the Green River floodplain between river miles 18.5 and 19.8. Facilities to be located in the 100-year floodplain include the barge dock and water intake/discharge facilities as well as portions of the coal storage, slag/ash disposal ponds, and solid/liquid product storage areas. The slag/ash pond and the liquid product storage areas will be contained by building floodproof, impervious dikes with the top of the dikes above the 500-year flood level. The flooding constraints associated with the development of these facilities on the floodplain of the site have been integrated into the facility's plot plan and design to minimize risk to the plant. The most environmentally significant plant areas (i.e., the process area and the hazardous waste landfills) have been located on areas of the site naturally above the 500-year flood elevation. The flooding impacts resulting from site development have been evaluated, and it is estimated that the floodplain encroachment will result in minor flood-related environmental impacts. The wetlands impacts, consisting of the loss of five small farm ponds (0.6 ha) and small acreages of riparian forest (up to 10 ha), are considered minor but unavoidable. Alternatives to the proposed development in the floodplain/wetlands have been evaluated including alternate sites and plant layout. This analysis indicates that there are no practicable alternatives to the projected floodplain/wetlands encroachment (Sect. 4.2.2.1 and Appendixes D and E).

Prime farmland. Conversion of 600 ha (1484 acres) of land from rural agricultural and residential use to industrial use for the life of the plant. Approximately 90% of the soils on the site have been designated by the USDA Soil Conservation Service as "prime farmland soils" (Appendix X). This represents approximately 0.65% of Daviess County's

prime farmland and 0.76% of all harvested croplands in Daviess County. The annual loss of revenue associated with removing this land from active farming will amount to $249,700 (1978 dollars) (Sect. 4.2.1.1).

Differential settlement. Unless densified, loose sand present beneath the southern portion of the site represents a potential for differential settlement of foundations in the southern portion of the site (see Fig. 2.3 and Appendix L, Fig. L.9). Mitigation of poor foundation conditions is feasible with careful design, site preparation, and construction (Sect. 4.2.1.2).

Air quality. PSD increment consumption modeling predicts compliance with new source regulations (Sect. 4.2.3.1). The criteria pollutant of greatest concern will be particulates. Plant emissions are estimated to consume 18.3% of the 24-h PSD increment. Criteria pollutant sulfur dioxide will only consume 2% of the 3-h PSD increment (Sect. 4.2.3.1). Carbon monoxide emissions for the 1-h averaging time amount to 16% of the NAAQS limits (Sect. 4.2.3.1). Ozone concentrations are not expected to be affected locally because of the long-range transport nature of the photochemical reaction of ozone's precursors (Sect. 4.2.3.1). Including fugitive sources, hydrocarbon emissions will total about 62 tons per year (Sect. 4.2.3.1 and Appendix C). Nitrogen dioxide concentrations due to the demonstration plant will be less than 3% of the NAAQS (Sect. 4.2.3.1). Hydrogen sulfide (H_2S) will be emitted from the Beavon unit in the 4 to 5 ppm range, except during upset conditions when emissions may be 60 ppm. Upset conditions could also cause an increase in SO_2 for short durations when H_2S is flared, forming SO_2. The resulting SO_2 concentrations are 29.3% of the 3-h and 32.2% of the 24-h average PSD increments. Normal startup and shutdown operation emissions will be less than the limits allowed by the new source regulations (Sect. C.4.1.2). Table 4.18 shows that the second-highest calendar-quarter average Pb concentration due to the SRC-I plant is predicted to be 0.82 $\mu g/m^3$ or 54.7% of NAAQS. The highest predicted 8-h concentration within plant property is 19.7 $\mu g/m^3$ or 13.1% of the TLV for Pb. Thus, based on very conservative estimates, Pb emissions from the SRC-I plant will not threaten the air quality in the vicinity of the site, nor the health of plant workers. The worst-case traffic situation occurs in Henderson, Kentucky, on U.S. Highway 60 between Route 41 and Tillman Bethel Road (Sect. 4.2.4.1). This section of highway was modeled using EPA's HIWAY model under worst-case meteorological conditions. The peak traffic flow resulting from both the proposed SRC-I plant and the proposed W. R. Grace plant was analyzed. The model predicted compliance with the air quality standards for the criteria pollutant of carbon monoxide in this worst-case scenario (see Sect. 4.2.3)

Cooling tower operation. The proposed mechanical-draft, evaporative-cooling tower accounts for most of the plant's consumptive water use. Based on computer-modeling, operation of the cooling system could result in localized increases in ground-level fogging (13% of the time) and icing (6% of the time) and in salt deposition resulting from drift (Sect. 4.2.3.1). However, actual experience at a large chemical complex in western Kentucky suggests that the computer prediction is conservative. Cooling tower drift losses will be small (60 gpm).

Because cooling tower makeup water is partially supplied by treated wastewater (zero wastewater discharge operating mode) and because cooling water is used in heat exchange subject to leaks, there is some potential for emission of contaminants with the cooling tower exhaust drift droplets. Drift deposition will be localized and mostly confined to the site. This risk will be minimized by tertiary wastewater treatment, by monitoring the stream to detect residual contaminants, and by using leak detection instrumentation on aerial coolers and indirect cooling systems for those process streams containing more than 5% of hydrocarbons with a boiling point greater than 500°F.

The impacts of increased fogging, icing, and drift deposition are expected to be low and will be mitigated by appropriate location and design of the system (Sect. 4.2.3.1, Appendix S, and Appendix C, Sects. C.3.3.1 and C.4.1.1).

Socioeconomics

Population increase. Construction employment is expected to peak at between 3500 and 5000 after about a year and a half of construction (mid 1983). Labor shortages expected in many of the required construction crafts will result in an estimated 840 to 1760 construction workers moving to the 21 county impact area. Including dependents and secondary employment, this in-migration is predicted to result in

a population increase of approximately 1500 to 3000 people in the Daviess-Henderson-Vanderburgh County area. This local impact region appears to have adequate housing and public services to accommodate the projected population influx (Sects. 4.2.4.1 and 4.2.5).

Cumulative socioeconomics. The socioeconomic impacts of the proposed facility will not independently exceed the capacity of the local infrastructure. However, SRC-I in concert with other planned and proposed large construction projects in the area could cause considerable stress on Daviess, Henderson, and Vanderburgh counties and their municipalities unless careful planning is undertaken at the State and local levels (Sects. 4.2.5 and 2.3.1.3).

Taxes. Potential removal of the proposed site from the local tax base for the duration of the demonstration operation would reduce the local tax base at a cost of $4200 in annual revenues to the relevant taxing jurisdictions. There will be no direct tax payments during the construction period. The reduction in the local tax base will be more than offset by property taxes paid by workers who relocate to new housing in the SRC-I region (Sect. 4.2.4.1). With the exception of transportation impacts and their mitigation costs, the overall costs to the local communities of providing additional services to in-migrating construction workers may be offset by plant-related income, but these costs are expected to be small.

Employment. Approximately 725 people will be employed at the facility during the operation phase. The Daviess-Henderson-Vanderburgh County area is expected to have the capacity to absorb all long-term project-related growth without major negative impact; the plant payroll will have a positive impact on the area (Sects. 4.2.4.1 and 4.2.5).

Displacement of families. Approximately 24 families (60 people) will be displaced from their homes in the site area (Sect. 4.2.1.1).

Rail and barge utilization. The increased rail and barge utilization will not overload the rail system or the barge carrying capacity of the Green River. As currently envisioned, coal will be delivered to the demonstration plant by train. Train schedules will be arranged to avoid the peak travel times on U.S. Highway 60. A barge unloading facility is also included (1) to permit delivery of heavy equipment during construction and (2) possibly to supplement rail facilities in the event that coal mines providing coal for the plant are not located close to rail lines (Appendix Y).

Noise. Noise impacts during construction are expected to be negligible except for the one-time steam blowout to clean high-pressure piping systems. During operation of the proposed plant, noise levels are expected to be slightly higher but comparable to existing ambient sound levels (Sect. 4.2.3.2). Construction and operational noise levels are expected to comply with Federal regulations and recommended EPA guidelines for noise at nearby residential locations (Sect. 4.2.3.2).

Solid wastes. Impacts from solid waste disposal are expected to be small (Sects. 4.1.3.1 and 4.2.2.2). Solid wastes, which will be stored onsite, include five major types: (1) slag and fly dust from the gasifier; (2) metal-bearing inorganic solids mainly from the wastewater treatment processes; (3) biological solids, also from the wastewater treatment facility; (4) water-soluble solids from wastewater evaporators when the plant is operating in the zero wastewater discharge mode; and (5) slop oil from various process sources. Slag will be stored as required to obtain an RCRA permit. The RCRA leaching results in Appendix P indicate that slag and flydust are nonhazardous. Although the detailed design is not yet available, the slag/flydust ponds will have features similar to landfills suitable for hazardous waste disposal (e.g., double liners, leachate detection and collection, and dikes to prevent flood inundation). The remaining wastes are assumed to be hazardous and, except for slop oil, will be stored in landfills suitable for disposal of hazardous materials in compliance with prevailing RCRA standards; slop oil will be incinerated or recycled. Leachates from landfills will be collected and sent to wastewater treatment, and groundwater will be monitored (Appendix C and Sect. 4.5).

Coal and product storage. Coal and solid SRC-I product will be stored onsite in lined, contoured storage piles. Leachates will be collected and treated in the wastewater treatment system. Fugitive dust will be suppressed. The American Society for Testing and Materials (ASTM) distilled water extraction test of the SRC-I product indicates that toxic trace elements are not soluble during short-term leaching of the solid product (Sect. 4.2.2.2 and Appendix C).

Erosion and sedimentation. Increased erosion and resultant sediment loads to surface waters will occur during construction. These impacts will be temporary and may be reduced to low levels by implementation of control and mitigation measures (Sect. 4.2.2.1 and Appendixes EE and GG).

Habitat loss. Vegetative communities and available wildlife habitat will be reduced. Because the vast majority of the site area has been cleared for agriculture, loss of habitat will be small. Several uncommon or rare bird species will be affected (Sect. 4.2.1.3).

Water withdrawal and consumption. Water withdrawal by the demonstration plant will not be significant in terms of regional and local water availability. The water withdrawal rate varies with the operation mode of the wastewater treatment plant. Operating in the wastewater discharge mode, the demonstration plant will withdraw 217 liters/s (3445 gpm) from the Green River, or 1.95% of the 7-day, 10-year low flow of 11,156 liters/s (176,855 gpm). The water withdrawal rate during the zero wastewater discharge mode will be 159 liters/s (2520 gpm) or 1.4% of the 7-day, 10-year low flow. The withdrawal rate in the discharge mode is greater because about 58 liters/s (931 gpm) of the treated effluent will return to the river. Net water consumption, however, is independent of operation mode of the wastewater treatment system; it would be 159 liters/s (2520 gpm) for both modes of operation (Sects. 2.2.1 and 4.2.1).

Product spills. Spills of SRC-I products have the potential for causing significant adverse impacts to surface water and groundwater. The SRC-I facility will be designed for maximum containment of any materials spilled onsite. Areas susceptible to spills will be paved or lined to prevent infiltration of contaminants to groundwater and surrounded by dikes or curbs to prevent contamination of surface waters. Spilled material will be collected by the runoff containment system and routed to oil/water separators for recycle to the process or treatment in the wastewater treatment system. These facility design and spill control measures will greatly reduce the probability and consequences of onsite spills.

Spills of SRC-I products during transportation may at some time result in direct or indirect exposure of the public (Sect. 4.1.3.7 and Appendix DD). Shipments of the liquid product are considered to pose the greatest risk because spilled materials may enter surface or groundwater supplies, be dispersed in the atmosphere, or cause exposure during cleanup operations. For the purpose of this analysis, it is assumed that SRC-I liquid products would be shipped to Pittsburgh, Pennsylvania, and Lake Charles, Louisiana, and would pass through several major metropolitan areas and cross numerous major rivers and creeks. The light SRC-I liquid product (naphtha and middle distillate fractions) would be produced in the largest quantities and carried over the longest route (1600 km from Newman, Kentucky, to Lake Charles, Louisiana). Based on the statistics for rail spills of hazardous materials, the frequency of occurrence for spills of light product to water bodies can be calculated as ranging from once every 2964 months (based on the number of shipments) to once every 26 months (based on car-miles) (see Table 4.2 and Sect. DD.4). The impacts of worst-case spills are assessed by identifying those locations where spilled SRC-I product could affect public water supplies. Such spills could cause water supply emergencies for Evansville, Indiana, and Nashville, Tennessee, requiring that water withdrawals for municipal supply be suspended during the passage of spill-contaminated water past the water supply intakes in the Ohio and Cumberland rivers. These worst-case spills of SRC-I product are considered to be exceedingly unlikely (see Sect. DD.5).

2.3.1.2 Impacts of alternative fates of the facility after the demonstration

One of the major objectives of the demonstration program is to expedite the commercial application of the technology by providing a base for construction of the first commercial facility. If a decision is made to proceed with construction of the demonstration plant as proposed, the

contract calls for a two-year demonstration period at the conclusion of which the facility will be offered for sale with the industrial participants having the right of first refusal. If the demonstration plant is not sold, DOE may elect to continue operation under the existing contract for a period of up to three years.

The following fates for the demonstration plant may result from a decision to proceed with construction:

- commercialization at an expanded capacity.
- continued operation of the facility at demonstration plant capacity.
- conversion of the facility to another government use.
- mothballing of the facility (cold storage for later use).
- decommissioning (salvage).

The suitability of the site for a commercial facility and the environmental impacts of its construction and operation are primary considerations in a decision to proceed with the project. It is possible that sale of the demonstration plant will not occur and that one of the alternate fates will result. The probable impacts associated with each of the possible alternate fates are identified below. Impacts of commercial operation at expanded capacity are also discussed throughout Sect. 4.

Commercialization at an expanded capacity

One of the primary objectives of constructing and operating the demonstration plant is to obtain an environmental data base. This data will be used by regulatory agencies to establish emission and discharge limitations for maintaining acceptable environmental quality, and by industry for evaluating the economics of a commercial facility including required environmental controls. It is assumed that the decision to construct a commercial-scale facility at the demonstration plant site will be made in consideration of information which is currently unavailable and can only be obtained by construction and operation of the demonstration facility. The analysis that follows focuses on environmental issues which can be identified at this time as potential impacts of commercial development at the proposed site. While the discussion of commercial scale impacts is limited in this FEIS, DOE will prepare appropriate NEPA documentation prior to transfer by DOE of the demonstration facility.

Socioeconomic. Commercialization at expanded capacity would provide a significant economic benefit to the area. The local tax base would increase significantly because ownership of the facility is expected to be transferred to private industry at the end of the demonstration phase. Further improvements to the property preparatory to commercialization would increase the valuation of the facility. Operation of the facility would result in a continuing monetary input to the local area in the form of salaries and wages as well as primary services provided to the facility by local business and by secondary services to support the personnel employed at the plant.

Secondary commercial development is expected to occur to support the demonstration facility in the short term. Commercialization would cause a continuing long-term demand for these services, as well as a probable expansion of such secondary commercial development. The initial operating labor force of 725 would expand to approximately 2200 workers, many of whom are expected to be local, thus providing a major local employment base. (The exact number is difficult to predict until operating experience has been gained during the demonstration phase. However, based on experience in scale-up of similar facilities, the labor force should not increase in direct proportion to the plant capacity.) Balanced against this positive impact is the negative impact of an increased strain on community services and resources, especially during construction.

Assuming that the socioeconomic infrastructure existing during the construction and operation phases of SRC-I demonstration remains unchanged during the commercialization phase, it is estimated that approximately 1000 to 2800 construction workers would relocate to Daviess, Henderson, and Vanderburgh counties at the peak of construction. The demands that these workers and their families will make on housing and public services should not exceed the capacity of the local infrastructure of the area as a whole, but localized significant impacts are still a possibility, and some increase in police and fire protection manpower could be required for much of the impact area. In addition, unless appropriate mitigative measures have been taken during the construction and demonstration phase of SRC-I, serious traffic problems

on U.S. 60 are likely to be associated with SRC-I commercialization (see Sect. 4.2.4.3). These traffic impacts may be particularly severe for residents of nearby small communities.

The required construction labor force will be larger than for the demonstration plant, but should not be a direct scale-up in proportion to plant capacity. Labor requirements are expected to be distributed much more evenly over a longer period of time compared to construction of the demonstration plant. Construction of the other proposed commercial-scale synthetic fuel plants and electrical generating plants simultaneous with construction of the SRC-I commercial plant would likely cause severe competition for labor and the need to import more workers (Sect. 4.2.5). Assessment of the available labor pool would be done when planning and scheduling for construction of the commercial plant. This would have to take into account competition with whatever other projects are under way in the area at this time. Appropriate adjustments would have to be made to minimize distortion of the local labor pool. Based on the best available present estimates, the peak construction labor force will be approximately 5000 to 10,000 compared to 3500 to 5000 for the demonstration plant.

Because of the duration of the commercialization construction project and the probable development of other projects, in-migrating skilled labor could tend to be of a less transient nature than during the demonstration plant construction. Continuous sequenced construction projects of many years duration requiring similar balanced distribution of skills might result in a long-term increase in the labor force. This would be of less impact to the local communities than a purely transient force, especially in the area of providing services for those workers. Experience gained by the local area in accommodating demonstration plant construction should help in planning for growth during commercial plant construction (Sect. 7.3 of Summary and Sect. 4.2.5).

Air quality. The commercial plant, which will process five times as much coal as the demonstration plant, will not result in five times as much impact on air quality. The emission rates from the commercial plant will depend on many factors, such as product slates and process design. Because planning for the commercial plant is still in an early stage, the emission rates cannot be estimated with a high degree of certainty. A worst-case analysis is used in the EIS in lieu of a definitive design.

It is estimated that the emission rates of the commercial plant will be less than five times those of the demonstration plant for all pollutants. The emission rates for SO_2 and particulates will be less than directly proportional to the plant capacity because the capacity of the coker/calciner, which is the major source (75-80%) of these pollutants in the demonstration plant, would not be greatly expanded beyond the demonstration plant capacity. Also, emerging process and control technologies, such as flash coal drying, which could greatly reduce emissions but are not commercially proven at present, will likely be employed for the commercial plant. Extensive monitoring in the demonstration plant, too, may reduce emissions in the commercial plant by providing more accurate emission data that can be used for design improvement.

Increases in ground-level concentrations of the pollutants may not be directly proportional to increases in the plant capacity either. About 75% of the site would be occupied by the commercial plant; some sources of emissions are separated by hundreds of meters. The relatively large distances separating the sources minimize the additive impact of each source.

The first key assumption is that the production rate of coke of the commercial plant will be about the same as that of the demonstration plant and that the production rates of the other products will be approximately five times that of the demonstration plant.

The PSD standards for an expanded commercial plant are expected to be met. It should be noted, however, that the availability of PSD increments cannot be projected to the date of operation of the commercial plant. Monitoring data recorded during demonstration will indicate the actual dispersion characteristics and will be applied to project dispersion for the commercial plant. This will result in greater accuracy in the model, which should help in designing the plant to meet guidelines.

Sulfur dioxide. The SO_2 emissions from the commercial plant are estimated at less than two times those of the demonstration plant. The commercial plant is anticipated to be a minor source of SO_2 in the area. No violations of the NAAQS are anticipated. It is expected to consume a very small portion of the PSD increment. Even if increases in the ground-level concentration were directly proportional to increases in the emission rate, it is estimated that only 8% of the 24-h increment for SO_2 would be consumed by the commercial plant.

Particulates. The particulate emission rates for the commercial plant are derived by scaling up the estimated emission rates from the demonstration plant. Since issuance of the DEIS, changes have occurred in the plant design and operating plans resulting in lower demonstration plant particulate emissions and consequently lower air quality impacts. The following discussion describes these changes and how they have affected the prediction of emissions and air quality impacts for the commercial plant. The DEIS stated that an estimated 73% of the PSD 24-h increment for particulates will be consumed by the demonstration plant. However, updated Industrial Source Complex (ISC) dispersion modeling analyses have reduced that figure to 18.3% for the demonstration plant. The DEIS predicted a maximum 24-h ground-level concentration of 26.9 $\mu g/m^3$; the new estimate is 6.74 $\mu g/m^3$ for the demonstration plant alone and 8.1 $\mu g/m^3$ for all PSD sources in the area. The new estimated average annual concentration for all PSD sources in the area is 1.26 $\mu g/m^3$. Based on overly conservative emissions assumptions it was estimated in the DEIS that, for the demonstration plant, 20 of the 26.9 $\mu g/m^3$ maximum 24-h concentration was due to fugitive emissions alone. New results have reduced this contribution to 2.41 of the 6.74 $\mu g/m^3$ total concentration. The reduction in fugitive particulate air quality impact was achieved by considering three key factors which had not been considered in the DEIS — the effect of wind speed on SRC- and coal-pile wind erosion losses, the impact of scheduling SRC and coal loading and unloading operations for only 8 out of 24 h, and the effects of using prewashed coal. Each factor is discussed in more detail in Appendix S.

The particulate emission rate from point sources in the commercial plant is expected to increase by a factor of 4 and fugitive emissions by a conservative factor of 5 over the demonstration plant, a total of about 615 tons per year. Considering point and fugitive sources, preliminary modeling indicates that about 56% of the allowable 37-$\mu g/m^3$, 24-h increment for particulates would be consumed. The modeling results indicate that the commercial plant can be constructed within the 24-h and annual incremental restrictions, if point source contributions increase by four and fugitive emissions are conservatively assumed to increase fivefold at the commercial size plant.

Accurate fugitive particulate emission predictions cannot be made at this time; only monitoring during demonstration plant operation can give a reliable estimate from which to scale. Fugitive particulate emissions from the demonstration plant were estimated using a variety of EPA publications and sources. The available fugitive particulate emissions literature is not very reliable because typically the information is not based on testing of coal dust sources, and the emissions do not take into account many important factors that can affect the emissions, such as surface area of coal piles and their orientation with respect to the prevailing wind, whether the coal has been washed to reduce silt content, or the effects of wind speed on pile losses. Only actual monitoring can accurately determine fugitive emission rates from the demonstration plant and provide a better basis for estimating fugitive emissions and the effectiveness of control measures from the commercial plant.

Hydrocarbons. The hydrocarbon emissions from point sources in the demonstration plant, as well as the commercial plant, will be small. As in the demonstration plant, hydrocarbon emissions from the commercial facility will depend on control of the fugitive sources. Fugitive sources of hydrocarbons in the demonstration plant are estimated to contribute almost 90% of the plant's overall 62 tons per year hydrocarbon emission rate. The estimates utilized for the demonstration plant emission inventory in Appendix C are based on the EPA guideline document *Assessment of Atmospheric Emissions from Petroleum Refining*, Vol. 3, Appendix B, April 1980. This document is based on emission measuring activities at 13 petroleum refineries throughout the United States. Overall fugitive emission rates from fittings such as valves, flanges, pumps, and compressors varied greatly among the refineries investigated, and none of the refineries studied employed maintenance or design consideration programs as stringent as those planned for the SRC-I plant. Consequently, the emissions inventory for the demonstration plant may be conservative. Operating experience at the demonstration plant would allow for more precise estimation of emissions for expansion to commercial capacity. If analysis prior to commercialization indicates the plant could be a major source of hydrocarbons, appropriate design considerations will be employed by the commercial plant operator as necessary. As a worst-case assumption, the hydrocarbon emission rate from point and fugitive sources in the commercial plant can be assumed to be five times that of the demonstration plant, or less than 350 tons per year. This hydrocarbon emission from the commercial facility would not result in a significant impact.

Nitrogen oxides. The nitrogen oxide emission rate of the commercial plant is estimated to be four to five times that of the demonstration plant. The resulting maximum increase in nitrogen dioxide due to the commercial plant is not anticipated to violate NAAQS for nitrogen dioxide, even if the ground-level concentration were to increase fivefold.

Carbon monoxide. The commercial plant would emit a maximum of five times the CO of the demonstration plant. The plant commercialization may result in only 2.5 times the CO emissions of the demonstration plant, if the large CO_2 vent stream (which also contains 50% of the facility's CO emissions) can be pipelined to a tertiary oil recovery operation, rather than vented to the atmosphere. This option appears feasible for a commercial size plant. Even if CO emission is five times that of the demonstration plant, no violation of the NAAQS is expected.

Hydrogen sulfide. Modeling for H_2S concentrations carried out for the PSD permit application for the demonstration plant indicates that the odor threshold for the demonstration plant (10 parts per billion) will not be exceeded. If the H_2S emissions are conservatively estimated to scale upward by a factor of 5 for the commercial plant, the odor threshold for H_2S could be exceeded under certain meteorological conditions. Analysis during the demonstration phase will determine whether H_2S emissions must be lower than these conservatively estimated rates to meet odor standards for the commercial plant. Mitigation measures will be taken in the design of the commercial plant if required.

Lead. Lead concentrations for the demonstration plant were predicted using very conservative estimates of atmospheric lead emissions (i.e., all lead entering with the coal was assumed to be vented to the atmosphere at each of two locations, thus doubling accounting). Actual lead emissions from the demonstration plant are expected to be much less than this conservative estimate, and emissions from the commercial plant are thus expected to be much less than a 5 times scale-up of this conservative estimate. The resulting lead concentrations will be lower than the ambient air quality standards. Monitoring during the demonstration phase will be done to confirm this analysis.

Solid waste. Alternatives for solid waste management for the commercial facility include, but are not limited to, onsite vs offsite disposal; landfill configurations for gasifier slag and fly dust; waste stabilization vs hazardous landfilling; disposal vs reutilization of the materials. The ultimate decision on the solid waste management at the commercial facility will be most effectively determined on the basis of studies and monitoring conducted at the demonstration plant. The demonstration plant will have an extensive monitoring program (Sect. 4.5) to determine the long-term fate of the contaminants in the solid waste materials. Runoff and leachate will be routinely analyzed. Such data will determine more definitively the environmental concerns related to disposing of such wastes and whether or not the waste is hazardous under RCRA criteria.

Because of large quantities, the gasifier slag and fly dust will occupy a large land area. For example, during the operation of the demonstration plant, a 16-ha (40-acre) area will be required for ash disposal and storage. During a 14-year period of commercial operation, an additional 224 ha (560 acres) would be required for ash storage, only 72 ha (180 acres) of which could be stored on site. Offsite storage areas may be required during commercial operation of the facility. Precise area requirements will depend on landfill configuration. Alternative configurations to minimize land requirement are being evaluated, and the best alternative will be employed in the demonstration plant. Experience gained in the demonstration plant will facilitate the landfill design at the commercial plant. Characterization and groundwater monitoring during operation of the demonstration plant will provide data for evaluating the adequacy of the disposal facility. Utilization of the gasifier wastes as by-products will also be fully evaluated in the demonstration plant. A long-range program is required for the evaluation. One potential application would be using the materials as aggregates for road construction. Utilization of materials would be a solution to the solid waste management problem at the commercial facility.

The additional onsite storage of more process wastes (in addition to process chemicals and products) increases the potential for accidental contamination of groundwater and surface water.

While no additional impacts are anticipated as a result of commercialization, actual large-scale production and disposal of SRC-I solid wastes have not been demonstrated. Hazardous solid wastes generated by the commercial facility will scale up to a conservatively estimated

81,000 dry tons per year. Sufficient hazardous landfill capacity will exist to dispose of this material on site. In addition, in situ evaluation of several commercially available waste stabilization processes will be a part of the solid waste testing program at the demonstration plant. The evaluations will determine whether or not the processes can convert hazardous wastes to nonhazardous or can improve handling properties of solid wastes. Again the data will be utilized in the scale-up to the commercial plant.

Aquatic ecology and surface water quality. Water quality impacts resulting from expansion of the SRC-I demonstration plant to commercial scale are difficult to predict. The fivefold expansion in plant capacity will cause less than a fivefold increase in the demand for water. Like the demonstration plant, the commercial plant is assumed to have capability for wastewater recycling and operate primarily in the zero-discharge mode. (It should be noted that zero wastewater discharge operation generates a considerable volume of water-soluble solid wastes that require special landfill disposal. The environmentally preferable wastewater treatment strategy involves an assessment of the trade-off between discharging dissolved solids versus attempting to landfill dried soluble salts.) For a worst-case analysis of water quality impacts, a fivefold increase in the volume of wastewater discharged was considered (Table 4.11). When fully mixed with the 7-day/ten-year low flow from the Green River (11,156 liters/s), the 295-liters/s discharged from the commercial plant is projected to cause violations of water quality standards for chromium, copper, cyanide, iron, manganese, mercury, phenol, selenium, silver, and zinc. The discharges of cadmium, chromium, copper, phenol, selenium, silver, and zinc would substantially degrade water quality and could require occasional plant shutdown or reduction of plant throughput during low flow to maintain water quality standards.

During the demonstration phase, much experience will be gained in wastewater handling. The characteristics of the raw wastewater and the performance of treatment systems will be determined under a variety of loadings, operating conditions, and environmental conditions. In addition, the impacts of the demonstration plant on the Green River will be monitored (Sect. 4.5), and performance and reliability of the wastewater treatment and recycling system will be established. The information and experience thus gathered will provide a sound basis for the design of the commercial-scale wastewater treatment system. If necessary, backup wastewater recycling systems can be included in the design to ensure that no discharge occurs when river flows would provide insufficient dilution. The ultimate impacts to water quality from commercial-scale plant operation will depend on the operating experience and a number of unknown factors, including the effluent limitations, other regulations applied to the solvent refining process, and possible changes in the process technology.

Land use. Construction of a commercial facility at the demonstration plant site would have minor additional impacts on land use. Acquisition of the site and construction of the demonstration plant would result in the major land use impacts. Whereas approximately one-half of the site would be utilized during the demonstration phase, approximately three-fourths of the site would be utilized during the commercial phase for the process area, product storage area, and solid waste storage area.

Endangered species. The Indiana bat, a species listed as endangered by the USFWS, occurs on the site along Martin Creek and may be affected (Sects. 3.2.1.3 and 4.2.1.3). No other species classified as threatened or endangered by the USFWS or Kentucky should be affected by the project. Commercial facilities would be located closer to Martin Creek than the demonstration facilities but would not require clearing of the forest. A biological assessment has been prepared for the USFWS (Appendix K.1). Appendix K contains a detailed discussion of mitigation options for fish and wildlife resources.

Increased barge traffic. Impacts will occur from increased barge utilization for shipment of construction equipment, feed coal, and some products. Commercialization of the demonstration plant would require expansion of the barge docking facilities. A small amount of prime farmland and riparian woodland would be destroyed. Erosion would increase during expansion construction, but this impact would be short-term. Coal transportation to the commercial plant is intended to be essentially 100% by barge. This additional coal barge traffic should not cause the total traffic to approach the current capacity of the Green River. However, cumulative effects resulting from other projects on the Green River combined with SRC-I could cause the capacity to be exceeded (Sect. 4.2.5).

Prime farmland. Additional disturbance of site soils and loss of prime farmland would occur. Expansion of the project to commercial scale would adversely impact site soils not directly impacted during construction of the demonstration plant. Approximately 90% of the site's soils are classified as "prime" by the U.S. Department of Agriculture Soil Conservation Service (Appendix X).

Habitat loss. Additional impacts on terrestrial ecology could occur. Commercialization would result in additional loss of wildlife habitat. During operation of the demonstration plant, monitoring programs (Sect. 4.5) will determine if any unexpected impacts to terrestrial ecology (e.g., severe vegetation stress from air pollutants) have occurred.

Floodplain/wetlands encroachment. Increased encroachment in the floodplain/wetlands would occur. Because of local site relief and topography and the need for barge facilities and water intake/discharge structures, it is not possible for the proposed demonstration plant to completely avoid encroachment in the Green River floodplain. The process area for the demonstration plant will be located on the southern part of the site in an area that is naturally above the 500-year flood elevation. During the commercial stage of the project, additional floodplain area would be required for plant facilities, product storage, barge facilities, and solid waste disposal. Risks to the commercial facility would be mitigated by filling the affected areas to an elevation above the project-design flood stage. Filling to raise required floodplain areas above flood elevations will reduce the flood storage area of the Green River floodplain. Calculations derived from the Army Corps of Engineers HEC-2 computer model indicate that impacts of such action will be minor and almost undetectable (Appendixes D and E). Large quantities of soil must be imported from off site to fill additional floodprone areas and build dikes. Solid waste landfills will be built in areas prone to floods, and unless the bases of the landfills are raised (as may be required by RCRA), the liners will be subjected to uplifting forces from high groundwater tables during major floods. The design of all landfills will take the flooding potential into account and will be consistent with any applicable RCRA guidelines. An additional wetland effect will be modification of a small additional amount of Green River shoreline and associated riparian forests because of expansion of the barge facility (Appendix D).

Erosion and sedimentation. The potential for increased erosion and sediment loadings as a result of construction will exist. The relatively small area to be disturbed, the use of sediment control facilities, and the experience gained in constructing the demonstration plant are expected to effectively mitigate these potential impacts. Because site preparation during the construction phase for the commercial expansion would be of relatively short duration, impacts would be short-term and would end essentially at the completion of construction.

Noise. Commercial plant construction will increase sound levels slightly and may exceed both the U.S. EPA's short-term guidelines for residential locations and the U.S. Housing and Urban Development (HUD) standards for residences. Commercial-plant-operation sound levels would not change the present ambient sound levels significantly. The estimated change is small, although the future day/night equivalent sound level may exceed the U.S. EPA's long-term goals of 55 dB for residences near the plant boundary (Sect. 4.2.3.2).

Continued operation of the facility at demonstration plant capacity

It is possible that the proposed two-year operation of the demonstration facility will not provide the data base desired for commercialization. A likely result would be an extension of the demonstration program and continued operation of the plant.

Changes in the design and operation of the plant will undoubtedly occur during the operating phase. Process and environmental monitoring during operation will be used to identify the significant environmental impacts, their sources within the plant, and the available methods for mitigating them (see Sects. 4.5 and 4.6). Consumption of available water and PSD air quality increments would continue, limiting other potential users. Solid waste would continue to accumulate. Rail and possibly barge traffic would continue.

If the Federal government continues to own the site, the area would continue to experience a modest loss of tax revenues. However, this loss of tax revenue would be somewhat offset by the continued employment of approximately 725 persons and with the additional indirect or secondary jobs created through the growth of support industries and services during construction and initial operation of the plant. The local jurisdictions have more than adequate infrastructure capacity to absorb the demands of a continued operation phase work force of 725 direct employees, secondary employees and their families.

Conversion of the facility to another government use

If, at the conclusion of the demonstration plant operation, there is no interest on the part of private industry in construction of a commercial plant, DOE may elect to convert the facility to another use or to offer it to other Federal agencies. Conversion to another use by either DOE or another Federal agency would be subject to NEPA review. In addition, appropriate permits would have to be modified or obtained.

The potential environmental impacts of an alternative use of the site would depend on the intended use and cannot be evaluated at this time. In view of the availability of onsite facilities for the receipt, transport, storage, and preparation of coal, it is likely that an alternative use would be related to coal utilization and that impacts associated with coal receipt and handling would continue.

Continued government ownership of the site would result in continued loss of tax revenue and, more significantly, would prevent an increase in revenue resulting from transfer of the site and improvements to private ownership. The significance of this loss of anticipated revenue would depend on the degree to which local financial plans had been developed in anticipation of such revenues. This reduction in revenue would be partially offset by continued employment resulting from the alternative use of the site.

Conversion of the facilities to an alternative use would probably require some construction work and associated work force. Impacts resulting from construction would probably be relatively minor since most of the disturbance would have occurred during construction of the demonstration facility, and construction activities would probably be limited primarily to the process area. The work force required for conversion would probably be smaller than that required for construction, and significant impacts would not be anticipated, in the absence of major competing projects.

Mothballing of the facility

If there is no interest in constructing a commercial facility or in converting the site to an alternative use, DOE may elect to discontinue operation of the demonstration facility indefinitely, with the intention of resuming operation at some future time. In this alternative, it is assumed that all process operations would cease and that equipment would be drained, cleaned as necessary, and prepared for extended shutdown. There would be minimal dismantling or removal of process equipment. Coal and product would be removed from the site. The slag disposal area and any other solid waste disposal areas would be closed and revegetated; leachate monitoring and treatment, if required, would be continued in accordance with RCRA requirements. Appendix C contains the proposed landfill closure plans.

Mothballing of the demonstration facility would result in elimination of air emissions, process wastewater discharge, consumptive water use, and slag production. Solid waste production would be reduced to that resulting from treatment of leachates from solid waste disposal areas and surface runoff. The facility would probably be maintained on the State air emissions inventory for a period of 18 months, temporarily limiting siting options for other emission sources. Location of other industries in the area could result in reduced availability of PSD increments and water resources for resumed operation.

Continued government ownership of the site would result in continued loss of property tax revenue and would prevent an increase resulting from transfer of the improved site to private ownership. This loss of revenue would not be offset by continued employment. It is anticipated that mothballing of the facility would result in layoff of most of the demonstration facility work force of approximately 725 and the elimination of essentially all secondary employment. The loss of this payroll would result in a minor, short-term decline in area income levels and a slight increase in local unemployment.

Decommissioning

If there is no interest in constructing a commercial facility, converting the site to another government use, or resuming operation of the demonstration facility, DOE may elect to decommission the facility and declare it excess property for disposal by the General Services Administration; the appropriate NEPA review would be done at that time.

If decommissioning occurs, it is probable that the significant value of the improvements and the short operating history would make the site desirable as an industrial facility and that it would be sold for this purpose. Impacts resulting from conversion to an industrial use other than an SRC commercial facility would result in impacts which cannot be fully evaluated at this time. As in the case of conversion to another government use, it is probable that an alternative use would involve coal utilization and that the impacts of coal receipt, handling, and preparation would continue. As in the case of conversion to another government use, impacts of construction required for conversion to another use would probably be relatively minor. Sale of the facility for an industrial use would result in a tax benefit since the site and improvements would be placed on the tax rolls. Continued employment would also be a positive benefit. Should there be no interest in purchase of the site for alternative use or should the government elect not to sell, the impacts would be essentially equivalent to those resulting from mothballing.

It is probable that major vessels and equipment would be removed. However, complete restoration of the site to its original condition would not be undertaken, and the site would be available for future development for industrial use.

2.3.1.3 Cumulative effects

The proposed SRC-I project (both the demonstration and expanded commercial phases) is one of nine energy projects under construction, proposed, or planned for construction and operation within a 70-mile commuting radius (40 air miles) of the proposed Newman site. The nine projects are SRC-I, W. R. Grace, Tri-State Synthetic Fuels, H-Coal, Rockport I and II, D. B. Wilson, Gibson, Hancock, and A. B. Brown. Some of these construction efforts are currently scheduled to have simultaneous construction periods, and all (except SRC-I demonstration phase) are scheduled to overlap significantly during the construction phase.

Construction of three electrical coal-fired generating plants is scheduled to be under way while the SRC-I demonstration plant is being built; Rockport I and II, D. B. Wilson Plant, and the A. B. Brown Plant. During the latter half of the SRC-I demonstration construction phase, construction will continue on the Rockport, A. B. Brown, and Wilson plants, and construction of two commercial synthetic fuel plants is projected to begin (W. R. Grace plant and Tri-State Synthetic Fuels plant).

Construction on three synthetic fuel plants and two electrical generating plants within a 70-mile commuting radius is scheduled to be ongoing when construction of the expanded SRC-I commercial plant is scheduled to begin. The synthetic fuel plants are the W. R. Grace, Tri-State, and H-Coal plants; the generating plants are the Hancock and A. B. Brown plants. During the latter half of SRC-I commercial plant construction, only the Hancock plant will still be under construction.

The W. R. Grace and Tri-State synthetic fuel plants and the Rockport generating plant would have the most interaction with the SRC-I project.

The potential adverse economic, social, and cultural impacts are the most significant cumulative effects of the region's development. The SRC-I project will take place within the framework of this large regional development of energy projects.

The projected labor demand in the region will require a cumulative peak construction work force of approximately 27,700 of which 3000 are employed at the start of SRC-I construction at other power plant projects in the area. Of the 24,700 new jobs at peak for the major energy facilities, it is estimated that about 75% of this work force will be imported from outside the region. The population will increase by about 55,000 over a period of several years as a result of these in-migrating workers, their families, and indirect economic expansion. This population increase is only 8% of the existing population of the 21-county impact region and would not cause a boomtown effect at the regional scale. However, the three-county area of Henderson, Daviess, and Vanderburgh, all of which are within easy commuting distance of the SRC-I plant and several other facilities, would receive a disproportionately large number of in-migrants and could face severe impacts.

Should this situation occur, the public services, housing, transportation, and local economic infrastructures would likely be faced with adverse impacts such that significant planning and mitigation measures would be required. According to present, very tentative schedules for all

of the projects, it appears that construction of the SRC-I demonstration plant would contribute somewhat to adverse impacts to area communities because of several simultaneous projects but that construction of the SRC-I commercial facility may actually aid some communities by extending the cumulative impact period. This latter situation could provide greater community incentive to undertake permanent improvements and could also help prevent rapid population fluctuations and their accompanying social impacts. These conclusions are very sensitive to schedules of the projects. Relatively minor delays or accelerations in construction schedules of individual plants would greatly affect the level of impacts (Figs. 4.10 and 4.11).

In regard to SRC-I specifically, the present schedule calls for construction of the demonstration plant to begin in late 1981 and end in 1984. Such a schedule would place SRC-I construction prior to the mid-1980s period of greatest impacts, thus making the SRC-I demonstration plant relatively noncontributory to cumulative impacts. On the other hand, delay of SRC-I by even one year would result in the plant's contributing more significantly to cumulative impacts, if other projects remain on schedule. In respect to the construction of the commercial plant beginning in 1987, the contribution of SRC-I to cumulative impacts would appear again to be negligible, based upon current schedules of all the facilities. Indeed, the SRC-I plant could actually prove beneficial to local communities by helping prevent rapid population fluctuations and their accompanying social impacts due to regional construction and by providing sufficient additional employment to encourage communities to invest in more permanent facilites for accommodating the overall population growth. Again, it should be pointed out that the SRC-I schedule as well as those of the other facilities are very susceptible to substantial change and that such changes could alter the magnitude of impacts. DOE would cooperate with the states of Kentucky and Indiana and with local jurisdictions to monitor the situation, do appropriate planning, identify any necessary mitigating measures, and provide relevant project data on a quarterly basis.

To prevent SRC-I construction activities from contributing significantly to peak cumulative impacts, the SRC-I construction schedule should be coordinated with those of the W. R. Grace and Tri-State Synthetic Fuels facilities to avoid concurrence of their peak or near-peak construction periods. To address those cumulative impacts which do occur, mitigation measures should be developed and implemented jointly by the management of all major construction projects in the area, with a special emphasis on coordinating the mitigation activities of SRC-I, Grace, and Tri-State. To maximize effectiveness, a joint mitigation plan should be developed by the major area developers acting in cooperation with local and regional governments. Such a regional mitigation plan resulting from these efforts would guide the timely provision of those services and accommodations necessary to handle construction-induced growth without any serious disruptions to local infrastructures. Contingency plans would also be made to deal with any worsening of projected impacts which may arise as a result of delayed construction schedules. In the event of construction delays, the potential for SRC-I contributing significantly to severe cumulative socioeconomic impacts would exist without the coordinated scheduling and cooperative mitigation planning described above.

Cumulative impacts on barge movement on the Ohio River are expected to be minimal. Barge traffic on the Green River, however, may experience delays because existing locks do not have the capacity to meet projected barge requirements for coal transport (Sect. 4.2.5).

The cumulative water consumption for the SRC-I commercial plant, the W. R. Grace synfuel plant, and the D. B. Wilson and Paradise generating plants could approach 30% of the Green River's 7-d, 10-year low flow. The Ohio River Basin Commission has adopted 10% of the 7-d, 10-year low flow as the guideline criterion for identifying potential adverse impacts from water consumption for energy. Water consumption on the Green River is a potentially serious cumulative effect. A study to assess the severity of impacts due to cumulative water consumption will need to be performed prior to commercialization.

Cumulative water quality effects will be limited to the lower course of the Green River downstream of the SRC-I plant. Cumulative impacts are unlikely in other portions of the region because of the distance between plants, and the dilution capacity of the Ohio River. If, like the proposed SRC-I plant, all the coal conversion facilities operate predominantly in a zero-discharge mode, impacts to surface water quality will only result from occasional wastewater discharge and from infrequent spill events. Because pollutant releases will be relatively small, any direct cumulative effects are expected to be infrequent and minor. If wastewater discharge is more frequent or is the predominant mode of operation, water quality impacts would have to be reassessed using data from the proposed plants which are currently unavailable.

Because of the distance separating the plants from the SRC-I site, cumulative air quality impacts with SRC-I are insignificant except for a small impact from the Grace plant, which is the closest and largest of the proposed plants. It is located at the edge of the 15-km (10-mile) zone considered to be the area likely to experience cumulative impacts to air quality. Cumulative effects are thus expected to have only minor impacts on regional air quality although they will add slightly to problems of nonattainment of TSP standards in the cities.

Effects on land use, geology, soils, terrestrial ecology, noise, and groundwater for the most part will be site specific and localized. Of these potential effects loss of prime farmland would probably be the most significant effect of a cumulative nature. No endangered terrestrial species occur in the area with the exception of the Indiana bat, whose habitat extends throughout the area during summer months. The facilities occupy an insignificant portion of the species' range and will have no cumulative effect on the winter habitat considered critical to the species' survival.

Cumulative impacts at the proposed site are discussed in greater detail in Sect. 4.2.5.

2.3.2 Selection of an alternative site, plant design, or plant layout

One of the three alternatives available to DOE is to modify the currently proposed action by use of alternative sites or plant designs. From an environmental standpoint, such modifications could be used to lessen the environmental impact of the proposal. The following section evaluates the feasibility of using alternative sites and plant designs to lessen the environmental impacts of the project.

Section 2.3.2.1 discusses the comparison of impacts at the proposed and alternate sites. Section 2.3.2.2 discusses possible alternative plant designs, and Sect. 2.3.2.3 discusses alternative plant layouts.

2.3.2.1 Alternative sites

Emissions and discharges from the demonstration plant are determined primarily by the design of process and support facilities and may be reduced through application of the various design alternatives discussed above. Assuming that the design of the demonstration plant is unchanged, the significance of the impacts produced by construction and operation is determined to a large extent by the physical characteristics and quality of the environment of the site at which the plant is located.

The contract awarded for the Phase Zero design study required that the industrial participant submit a site-specific proposal. Although environmental factors were considered by Rust Engineering Co. in the site-selection work, they were considered in combination with a number of other factors to arrive at the choice of Newman as the proposed site. In 1976 Rust, under the sponsorship of the Kentucky Center for Energy Research (KCER), undertook this alternate site analysis for selection of a site for a 2000-tons/d SRC-I plant. The Rust study evaluated sites from a list of potential Kentucky sites supplied by KCER. The siting criteria used in the Rust study were primarily physical, engineering, and economic factors that were judged to be important for construction and operation of the SRC-I plant. The Rust study consisted of four phases that, by eliminating potential sites from a large list, sequentially narrowed the number of potential SRC-I sites. Phase I of the analysis concentrated on potential siting "areas" and evaluated these areas on general, physical, and environmental requirements and constraints. Phase II of the analysis consisted of a more detailed evaluation of the 24 potential siting areas identified in Phase I. This phase reduced the number of potential sites to ten. Phase III of the analysis eliminated five of these ten sites because of site-specific physical constraints and land availability. The final phase included a more stringent evaluation of the physical, cultural, and economic constraints of the five remaining sites. In the final phase, seven site requirements were assigned weighted values and the sites compared. Newman, Kentucky, was selected as the preferred site in Rust's study, and Equality and Lewisport were rated as prime alternative sites. At that time, the Executive Orders 11988 and 11990 concerning floodplain/wetland encroachment had not been issued, and DOE was not a participant in the project.

After Rust Engineering completed its site-selection activity for the SRC-I project, several important events transpired. DOE became a participant in the project, the proposed plant

capacity was increased to 6000 tpsd with the goal of commercial expansion to 30,000 tpsd in the future, and Executive Orders pertaining to floodplain/wetlands encroachment were issued (May 24, 1977).

Although a site had already been proposed for the project (as specified in DOE's Request for Proposal and in its contract with its industrial partner), it was recognized that an evaluation of the impacts of the proposed plant at alternate sites would be necessary. To evaluate the impacts of construction and operation at possible alternative sites, an independent analysis of available sites was conducted. Based on this analysis, which is described in detail in Appendix B, two sites were identified as reasonable alternatives to the proposed site: one on the Green River near Equality, Kentucky, and one on the Ohio River near Ravenswood, West Virginia (Fig. 2.6). Appendix B (Sect. B.2) describes the actual site selection process conducted by Rust Engineering Company in 1976, which includes the proposed site. Section B.3 describes the ORNL analysis, which evaluates sites other than Newman for selection of two reasonable alternative sites for evaluation against Newman in Sects. 2.3.2, 4.3, and 4.4.



Fig. 2.6. Regional setting of alternative sites.

A definitive comparison of the environmental acceptability of alternative sites is severely constrained not only by the degree to which judgmental factors enter the analysis but also by the availability of consistent and detailed information on each site. In this case, detailed information exists for the proposed site from over one-year of baseline monitoring whereas only reconnaissance-level information is available for the alternative sites. Even though environmental comparisons such as these are based on dissimilar levels of baseline data, sufficient information is available to enable a reasonable evaluation of the alternative sites.

Summary descriptions of proposed and alternative sites

Except for the plant layout, the design alternatives discussed in Sects. 2.2.1 and 2.3.2.2 are essentially independent of site considerations, as it may be reasonably assumed that the plant design and resultant emissions would be the same at either the proposed or alternative sites. However, the impacts of construction and operation of the demonstration plant depend on the environment of the site and physical conditions of the site. The alternative sites are briefly described below.

Proposed site: Newman, Kentucky. A summary description of the proposed Newman site is presented in Sect. 2.2.2.

Alternative site 1: Equality, Kentucky. The Equality site is located on the Green River between river miles 75 and 80, about 1.6 km (1 mile) west of the town of Equality in northwestern Kentucky. The entire site is within the boundaries of Ohio County, about 21 km (13 road miles) west of the county seat of Hartford on the two-lane Equality access road. The major trade center for the area is Ownesboro, 64 km (40 road miles) north in Daviess County. Although no boundaries have been delineated, the site consists of more than 400 ha (1000 acres), which are about equally divided between floodplain and moderate-to-steep hills. Current land use is primarily rural-agricultural. There are about ten residences in the hilly portion of the site area. About one-half of the floodplain is currently cultivated for corn production. Over 75% of the site qualifies as prime farmland, and an additional 69 ha are of Statewide importance. Two slough wetlands are also located on the floodplain. The hill slopes are in pasture and idle forestland. On the basis of available information, no critical habitat for any threatened or endangered species is believed to be located on the site. The site is in seismic risk zone 2 (moderate) near the boundary with zone 3 (high).

Water availability at the Equality site is adequate for the SRC-I demonstration plant, but water availability during periods of low flow might constrain development of a full-scale commercial facility. A study to assess the severity of impacts resulting from cumulative water consumption should be performed prior to development of a commercial-scale facility at the Equality site.

Water quality in the Green River is adversely affected by soil erosion and acid mine drainage plus municipal, industrial, and agricultural wastes. High concentrations of suspended and dissolved solids present the most significant problems; however, the water quality is considered acceptable for plant use. The area has been designated by Kentucky as attainment for all air quality parameters except ozone; however, ambient concentrations are approaching NAAQ standards. The major share of the socioeconomic impacts resulting from construction and operation of the SRC-I facility are expected to occur in a multi-jurisdictional impact region comprised of Ohio, Daviess, McLean, and Muhlenberg counties. Throughout much of this region, current housing stock and public service systems have only limited capacity to absorb new population growth. At the same time, there are numerous other ongoing or proposed projects in the area, including the W. R. Grace commercial project and the H-coal commercial plant (Sect. 4.2.5).

Alternative site 2: Ravenswood, West Virginia. The Ravenswood site is located on the Ohio River, near Mile Point 230, in Jackson County, West Virginia. Meigs County, Ohio, is directly across the Ohio River to the west of the site, and the town of Ravenswood, West Virginia, is about 8 km (5 miles) to the northeast on West Virginia Highway 2. Seventy-five kilometers (47 miles) to the south, on Interstate 77, lies Charleston, West Virginia; Parkersburg, West

Virginia, is 65 km (41 miles) to the north, also on I-77. The site is bounded on the north by the Ravenswood Works of the Kaiser Aluminum and Chemical Company, which owns the largest tract [400 ha (1000 acres)] of the four which comprise a potential site area of about 641 ha (1585 acres). The site is bounded on the south by Ripley Landing, a community of several dozen residences, by the Ohio River on the west, and by the Keraland Recreational Area on the east. Land use on the site is rural, slightly over half agricultural with the remainder woodland, although adjacent land uses are residential and industrial. Slightly more than half the site has been classified as "prime" farmland by the U.S. Soil Conservation Service. Because of agricultural disruption, it is unlikely that the site constitutes a critical habitat for any threatened or endangered species, although one area, the Spring Creek Forest, represents an unusually diverse habitat of interest to researchers and conservation groups. The portion of the site parallel to the Ohio River and the area along Spring Creek are within the 100-year floodplain. The site is in seismic risk zone 1 (low).

Water quality in the Ohio River is adequate and is available in quantities adequate for both demonstration and commercial operation. The site area has been designated attainment for all NAAQS standards; however, no monitors are located in the vicinity. Emissions from the adjacent Kaiser facility may be adversely affecting air quality. The socioeconomic impact region is comprised of the West Virginia counties of Jackson and Mason, and the Ohio counties of Gallia and Meigs. The availability of housing varies considerably among these impacted jurisdictions, but the current capacity of public service systems to absorb new growth is more uniformly limited throughout the area. As at the other two sites, impacts here could be compounded by the presence of other proposed large-scale construction projects in the same general area.

Comparison of impacts at proposed and alternative sites

Construction and operation of the demonstration plant at any site will result in changes in land use and impacts on air and water quality, terrestrial and aquatic ecology, and social and economic resources. Assuming that the process design remains the same, the significance of these impacts depends on location-specific considerations and is subject to some degree of mitigation through changes in plant layout, inclusion of control equipment, or implementation of specific mitigating measures. The following sections compare the potential impacts and the requirements for mitigating measures.

Land use. Construction of the demonstration plant at the proposed site or at either of the alternate sites will result in conversion of land from predominantly rural-agricultural to industrial uses. The proposed and alternate sites are approximately the same size. Only about 100 ha (247 acres) is actually required for plant facilities at any of the sites. The total area required is determined by the topography, pattern of current ownership, desirability of buffer zones between adjacent land uses, and the wishes of adjacent landowners.

It is assumed that all agricultural uses will be discontinued and that all other areas not required for facilities or disturbed by construction will be left to natural succession. It is also assumed that the entire Ravenswood site [634 ha (1585 acres)] would be acquired, as will at least 400 ha (1000 acres) at the Equality site. Location of the SRC-I project at either the proposed site or at either of the alternate sites will withdraw prime farmland from its current use. Farmland at the proposed site, however, constitutes a larger percentage of the total site than at either of the alternate sites. USDA prime farmland also constitutes a larger percentage of the total site area at the proposed site than at the alternate sites. At the proposed site, approximately 380 ha (938 acres) of prime farmland will be withdrawn from production. At Equality, approximately 320 ha would be withdrawn, and at Ravenswood approximately the same amount (320 ha) would be withdrawn.

Utilization of either the proposed site or the Equality site would result in conversion of some residential property to industrial use. Approximately 24 families are included in the proposed site and ten residences in the Equality site. These residences would normally be purchased and vacated unless other arrangements were mutually agreed upon. Additional residences may be acquired at the proposed site, along the property boundary, if noise levels from the plant are judged unacceptable and other mitigation measures are not deemed appropriate. This would provide a buffer zone between the plant and other nearby residences. Approximately ten residences would be eliminated by construction at the Equality site. Construction at the Equality site would impact on semipublic land uses such as for churches and cemeteries. Two churches and two cemeteries are located within the vicinity of the proposed Equality site.

Although there are only a few residences at the Ravenswood site, there are more residences in the immediate vicinity of the site, particularly in the community of Ripley's Landing, and the number of residents directly impacted by construction and operation of the plant would be somewhat greater if this site were used.

The Owensboro Metropolitan Planning Commission has designated the proposed site area for agricultural and floodplain use in the Regional Land Use Plan and has recently zoned the site A-R (rural-agricultural). Rezoning of the site to I-2 (heavy industrial) would be required prior to commencement of construction. Because neither zoning nor land-use planning is in effect at the two alternate sites, location of the plant at either of these sites would not conflict with any zoning or land-use plan. In view of the currently predominantly rural land uses of the sites, it is probable that any industrial construction would be viewed by the area residents as an undesirable or conflicting land use. Fewer people would be affected directly at the proposed and Equality sites, although the impact would be severe because they would be required to relocate their residences. More people would be affected at the Ravenswood site through interference with their recreational activities, but this interference would be less significant for each of these individuals than for those permanently displaced at the proposed and Equality sites.

At all three sites, project-induced growth and development in the multi-county impact region surrounding the site will result in increased use of land for residential and commercial purposes which can conflict with existing land uses such as agriculture.

Floodplain/wetlands

Location of the proposed SRC-I project at the proposed Newman, Kentucky, site or at either of the alternative sites would encroach upon floodplain/wetland areas. The Newman site would sustain the greatest floodplain/wetland disturbance from a 100- to 500-year flood event; the least disturbance would occur at the Ravenswood site. At each of these sites, the risk of damage and environmental impacts of a 100- or 500-year frequency flood could be greatly reduced with the establishment of mitigation measures and flood protection (e.g., fill, diking, riprap, etc.).

The Ohio River's 100-year floodplain occupies less than 25% of the land area of the Ravenswood site. There would be negligible risk of flood damage to an SRC-I plant located on elevation of the site which is above the floodplain. However, barge loading facilities, coal conveyors, pipelines, and utility lines may be exposed to flood hazards if they are located near the river. Wetlands habitat at the site includes the riparian floodplain forest lying between the Baltimore and Ohio railroad tracks and the Ohio River and a backwater pond near the mouth of Spring Creek. Some of the wetland habitat in these areas may be lost during plant construction, though impacts could be minimized by proper plant layout.

Similarly, plant layout would be an important consideration if the Equality site were chosen for the SRC-I plant, since about 50% of the site is in the 100-year floodplain of the Green River. Siting plant facilities at this site would increase the potential for flood damage over that predicted for the Ravenswood site because less nonfloodplain area would be available for plant layout. Again, facilities such as barge unloading areas, coal conveyors, etc., would probably be located in the floodplain and would require mitigation techniques to minimize flood damage. Some of the wetland habitat within the floodplain at the Equality site would be destroyed by plant construction if the swamps and marshy forests are filled, and if utility lines and access roads are constructed.

The 100-year floodplain at the Newman, Kentucky (proposed) site occupies about two-thirds of the site. Major facilities which would be constructed within the 100-year flood zone include the barge facilities, raw water intake, waste water diffusion system, slag/fly dust pond, liquid and solid product storage areas, and temporary construction facilities. Flood-related impacts can be minimized, however, if all flood-prone areas containing sensitive facilities are filled and/or diked up to or above the critical 100- and 500-year flood elevations. Several small farm ponds and small areas of riparian forest which serve as wetland habitat at the site could be destroyed during plant construction. Since it is indicated that these areas are not unique, the impact of their loss would probably be minimal.

In summary, floodplain/wetland impacts would occur from construction of an SRC-I plant at the proposed Newman site or at either alternative site. Impacts at the alternative sites would

likely be less than those at the proposed Newman site (i.e., without mitigation) since less of these areas lies within the floodplain. However, with proper plant design and layout, such as filling and diking to locate facilities above the floodzone, and the use of flood-proofing measures for those facilities which must be located in the flood plain (e.g., barge docking), onsite impacts can be minimized. Adverse flooding impacts offsite (upstream or downstream) due to construction of the SRC-I plant are expected to be negligible for all sites considered, based on flood profiles determined by computer modeling. Cumulative effects of any floodplain encroachments increase the risk of flooding. Since a key site selection criterion is the ability of the site to accommodate a commercial-scale facility, it is important to examine floodplain effects from building the expanded commercial facility at Ravenswood and Equality. As Fig. 3.26 shows, most of the Ravenswood site is above the elevation of the 100-year flood, implying that much of an expanded commercial plant could be situated out of the 100-year floodplain. At Equality, however, Fig. 3.21 points out that approximately half of the site is below the 100-year floodplain. If the commercial plant requires the same quantity of land at Equality as it would at Newman, virtually all of the Equality site would be utilized, thus requiring nearly 500 acres of encroachment on the 100-year floodplain. A different commercial plant layout could perhaps reduce this impact, or offsite slag/flydust disposal could be considered, but commercialization would in any case require some construction in the floodplain (see Appendixes D and E).

Geology and soils

Soils in the area of the proposed site are primarily alluvial deposits associated with the Green River floodplain. At the site the alluvial material is underlain by unconsolidated sand deposited by glacial outwash. Because of the characteristics of the soils, several impacts will result from siting the SRC-I facility at the proposed site. First, a large parcel of soils [380 ha (938 acres)] classified as "prime" for agricultural use will be removed from productive use. This is discussed in the preceding Land Use section. Large areas of "prime" agricultural soils will also be taken out of production at the alternate sites. Second, because the site is underlain by unconsolidated sands and is located on the border between seismic risk zones II and III, soil liquefaction is a possibility (see Sect. 4.2.1.2). Mitigation measures, therefore, will have to be employed to ensure the integrity of facility foundations and waste disposal liners. Site preparation requirements in process areas are likely to cause extensive alterations of site soils that will reduce soil productivity.

Because of the relatively steep terrain at the Equality site and the high seismic risk at the proposed and Equality sites, these two sites are considered less favorable geologically than the Ravenswood site.

Although erosion mitigation and control measures would be incorporated at any site, the relatively steep terrain of the Equality site would require more extensive controls than the proposed or Ravenswood site. The impact of increased sediment loads would probably be more significant in the Green River, because of the already elevated suspended solids levels. Because there are these water quality problems associated with the Green River, the surface-water impact to the Ohio River at the Ravenswood site, should it be chosen, would likely be less severe.

Terrestrial ecology

Construction of the demonstration plant at the proposed site may affect the Indiana bat, which occurs in an onsite forest that will not be cleared for the project (Appendix K). It is possible that the Indiana bat also occurs at the alternate sites. No other threatened or endangered species is expected to be present at the proposed or alternate sites. Locally important species habitats, however, may be adversely impacted as a direct or indirect result of the proposed action. Construction at the Ravenswood site might destroy the unique Spring Creek forest area, and the Ravenswood site is considered least favorable from the standpoint of impacts on terrestrial ecology. Depending on the plant layout at the Equality site, construction activities could destroy a mixture of upland, floodplain, and swamp hardwood forest, thus reducing potential habitat for seven animal species considered rare in Kentucky. Impacts to the terrestrial ecology at the proposed site would be minimal, as over approximately 90% of the site is cleared for agricultural use. A small area of riparian hardwood forest along Green River, however, would be destroyed at the proposed site.

Groundwater

Short-term groundwater impacts resulting from construction activities at any of the three sites are expected to be minimal. The design of the demonstration plant will include measures to minimize the contamination of groundwater resulting from process operations, coal and product storage, wastewater treatment and solid waste disposal, and accidental releases of product or process materials. Although these measures are expected to be effective, the possibility of liner failure in coal storage or waste disposal areas or of a spill outside of the drainage collection area cannot be totally eliminated. The greater seismic risk at the proposed and Equality sites increases the possibility of liner failure. Should liner failure or a major spill outside the drainage collection system occur, the severity of impacts would depend on the characteristics of the site. All three sites are underlain by aquifers which are developed locally for domestic water supplies. Impacts due to groundwater contamination, should it occur, would be similar at each site considered. Groundwater impacts at the proposed and alternative sites are discussed in Sects. 4.2.2.2, 4.3.2.2, and 4.4.2.2. A groundwater contingency plan for the proposed site in the event of liner failure is presented in Appendix HH.

Surface-water quality

Primary surface-water quality impacts to adjacent streams and rivers involve increasing sediment loads during plant construction and polluting adjacent water bodies by occasional treated wastewater discharge and accidental spills during operation. Increasing sediment loads and the concentration of several chemical parameters would aggravate current water quality problems. At all sites, an increased sediment load to the rivers during the construction phase would likely increase turbidity, which is currently causing concern. These impacts are anticipated to be temporary. Low flowwater availability at all three sites is considered adequate for normal operation of the SRC-I facility and will not create significant problems or shortages downstream of the plant. Because of the steeper terrain, impacts at the Equality site may be more severe. Because low stream flows at the Equality site are slightly lower than at the proposed site, impacts of wastewater discharge would be more severe. The Ohio River has far greater dilution capacity than the Green River and would be expected to experience less impact from wastewater discharge than any of the other sites should the Ravenswood site be chosen.

Aquatic ecology

No threatened or endangered species habitats would be encroached upon or affected by plant location at any of the sites. The aquatic ecology of the small streams at the Equality site may be adversely affected by the SRC-I project construction. The spawning habitat, nursery, or refuge for various biota may be destroyed by habitat degradation during construction. These habitats are not considered rare, or of unique ecological importance. At the Ravenswood site the slough of Spring Creek may serve as a spawning habitat, nursery, or refuge for Ohio River biota. The creek and slough are also of some importance from the standpoint of terrestrial ecology. Construction activities at the Ravenswood site may potentially disturb or destroy this unique area. Because of the relatively low stream flows, impacts of wastewater discharge would be most severe at the Equality site and least severe at the Ravenswood site.

Air quality

Construction of the demonstration plant at any site will result in increased particulate emissions (fugitive dust) as a result of site clearing, grading, excavation, and construction. Construction at the Equality site would require extensive earth moving, similar to that proposed for the Newman site, and fugitive emissions would tend to exacerbate the particulate problem measured in the area. Although construction at the Ravenswood site would also require similar earth moving activities, the lower wind speeds and greater number of days with rain or snow cover would tend to make the impacts of fugitive emissions somewhat less significant at this alternate site. Fugitive dust from construction is considered a temporary impact.

Approximately the same short-term maximum pollutant concentration increases would result from emissions during operation of plants constructed at either the proposed or alternate sites. Impacts at the Equality and proposed sites are expected to be similar, while impacts at the Ravenswood site could be slightly less. Impacts of releases during abnormal conditions could

be more severe at the Ravenswood site, because of the larger population of the nearby Kaiser facility and the community of Ripley's Landing. Impacts of releases resulting from a major accident would also be more significant at Ravenswood. Impacts of emergency and accidental releases are estimated to be similar at the Newman and Equality sites.

Social and economic impacts

Sections 3.2, 3.3, and 3.4 present baseline information for the proposed and alternative sites while Sects. 4.2.4, 4.3.4, and 4.4.4 analyze the potential impacts associated with construction of the SRC-I facility on each of those sites and their respective impact areas. After careful consideration of this data, it is concluded that the proposed site located near Newman, Kentucky, is preferred over either the Ravenswood, West Virginia, or Equality, Kentucky, alternative sites in respect to socioeconomic considerations. The three sites are ranked in the order shown above, based on the number and magnitude of impacts identified at each and the likelihood of their successful mitigation. This evaluation is based primarily on an analysis of those impacts expected during the demonstration and commercialization stages as a result of construction and operation of the SRC-I facility itself. The construction of other large-scale energy projects that are currently planned or under way in the general vicinity of the prospective sites could result in cumulative effects that would add significantly to those socioeconomic impacts induced by the SRC-I project alone. The magnitude of these cumulative impacts will not occur uniformly across all three sites, and the severity of these impacts, as well as the degree to which SRC-I construction will contribute to them, can vary considerably with modifications to currently proposed construction schedules. A more complete discussion of cumulative impacts will be found in Sect. 2.3.1.3 and in Sects. 4.2.5, 4.3.5, and 4.4.5.

During the demonstration stage, impacts are expected to differ among the three sites in several important issue areas. Because the size of the urban areas surrounding the Newman site are substantially larger and have a significantly better developed public and private infrastructure than do those in the vicinity of the alternative sites, project-induced in-migration can be better absorbed in the proposed impact area than in the alternatives. This is illustrated in the analysis of housing and public services (Sects. 4.2.4.1, 4.3.2.2, 4.3.2.3, 4.4.2.2, and 4.4.2.3) which projects a greater degree of stress for communities in the vicinity of the two alternative sites.

The one instance in which demonstration-period impacts at the proposed site are significantly greater than those at one of the alternatives (Ravenswood) is in the area of highway traffic. While a severe impact is projected at the proposed site, this can be largely alleviated through careful implementation of the mitigation measures presented in Sect. 4.6.2.2. Without effective mitigation, project-induced traffic would entail an unacceptable social impact to the communities in the vicinity of the proposed site.

Problems often experienced by impacted communities related to local inflation during large construction projects and economic dislocations afterward should be least evidenced during the demonstration stage at the Newman site because of the larger and more diversified economic base in this area (Sects. 3.3.4.8, 3.4.4.8, 4.2.4.1, 4.3.4.5, 4.3.4.6, and 4.4.4.6).

Finally, in terms of demonstration-period impacts on archaeological resources, the proposed site is superior in relation to the two alternatives, both of which are expected to have numerous archaeological sites in the project area (see Sects. 4.3.4.8 and 4.4.4.8).

During the commercialization stage, the impacts expected to occur in the impact areas surrounding all three sites will be similar to those demonstration-period impacts discussed in Sect. 4.2, 4.3, and 4.4 but at a larger scale due to the significantly larger work force required for commercial plant construction. Neither alternative site is expected to change its standing in relation to the proposed site during the commercialization stage.

As the above discussion shows, the Newman, Kentucky site is preferred over both alternatives based on projected impacts of the SRC-I facility by itself. When the cumulative impacts arising from all the major construction projects planned for the general vicinity of the SRC-I site are taken into consideration, the Newman site is still superior *provided the currently proposed schedules for SRC-I and the two nearest synthetic fuels facilities (W. R. Grace and Tri-State) are followed or corresponding delays are experienced by all three facilities.* Under the proposed schedules for these facilities, the cumulative impacts arising at the Newman site during the peak of SRC-I construction (1983) will be only slightly more

adverse than those that would be engendered by SRC-I alone and are less severe than the projected impacts at either alternate site. While the impacts projected to occur in the vicinity of the Newman site during the peak of cumulative construction (1986) will be more severe than those anticipated at either alternative site during the same period, they will be generated *after* the completion of SRC-I as a result of other area construction projects. Accordingly, the level of peak cumulative impacts described in Sect. 4.2.5 can be expected to occur whether or not SRC-I is ever built.

If the SRC-I demonstration-phase construction schedule in this document is delayed by as little as one or two years and the schedules of the other facilities in the region are not delayed, the cumulative impacts occurring in the region will increase in severity. Traffic problems in particular will become much more acute as workers at the SRC-I, Tri-State, and W. R. Grace facilities all attempt to use the same area roads. If, alternatively, the construction schedules of these other two synthetic fuels projects were to slip while SRC-I remains on schedule, impacts are then likely to be exacerbated during the commercial-phase construction of SRC-I as, again, all three projects overlap. With either of the scheduling delays described above, SRC-I construction activities at the Newman site will contribute to a set of cumulative impacts significantly more severe than those at the alternate sites. Under these conditions, an evaluation made based on the *total* socioeconomic impacts at each site (and not just that portion caused by the SRC-I project) would find Ravenswood, W. Va., to be superior from a socioeconomic standpoint.

The above discussion points out some of the difficulties of making a decision on the merits of the alternative sites based on a consideration of cumulative impacts. The uncertainties that still exist in project scheduling, and even on whether or not a particular plant will be built at all, make definitive decisions difficult.

If current construction schedules are adhered to, the Newman site emerges as the preferred alternative. To prevent any additional impacts that could arise from construction delays, the SRC-I construction schedule should be coordinated with the W. R. Grace and Tri-State facilities to avoid, as much as possible, an overlapping of their peak or near-peak labor forces. In addition, mitigation measures should be developed and coordinated for all these synthetic fuels facilities so that, between all the responsible parties, all major plant-induced impacts are adequately addressed. These mitigation measures should include contingency plans to account for the possibility of slipped schedules and the resulting worsening of impacts. In the event of construction delays, the potential for SRC-I contributing significantly to severe cumulative socioeconomic impacts would exist without the coordinated scheduling and cooperative mitigation planning described above.

2.3.2.2 Alternative plant designs

Analysis of alternative plant designs began with screening of the major process areas to identify effluents and emissions under normal and upset conditions, potential for adverse environmental impacts, and control requirements. Within the limits of the existing conceptual plant design, twelve major process areas and control options, identified as having potential for causing significant adverse impacts, were evaluated to identify the environmentally preferable alternatives and, where possible, to determine the potential for reducing impacts through selection of this alternative. The following areas and options were evaluated and are discussed below and in Appendix C:

- separation of mineral residue
- disposition of mineral residue
- hydrogen production
- gasification processes
- sulfur recovery and emission control
- process hydrocarbon emission control
- waste heat rejection
- wastewater treatment
- plant fuels
- particulate emission control
- product solidification
- slag/flydust disposal

Summary of environmentally preferable alternatives. The results of this evaluation of alternatives are presented below. This evaluation indicates that the proposed design includes the environmentally preferable alternative for (1) separation and disposition of the mineral residue; (2) hydrogen production; (3) sulfur recovery; (4) particulate emission control for process emissions and the storage of coal, SRC solid product, coke, and sulfur; (5) plant fuel; and (6) wastewater treatment. The evaluation of alternatives for gasification processes did not identify significant differences in the potential environmental impacts of the technologically viable alternatives.

Evaluation of alternatives for heat rejection, process hydrocarbon emission control, slag/flydust disposal, product solidification, and sulfur emission control for the coker/calciner indicates that further study might reveal an alternative with less environmental impact than the proposed design. It should be noted that this evaluation is limited by the conceptual nature of the current plant design. These alternatives are being further evaluated by both DOE and the industrial participant to determine their technical and economic feasibility and to obtain a more quantitative evaluation of their potential for reducing adverse environmental impacts. The work plan between DOE, EPA, and the Kentucky Department of Natural Resources and Environmental Protection (Appendix EE) discusses the review role of these agencies in some of the pollution control design decisions. Process and control alternatives currently under study are discussed below.

Alternative designs currently under evaluation

The designs of several plant features of environmental significance are incomplete and will be highlighted for environmental review during detail design.

- Although the main processing units will normally not emit hydrocarbons, other than fugitive releases, process upsets and emergencies may occur that require immediate disposal of combustible vapors and gases to relieve internal pressures. Some of these combustible materials may contain complex organic compounds including carcinogenic substances, and flaring from an elevated flarestack (a conventional refinery and petrochemical industry practice) may not adequately destroy these compounds. Separation of light from heavy materials by cooling and condensing, then flaring the easily combustible light vapors while incinerating the heavy liquids may provide complete combustion of all hydrocarbons. A controlled combustor system could be used to incinerate the heavy hydrocarbons. The design of this system is under evaluation by DOE and the industrial participant and represents one of the major environmental control decisions to be made during the detailed design phase.

- The proposed design calls for predominantly wet evaporative cooling for heat rejection and the use of dry aerial cooling and indirect cooling for process units containing heavy hydrocarbon compounds (the compounds of principal concern from a health standpoint). Such systems would virtually eliminate potential cooling system emissions of such hydrocarbons to the atmosphere. However, several alternative cooling configurations exist for accomplishing this objective with varying amounts of water consumption and varying atmospheric effects. Furthermore, the choice of cooling system is linked to the use of a zero wastewater discharge treatment system that would require some wet evaporative cooling as a means of water consumption. Consequently, alternatives for both the cooling and wastewater recycle systems are being evaluated concurrently because most of the treated effluent will be used as makeup water for evaporative cooling.

- The proposed SRC product solidification system using indirect cooling is the environmentally preferable alternative of the technically proven processes. A direct contact cooling alternative is presently being investigated to determine technical feasibility. Should this alternative prove to be technically viable, it will probably be the environmentally preferable alternative.

- The proposed design for SO_2 control from the coker-calciner is a wet soda ash scrubber that appears to be the preferred alternative among the wet-scrubbing systems. Dry scrubbing with soda ash and cloth filters is also being considered. Dry scrubbing could provide a higher particulate-removal efficiency than wet scrubbing, at the potential expense of less certainty in the level of SO_2 control achieved since dry scrubbing is not considered commercially proven technology for the low feed concentration found in this application. Sending the flue gas to the gas treatment system (sulfur-recovery

system) would not be a feasible alternative because the gas would be too voluminous and the concentration of SO_2 would be too dilute for effective removal.

- Laboratory tests on gasifier slag and flydust (Appendix P) indicate that these materials are nonhazardous under RCRA criteria. This would suggest that these solids could be acceptably stored in a nonhazardous landfill. The Phase Zero conceptual design proposed storing the wastes in a nonhazardous landfill having a 6-in.-thick clay liner. During preparation of the DEIS, DOE/ICRC evaluated alternatives to this landfill design and proposed constructing the first slag landfill as a hazardous waste disposal facility having a 3-ft-thick clay liner above a synthetic liner. At this time several alternatives are under consideration and EPA and KDNREP are providing guidance to DOE/ICRC. In any case, the design will incorporate compacted clay and synthetic liners, leachate detection and removal systems, and dikes to prevent inundation in the event of a 500-year flood. The design alternatives being evaluated relate to liner thickness, liner permeability, and the elevation of the landfill base relative to the groundwater table.

Separation of mineral residue

Removal of the mineral residue (ash) from the product materials is a major objective of the process. Based on pilot-plant experience, two separation methods were considered: Filtration and Kerr-McGee Critical Solvent Deashing (CSD). Filtration is a cyclical batch operation that has potential for mechanical difficulties resulting in upsets and plant shutdown for maintenance. These maintenance requirements of filtration equipment involve the potential exposure of workers to the heavy hydrocarbon materials, some of which may be toxic and/or carcinogenic (Sect. 4.1). Kerr-McGee CSD with a continuous solvent extraction process is mechanically simpler than filtration and does not result in emissions to the environment or in worker exposure. Therefore, Kerr-McGee CSD was selected as the preferred alternative from both a process and environmental standpoint.

Disposition of mineral residue

Four alternatives were considered for disposition of the ash concentrate from the Kerr-McGee CSD: direct disposal, utilization as a boiler fuel, gasification, and incineration. Direct disposal was rejected in view of the high concentration of complex organic materials (such as polynuclear aromatic compounds exhibiting carcinogenic properties) in the ash concentrate and the potential value of the carbon content. Utilization as a boiler fuel was not considered feasible using conventional boiler types because of the low carbon content relative to the high ash content, the difficulty in controlling combustion, and the need for additional equipment for control of particulates and sulfur dioxide. Incineration would provide a high degree of assurance of destruction of complex organic materials but would require supplemental fuel plus equipment for control of particulates and sulfur dioxide. The gasification method chosen recovers the carbon content of the ash concentrate, provides a high degree of destruction of the organic materials, produces a relatively inert slag as the solid waste product, allows recovery of sulfur from the off-gas, and requires no additional emission control equipment beyond that required for gasifier operation. Gasification of the mineral residue was selected as the preferred alternative from both a process and environmental standpoint.

Hydrogen production

Four alternatives were considered for production of the hydrogen required by the process: electrolytic production from water, methane reforming, gasification of coal or oil, and gasification of the ash concentrate from the Kerr-McGee CSD. Electrolytic production of hydrogen would consume large quantities of electricity with associated impacts of generation (SO_x, NO_x, and particulates) and would reduce the plant's overall thermal efficiency. Electrolytic production was rejected based on economics. Methane reforming is feasible but would consume a resource already in short supply and was rejected on this basis. Gasification of coal or oil is also feasible; however, it would consume additional coal or more valuable oil products and would require alternate disposition of the Kerr-McGee ash concentrate. Therefore, the choice is gasification of the ash concentrate as the preferred alternative for supplying the needed hydrogen from both a process and environmental standpoint.

Gasification processes

Only three available gasification systems are considered suitable for gasification with high conversion of the ash concentrate: the Texaco and Shell-Koppers processes which operate at high pressure, and the commercial GKT process which operates at atmospheric pressure. Comparison of potential environmental impacts* indicates no significant differences among the three processes. The GKT process is viewed as the preferred alternative on the basis of commercial status and process considerations and was selected as the proposed alternative.

Sulfur recovery and emission control

Sulfur recovery. Sulfur enters the plant as a component in the coal. Approximately 93.6% of the total sulfur entering in the coal feed will be recovered as elemental sulfur in the sulfur recovery area. Nearly all of the remaining sulfur in the coal remains as residual sulfur in the plant products. The total sulfur emitted to the atmosphere is estimated to be 1209 lb/d, or 0.3% of the total sulfur entering the plant. This percentage includes sulfur in the fuel gas to be used in-plant (8 lb/day), in the effluent from the flare and controlled combustors (48 lb/d), sulfur recovery area (46 lb/d of mostly reduced-sulfur compounds), the scrubbed flue gas from the calciner (217 lb/d), and the vent from the gas treatment system (890 lb/d). Emissions from the calciner scrubber account for 14% of the total atmospheric sulfur emissions but approximately 74% of the sulfur dioxide emissions. (See Appendix C for the plant-wide sulfur balance.)

Through a series of processing steps in the SRC, gasification, coking, and expanded-bed hydrocracking areas in the plant, sulfur contained in the coal is hydrogenated to H_2S. The H_2S is contained in those various process streams in small quantities. These process streams are sent to the gas treatment area for acid-gas removal. Two parallel acid-gas removal processes are planned to remove H_2S, COS, and CO_2 from the process streams: (1) the process which uses a proprietary physical selective solvent, Selexol, and (2) a diethanolamine (DEA) solvent process. Both these processes produce a concentrated H_2S stream, which is sent to the sulfur-recovery area. No atmospheric emission is evolved from the DEA unit; however, some carbonyl sulfide and H_2S is emitted to the atmosphere from the Selexol unit in a CO_2 and N_2 waste stream (890 lb/d sulfur).

The selection of acid gas treating process depends upon the acid gas partial pressure, the ratio of CO_2 to sulfur compounds, feed stream impurities, hydrocarbon content, and the treated stream purity requirement. The shifted syngas from the shift unit has about 360 psi gas partial pressure and contains no heavy hydrocarbons. Physical solvent processes, Selexol and Rectisol, are judged to be more favorable for treating this type of gas stream than are chemical absorption processes. However, of the chemical absorption processes, the hot carbonate process is considered the most likely to be competitive. A screening type study was conducted concluding that Selexol is more economical than Rectisol on a nonselective acid gas removal basis. According to the screening selection, Selexol or Benfield's Hi-Pure process were the recommended technologies for this service. Rectisol was eliminated based on these recommendations. Selexol and Hi-Pure processes were considered in the trade-off study for gas treating in the makeup hydrogen producing facility for the SRC-I project. The project costs, annual utility costs, and annual operating costs for these two processes were considered.

The results of the cost estimates show that Selexol process is economically more feasible than Benfield's Hi-Pure process. Therefore, Selexol was selected for gas treating of the makeup hydrogen stream.

The sulfur recovery plant consists of two three-stage straight-through Claus units (one being a 100% spare) and a Beavon Sulfur Removal Unit (BSRU). The concentrated H_2S stream from Selexol and DEA units is converted to elemental sulfur in one of the Claus units; the tail-gas from the Claus unit is further treated in BSRU. Provisions will be made to incinerate the Claus tail gas in the thermal oxidizer of the flare system when the BSRU is not operating. Based on data from several operating plants, typical concentrations of total sulfur compounds in the BSRU effluent are in the 50 to 100 ppmv range, normally at the low end of this range. The concentration of H_2S specifically is expected to be less than 5 ppmv.

---

*See, for example, "Environmental Performance of Coal Gasifier," TRW Report 2623-10, Sept. 15, 1980, submitted to DOE.

While many alternative processes for sulfur removal are available, the combination of Claus and Beavon Sulfur Removal was chosen as the preferred alternative because it has been well demonstrated in full-scale operation in similar services with a high degree of reliability and because it provides high removal efficiency.

Beavon Sulfur Removal units have been sufficiently demonstrated; 35 units are in operation, serving approximately 7000 long tons per day of Claus capacity. This is approximately one-half the 1980 sulfur recovery in the United States. No operating problems are expected, and greater than 99% operating reliability is expected. Stretford absorber plugging was an early problem, which occurred when packed tower absorbers were used, but it has since been solved by design changes that include a preabsorber venturi. Trace species of metals which may enter the unit are not expected to cause operating problems. Ammonia has not posed a problem to Beavon Stretford units, and any HCN passing the Claus plant would be converted to NH_3 and CO by the Beavon Stretford system.

One of the alternatives considered, a combination of Claus and Shell SUPERSCOT, was not selected because it has a lower efficiency (the effluent concentration is typically about 250 ppmv) and because of its high energy consumption. Another alternative, Giammarco-Vetrocoke, could replace the Stretford unit in the Beavon-Stretford system, possibly reducing the SO_2 concentration further. A major drawback is the use of arsenic compounds that would appear in trace quantities in all effluents, including the sulfur product.

Two commercially available alternative technologies exist that could potentially replace the Claus sulfur recovery system: Stretford and Giammarco-Vetrocoke. Both of these systems have demonstrated lower sulfur emissions than Claus systems in some applications, although they would be considerably more costly for the sulfur throughput of this plant. The performance of these systems is sensitive to feed-stream composition, and the feed stream in the proposed plant may contain process contaminants that would preclude the effective use of these alternative systems. They are best suited to dilute inlet H_2S levels, such as the tail-gas-cleaning applications.

The Chiyoda Thoroughbred 101 process is a potential alternative which (after incineration) would provide a gypsum product from the remaining sulfur in the tail-gas instead of elemental sulfur. Sulfur dioxide in the off-gas would be higher than with the proposed system. Other potential alternatives include the Dual Alkali process, the Cleanair process, the Wellman-Lord system, the IFP-2 system, and a lime-limestone slurry system. They have been rejected because they are either less efficient or more difficult to operate, and in some cases solid waste is generated.

Fuel-burning. Operation of the SRC-I process and supporting processes requires significant quantities of heat, which must be supplied by combustion of fuel in indirect heat exchangers (fired heaters). Four alternative fuel sources were considered: purchased gaseous fuels [natural gas or liquified propane gas (LPG)], purchased petroleum distillate fuels, coal, and process-generated fuels. Because purchased gaseous and distillate fuels would consume resources which are already in short supply, these fuels were rejected. Use of process-generated heavy distillate fuels or coal would require extensive facilities for control of sulfur dioxide and particulate emissions and less efficient combustion to control NO_x formation. Utilization of process-generated gaseous and light distillate fuels is environmentally cleaner than combustion of heavy fuels and allows compliance with applicable environmental standards without requiring a great deal of additional control equipment. For both environmental and process considerations, gaseous fuel was selected as the preferred alternative for normal continuous operation. Startup of heaters normally using gaseous fuels will utilize process-generated liquid fuels.

Further reductions in sulfur oxide emissions could be achieved through further reductions in fuel-gas hydrogen sulfide content, but only at the expense of increased capital investment, operating costs, and energy consumption. The economic and energy penalties may not be justified in view of the fact that fuel-gas hydrogen sulfide contributes less than 3% of the plant's total sulfur emission rate.

In conjunction with the use of the clean fuels, minimizing energy consumption will indirectly reduce SO_2 emission. Energy conservation practices, such as use of power recovery turbines, optimum use of high-pressure steam, and air preheat to large heaters, will be incorporated in the design of the facilities.

Coker-calciner. The flue gas from the calciner is incinerated to destroy virtually all of the hydrocarbons and reduced sulfur compounds. The SO_2 in the incinerator effluent will be reduced

by a scrubber before discharge to the atmosphere. Sending the flue gas to the gas treatment system is not a feasible alternative because the gas flow rate is too large and because the concentration of SO_2 is too dilute for effective removal.

Several wet scrubber alternatives were considered: Wellman-Lord, lime/limestone, and soda ash. Wellman-Lord is technically feasible but is more expensive than the soda ash. Lime/limestone is not technically feasible at the low SO_2 concentrations encountered in this application. The soda ash is the preferred alternative among the wet scrubbing systems.

In addition to wet scrubbing, dry scrubbing with soda ash or lime, and cloth filters is also being considered. Dry scrubbing could potentially provide a higher particulate removal efficiency than wet scrubbing but is not considered commercially proven technology for the low feed concentration found in this application.[2,3]

Process hydrocarbon emission control

Although the hydrocarbon processing facilities are designed to operate without producing atmospheric emissions, almost all will at some time require venting to reduce pressure or remove trapped gases. In addition, filling of storage tanks and process vessels will displace hydrocarbon vapors. Vapor recovery will be employed wherever practicable; however, some vapors will still require disposal. Four alternatives are available: direct venting, uncontrolled combustion (flaring), controlled combustion, and hydrocarbon sorbent beds.

Direct venting even through an elevated stack is considered unacceptable in view of the potentials for fire hazards or the release of toxic materials.

Uncontrolled combustion (flaring) is a standard practice in many chemical and petrochemical industries and would significantly reduce the concentrations of potentially toxic materials such as H_2S and CO. It would not assure complete combustion of complex organic materials, and incomplete combustion could result in formation of additional complex materials. In addition, utilization of a conventional flare (open flame) would make it impossible to sample the combustion products.

Incineration (enclosed thermal oxider), in which the waste materials are mixed with a supplemental fuel (as required) and burned in a special combustion chamber, is designed to assure complete combustion through maintenance of a specified flame temperature and residence time in the presence of excess air. Incinerators permit sampling of the combustion products and, when operated at design conditions, provide a very high degree of assurance that the materials for which they are designed will be destroyed. Since they are designed for specific combustion rates and feed compositions, incinerators are very sensitive to variations in these parameters, and relatively minor deviations from design conditions may produce significant reductions in their efficiency. For this reason, the incinerator will be preceded by a holding tank so that liquids can be fed into it at controlled rates. Thus, it functions as a controlled combustor. The base case design presently being evaluated (described in Appendix C) employs a combination of combustion equipment including: an enclosed thermal oxidizer for which combustion conditions can be tightly controlled, a multiple ground flare field with wide turndown capability to handle all foreseen hydrocarbon emissions, and a backup emergency flare. It includes a flow control system to maintain flow rates within the chosen envelope of optimal combustion for each element of the system. It also contains cooling, condensation and separation systems designed to minimize flow of heavy hydrocarbons to combustion equipment where burning takes place in an open flame. Alternatives being evaluated include the flow rates at which each type of combustor comes into service, and specific equipment designs for cooling and separation, flow control and manifolding systems.

Appendix C discusses the plant upset and emergency conditions that would require use of a flare/controlled combustor. Sections 4.2.3 and 4.1 discuss the environmental effects of such events.

Double-piping was considered for areas of the plant handling heavy hydrocarbon streams and was rejected from an engineering feasibility standpoint. The size of the pipes and the projected thermal stresses preclude the use of this alternative. Enclosing the dissolver, separator, and fractionator area was considered and rejected based on safety considerations involving handling of high temperature and pressure flammable materials, particularly hydrogen. Enclosure of specific items of equipment such as reciprocating pumps will be evaluated during detailed design.

Other sources of process hydrocarbon emissions are fugitive sources. Fugitive sources are categorized as unintentional sources such as leaks, as opposed to continuous point sources such as stacks or vents. It should be noted that fugitive hydrocarbon emissions are characteristic of chemical and petrochemical plants as well as many other industries handling gaseous and/or volatile liquid hydrocarbons. In general, best refinery and petrochemical practices for minimizing fugitive gaseous emissions are being employed in the design of the demonstration plant. Examples of these practices are enclosed vapor recovery systems for storage tanks and loading and transfer equipment, and extensive use of mechanical seals on rotating shafts which leak less frequently than packing. To address the concern that some coal-derived liquids are more likely to contain carcinogenic compounds than natural crude oil derivatives, special considerations are being given to new features to reduce the exposure of the public and plant personnel to fugitive hydrocarbons. Examples of such features are: use of double mechanical seals wherein the outer seal contains a safer fluid; use of enclosures around some reciprocating pumps; use of indirect cooling (see below) in some areas of the plant to prevent hydrocarbon releases through conventional evaporative cooling towers from heat-exchanger leaks; use of enclosures for the oily water separator on the plant drain system; and use of enclosures for local sumps for specific drains such as Selexol, DEA, and Dowtherm systems.

Waste heat rejection

During normal operations, the SRC-I demonstration plant will generate approximately 1.8×10^{12} J/h (1.7×10^{9} Btu/h) of nonrecoverable process heat. The heat rejection rate is comparable to that of a coal-fired steam plant of 225 to 270 MW(e) output.

A major environmental concern affecting the selection of cooling systems for the SRC-I demonstration plant is the potential for contamination of the cooling water by PNAs and other hydrocarbons. These contaminants may enter the cooling system through leaks and failed tubes in high-pressure heat exchangers. The coal dissolver, liquid refining and fractionation, hydrogen recovery, and coker-calciner are units where high-temperature and pressure hydrocarbon streams exist, potentially containing toxic and/or carcinogenic substances. These units require cooling and are, therefore, susceptible to heat-exchanger failure and contamination of cooling water by hydrocarbons and PNAs. The cooling system ultimately employed in the demonstration plant will minimize or eliminate the release of toxic and carcinogenic compounds to the environment.

Available cooling tower alternatives. Several alternative waste heat rejection methods are available. Six types of cooling systems are considered in this section because each involves different amounts of water usage and different risks of hydrocarbon releases to the atmosphere. Figure C.13 in Appendix C shows these alternative configurations. As discussed under wastewater treatment alternatives, the choice of a cooling system has a large effect on the choice of wastewater treatment system.

Aerial coolers are feasible for cooling hot process streams down to about 150 or 140°F, which reduces the size of the cooling-water system and thus the makeup water requirements. Process fluids would flow inside finned tubes, and atmospheric air would be circulated around them by motor-driven fans. Aerial coolers require an extensive plot area. By using welded connections as much as practical, the possible leak points at flanges could be minimized. Because of the significantly lower volatility of heavy liquids, gaseous emissions due to leaks from fittings of lines in heavy-liquid service are quite small when compared with leaks from fittings in gaseous or light-liquid service. A large leak in the aerial-cooling system will be detected by process monitoring and control instrumentation. Smaller leaks would not be expected to result in significant total mass emissions because of the heavy nature of the process fluids, but will be detected by analyzing aerial cooler exhaust gases for total hydrocarbons with a gas chromatograph on a quarterly basis. For these coolers, performance depends on ambient conditions and varies according to season.

Wet evaporative cooling towers are the most widely used type. Cooling water is circulated through exchangers to remove heat from the process fluid and then cooled by contacting air in a cooling tower open to the atmosphere. The circulating water can become contaminated with process materials introduced through cooling system leaks from higher-pressure process environments. These contaminants can escape to the atmosphere through the cooling tower evaporation and drift. Drift losses can be minimized by high-efficiency drift eliminators. This type of system would be the lowest in overall cost and suitable for cooling down to 85° to 95°F, depending on atmospheric wet-bulb temperatures. It would also have the highest makeup water requirements to replace evaporative water loss.

Dry indirect cooling is a method in which the process fluids would be cooled in heat exchangers by a circulating heat transfer fluid isolated from the environment. The circulating heat transfer fluid would then be cooled in an aerial cooler. The dry indirect type system eliminates evaporation and drift losses of water to the air with the advantage of reducing the plant makeup water requirements and any subsequent impact on the river supply. The heat transfer fluid would be low-pressure, moderate-temperature, corrosion-inhibited water so that leakage into this water would not be a problem. If a leak occurs, the process materials would be separated from the heat transfer fluid in a disengaging drum. Vapors would be flared, and liquids would be recovered until the plant could be shut down for repairs. Any contaminated heat transfer fluid (water) would be sent to the water treatment system. The dry indirect type system thus prevents risk of contaminating the atmosphere by leaks of certain process hydrocarbons into the circulating cooling water.

Three major disadvantages of the dry indirect system are (1) the increased complexity of the system; (2) the cost involved, considerably more than that of the conventional wet evaporative cooling system; and (3) if used extensively, the potential decrease in the plant's water evaporation rate to such an extent that the method of consuming condensate from the zero wastewater discharge treatment system would be affected.

Wet indirect cooling is similar to the dry indirect method described earlier, except that heat is rejected indirectly to a second circulating evaporative cooling water system rather than to the air. Its use would result in the same net evaporative rate as would conventional wet evaporative cooling. Thus, the risk of contamination would be eliminated, and the drift and the effect on plant water balance would be the same as for wet evaporative cooling.

Wet/dry cooling towers use a dry upper section (cooling water in tubes, cooled by upward air flow) and a lower wet evaporating cooling section, with the water in open contact with air in order to cool by evaporation. The principal advantages of this type are its capabilities for (1) diminishing visible water-vapor plume and reduce fog, (2) obtaining a colder fluid temperature that approaches ambient wet bulb, and (3) conserving makeup water as compared with the 100% wet evaporative cooling tower.

The risk of hydrocarbon contamination of the cooling water and emission to the atmosphere would be the same with this system as that with the wet evaporative system.

Direct contact after cooler (DCAC) is a method of cooling the compressed air feeding the oxygen plant. In this method, air is passed up a packed or tray tower and cooled with a recirculating water stream that passes countercurrently down the tower. The circulating water in turn is cooled with the cooling water system through a heat exchanger.

Cooling process water requirements for the DCAC heat exchanger on the oxygen plant are only 5% of the total process water requirements of the demonstration plant. The use of DCAC would not significantly affect the water balance for the zero wastewater discharge system.

Base case and alternative designs. The base case design for the demonstration plant uses wet evaporative cooling towers for most process needs and a direct contact after cooler for the oxygen plant. Aerial coolers or indirect cooling will be used for streams containing heavy hydrocarbons of concern from a health standpoint. The sections served by aerial coolers or indirect cooling would include the coal dissolver, hydrogen recovery, expanded-bed hydrocracker, and coker-calciner. This heat load is a small fraction of the plant's total heat load.

The extensive and long-term toxicological testing program under way on SRC intermediates and products will provide the information for final selection of the cooling system. The base-case design is based on some preliminary results that are available so far. It is possible that the final results may require reappraisal of the base-case design.

The preliminary results show that Ames test effects are minimal with cuts boiling below 600°F and begin to be noticeable above 760°F. The base case calls for aerial coolers or indirect cooling for the streams containing 5.0% or more by weight of coal or SRC-derived material having boiling points greater than 500°F. An exception would be instances where cooling water has a pressure higher than that of process fluids. For streams that are not carcinogenic or mutagenic, wet evaporative cooling towers will be used, and the circulating water will be closely monitored for hydrocarbon leaks (except for the air-separation plant, which will use a direct-contact after cooler).

Environmental concerns with the evaporative portion of the proposed cooling system are blowdown disposal, drift losses, visible plumes, and noise. By providing a separate aerial or indirect cooling system for the part of the process handling heavy hydrocarbons, the possibility of releasing hazardous hydrocarbons to the atmosphere through the cooling system can be minimized.

Three alternative designs, each composed of a different combination of cooling system unit operations, have been evaluated.

- Alternative A. By using dry indirect systems for rejecting the heat load of the entire plant, the risk of atmospheric contamination by the cooling water system would be essentially eliminated. However, this system would be expensive and require a significant amount of plant area. Furthermore, a consumptive use of treated and recycled wastewater other than cooling tower makeup would be required for the zero wastewater discharge system.

- Alternative B. Dry indirect cooling systems would be provided for all the process cooling water users, with a wet/dry cooling tower system for the oxygen plant. The advantages and disadvantages are similar to Alternative A.

- Alternative C. Dry indirect coolers would be provided for cooling process streams that have appreciable concentrations of objectionable hydrocarbon materials (PNAs). A conventional wet cooling tower system would be provided for the rest of the process users, and a wet/dry cooling tower for the oxygen plant. The advantages of this alternative are similar to those for the base case, although the system would be more complex. Less plant area would be required and lower cooling temperatures could be achieved.

Appendix C has a preliminary comparison of several factors for the base case and the three alternatives. Based on these factors, the base case and Alternative C appear to be the preferred environmental choices to the other alternatives. However, only a preliminary evaluation has been made at this time. A more detailed engineering and environmental review will be conducted during the detail design to establish the advantages, disadvantages, and degree of risks of these systems, and possibly others, before a final decision is made.

Wastewater treatment

The treatment system in the proposed design features zero wastewater discharge under most conditions and includes a physical-chemical pretreatment, biological oxidation, and final physical-chemical treatment with filtration, activated-carbon adsorption and possibly ozonation (Figs. 2.4 and 2.5). As discussed in Appendix C, some operating conditions will require discharging a treated wastewater. Experience at numerous pilot plants for coal gasification and liquefaction processes (including SRC-I operation at the Wilsonville and Fort Lewis Pilot Plants) and conceptual studies indicate that this system can effectively control the biochemical oxygen demand and the acute toxicity of the wastewater. The data in Table 4.10 suggest that this system can also remove toxic metals and trace complex organics that may be toxic and/or carcinogenic.

A comprehensive laboratory study is being conducted to determine how effectively the proposed system can control trace toxic metals and the complex trace organic materials that may be toxic and/or carcinogenic. The laboratory program will characterize the contaminants in the streams expected in the demonstration plant and will determine the treatability of the wastewater expected at the demonstration plant. Pilot plant wastewaters have been obtained from the following operations: GKT gasification of mineral ash residue obtained from the SRC-I operation, coking of SRC-I, expanded-bed hydrocracking of SRC-I, and SRC-I production. In addition, coal and SRC pile runoff wastewater and oily wastewater from SRC-I operation were obtained.

The treatability study will evaluate the various pretreatment methods proposed, including separation of emulsified and floatable oils from oily wastewater and precipitation of metals from metal-containing wastewaters. The treatability study will also evaluate the use of a two-stage biological system to biodegrade the majority of contaminants expected in the demonstration plant wastewaters. This evaluation will determine the effect of sludge age, temperature, and powdered activated carbon addition to the biological system. Tertiary treatment will also be evaluated and will include multimedia filtration, granular activated carbon adsorption, and ozonation.

The majority of the wastewater characterization study is expected to be finalized in late 1981. Preliminary data from the treatability studies should be available in late 1981 or early 1982.

Several alternatives to the proposed wastewater treatment system are given below:

1. Holding of the untreated process area runoff and wastewater for natural evaporation was considered not feasible because the natural evaporation rate is lower than the precipitation rate for the proposed plant site.

2. If the coal storage were inside a silo, the quantity of runoff requiring treatment would be decreased to about 80 gpm. This alternative was rejected because of high costs and safety (fire and carbon monoxide) hazards of silo storage.

3. A 100% treated wastewater discharge system to replace the proposed zero-discharge system, an evaluation of which is found in Sects. 4.2.2.3, 4.2.2.4, and Appendix C.

4. An economic comparison of the use of air or oxygen systems for activated-sludge wastewater treatment indicated that the total annual cost for the air system was 11.6% less than that for the oxygen method. Capital-cost differences were insufficient to make a recommendation at this time; technical merits and limitations will be reviewed.

5. Preliminary capital cost estimates for phenol recovery from sour water streams range from $5 million to $13 million. Because savings in wastewater treatment due to the reduced phenol load are only 3 to 7% of the total removal costs, phenol recovery is not being considered. To prevent high phenol loading to the bioreactors, the following methods will be included in wastewater treatment design: equalization of wastewaters to dampen loading fluctuations, recycling treated effluent to dilute bioreactor feed if necessary, use of completely mixed reactors to dilute contaminants uniformly, the capability to add activated carbon to the bioreactors, and use of carbon adsorption of the effluent to remove residual phenolics.

6. Another plant alternative being considered is phosphate cooling tower corrosion inhibitor rather than chromate.

Plant fuels

Operation of the SRC process and supporting processes will require the input of significant quantities of heat which must be supplied by combustion of fuel in fired heaters. Four alternative fuels were considered: gaseous fuels (natural gas or LPG), petroleum distillate fuels, coal, and process-generated fuels. Gaseous and light distillate fuels are acceptable from an environmental standpoint; however, their utilization would consume resources which are already in short supply and their use was rejected for this reason. Use of heavy distillate fuels or coal would reduce furnace reliability and require extensive facilities for control of sulfur dioxide and particulate emissions to meet emission limitations and PSD requirements. Although implementation of required controls is technically feasible, the cost of control equipment must be weighed against the possibility that the plant may not subsequently enter an expanded commercial operating phase. Utilization of low-sulfur process generated gaseous fuels allows compliance with applicable environmental standards without requiring additional control equipment, and was selected as the preferred alternative based on economic considerations. Ability to comply with environmental standards without reliance on additional control equipment, which is subject to failure, makes the use of process-generated fuel the environmentally preferable alternative for demonstration plant operation. It is anticipated that the entire plant will use fuel gas. As discussed earlier under sulfur recovery and emission control, further reductions in sulfur emissions could be achieved through further reductions in fuel-gas hydrogen sulfide content, but only at the expense of increased capital investment. This cost may not be justified in view of the small SO_2 contribution from combusting the already low-sulfur plant fuel gas.

Particulate emission control

Process emissions. In general, four particulate control alternatives are available: cyclones (alone or with other control methods), scrubbers, electrostatic precipitators, and baghouses

(or media filters). Although cyclones could probably achieve compliance with applicable emission standards in some applications, they generally produce only moderate particle collection efficiencies. Both electrostatic precipitators and baghouses provide significantly higher collection efficiencies; however, for equivalent cost installations, baghouses provide significantly higher collection efficiencies and were selected as the preferred alternative from both a process and environmental standpoint for particulate control except for the cleanup of the calciner flue gas, where a scrubber would be used. Scrubbing is a better alternative for that stream because it will also contain a significant quantity of SO_2. A scrubber can remove both pollutants at the same time. The use of dry FGD to remove SO_2 in conjunction with a baghouse to remove particulates is an alternative currently being evaluated for controlling calciner emissions.

Coal storage. If no controls are used, total fugitive particulate emissions from the active and reserve coal piles would be approximately 430 tons per year. Dust suppression systems will be used to reduce the emissions.

Use of water spray as a dust suppressant system is expected to reduce emissions by 70% on active piles, and the use of washed coal is expected to reduce potential active pile emissions by 97%. The use of surface polymer crusting agents is expected to reduce emissions 99% on the reserve piles, which will not be disturbed during normal plant operation.

The proposed design will incorporate a water suppression system and the use of washed coal (99% combined control) for the six active piles and the polymer crusting agent for the two reserve piles. This alternative, combined with under-pile/underground reclaim for the active piles and the use of retractable spouts and water sprays when needed during load-on to the piles, should reduce the fugitive emissions from coal piles to less than 3 tons per year.

SRC storage. The solid SRC product will be stored in open piles. A water suppression system will be incorporated in the design of the SRC storage and handling system to control fugitive particulate emissions. This control method should reduce the fugitive emission rate to less than 10 tons per year. The environmentally preferred alternative (up to 99% control) for fugitive emission control would be enclosed storage. However, storage bins or silos for this material will be very costly because of the large volume involved. Therefore, this alternative was not selected.

Coke storage. Because of small volume and powdery nature, coke will be stored in silos; there would be virtually no fugitive emission. This represents the most effective alternative available.

Sulfur storage. The elemental sulfur by-product will be stored in the molten state in a closed tank. The sulfur is transferred in the molten state to prevent fugitive particulate emissions during shipping and to facilitate loading and unloading. This is the preferred environmental alternative.

Coal drying. Two methods of coal drying are available. The currently proposed design uses conventional technology, with wet coal obtained from the stockpile simultaneously pulverized and dried in a system heated by combustion flue gases.

In the system of conventional technology, the feed coal is both ground and dried to 2 to 5% moisture in an enclosed system. Particulates generated during pulverization and drying will be removed from effluent gases by a filter baghouse. Drying temperatures in the mill are well below the oxidation temperature of the coal and metallic sulfides. The exhaust air contains the combustion products of the furnace, the water removed from the coal, entrained particulates, volatiles from the coal and, potentially, entrained sulfurous water present in the feed coal. The baghouse is designed to remove 99+% of the particulates.

An alternative is flash drying, with wet coal crushed and dried separately. In the flash dryer system, crushed coal is injected into warm solvent. The coal-solvent mixture flows to the slurry mixing vessel, where a hot process recycle solvent and a recycle slurry are added and slurried. The water flashes off as steam and is later condensed, leaving a hydrocarbon gas that would then be injected into the vapor recovery system. The flash drying system would not produce a particulate emission, whereas the proposed conventional dryer would generate about 5.6 kg/h (12.4 lb/h) of particulates (37% of the plant's overall emission rate from point sources); however, the larger-sized particles, especially rock, could settle in various parts of the process, resulting in plugging and coking. This type of system has potential

economic and environmental advantages but has not been tested sufficiently for inclusion in the construction of the SRC-I demonstration plant. A modification of this alternative would be the addition of a ball or rod mill to grind the coal-solvent stream before or after mixing it with the hot slurry. The conventional drying-pulverization system is the selected method for the initial operation of the SRC-I demonstration plant because flash drying is still developmental. To demonstrate flash-drying technology, such equipment could be installed at a later time, should a decision be made to do so. Flash drying could then be considered in the expansion to a commercial SRC-I facility.

Because the flash drying system retains potential pollutants within the process, it would appear to be the environmentally preferable alternative. However, all the several types currently being considered require further information from testing in a pilot plant, which will define process design and operating parameters. Choice of a system will involve trade-offs between capital cost, environmental impact, maintenance, process benefits, and operational reliability. Until more information is obtained about the alternatives, conventional drying-grinding is incorporated into the proposed design and is the basis for the worst-case emissions estimates presented here.

Coal and product transferring. At rail car unloading points and the transfer to the storage pile, water sprays will be used as required for dust suppression. Conveyors transferring coal to storage piles will be covered. Underground reclaim from the storage piles will be totally enclosed and ventilated through a baghouse. After reclaim, prior to pulverization, transfer points and conveyors will be totally enclosed to the extent possible. Any ventilation of these enclosures will be exhausted through a baghouse to the atmosphere. Provision will be made to install water spray at transfer points should monitoring during operation indicate this is necessary. After pulverization all conveyors, transfer points, and coal processing equipment will be totally enclosed and ventilated through baghouses.

The SRC solid product will be transferred in semi-enclosed conveyors, and dust will be controlled by chemical dust suppressing agents. Coke will be transferred in a totally enclosed conveying system.

Product solidification

The proposed design for product solidification is indirect cooling of molten SRC in small batches on vibrating trays. In the indirect cooling design, the molten SRC is sprayed onto a metal surface for indirect cooling. The SRC is open to contact with the atmosphere for the entire cooling process. Cooling is accomplished by cooling water circulating through coils on the opposite side of the cooling trays. The cooling water does not come in contact with SRC, so contamination should not occur. Because the SRC is open to the atmosphere, the entire operation is enclosed and ventilated. Ventilation air for the enclosure is withdrawn and treated by combustion to destroy hydrocarbon vapors emitted by the SRC as it cools.

An alternate design being evaluated is direct contact cooling by injection into water. Molten SRC would be dropped into cooling water where it would be cooled and solidified by direct contact. The cooling water would be circulated in a closed loop, so that contaminated water discharge resulting from direct contact with SRC would not occur. Fine particles would be separated from a slip stream of the cooling water in a separate operation. The water would be returned to the cooling loop without further treatment. Some evaporation of cooling water would occur, mainly at the point where SRC is injected, requiring makeup water.

Hydrocarbon emissions to the atmosphere would be minimal, occurring primarily only as a result of the very short contact with air above the water surface as SRC is injected. Some additional hydrocarbons could result from codistillation as some of the possibly contaminated cooling water evaporates at the injection point. The injection point would be enclosed, and ventilation air would be withdrawn for treatment. The amount of hydrocarbon losses as well as the size of the ventilation flow are expected to be much smaller than for the proposed indirect cooling options.

In addition, the SRC product would still be wet from residual water at the discharge from the solidification unit. This would reduce significantly the amount of fugitive dust generation at this location.

The current process design proposal utilizing indirect cooling is the most economical and environmentally acceptable of the technically proven processes. The direct contact cooling alternative is presently being investigated to determine technical feasibility. Should this option prove to be technically feasible, it will probably be the environmentally preferable alternative as well because of the low hydrocarbon emissions. If only indirect cooling should prove technically feasible, emissions will be controlled as discussed in Sect. 2.2.1.

2.3.2.3 Alternative plant layouts

The possibility of building the facilities above the designated floodplain areas has been studied. If the ability to expand to a commercial plant (30,000 tons/d) were not an objective, it would be possible to build the demonstration plant (6,000 tons/d) completely above the base floodplain with the exception of the barge facility and the water intake/discharge structure. This assumes that the estimated areas for gasification (for which detailed information is not yet available); coal storage area (30-d inventory and no provisions for blending); and slag/ash pond would not increase in size. Piping runs to the storage areas would be longer and cost more. Construction areas would be more confined and would probably result in higher cost. Such an approach would preclude or seriously constrain the possibility of expansion to a commercial plant since only low-lying flood-prone areas with inferior subsoil conditions would remain available. Therefore, construction of all facilities above the base floodplain is impractical.

The facilities plan (Appendix D, Figs. D.1 through D.3) calls for grading the site and locating all the demonstration plant processing facilities and hazardous waste landfills above 500-year flood level (118 m or 388 ft elevation), locating all remaining facilities above the 100-year base flood level (117 m or 385 ft elevation), and building flood-proof impervious dikes around liquid storage and ash ponds with the top of the dike above 500-year flood level.

Using onsite soils as the only source of fill material, these elevations would only be possible if the bottom of the slag ponds and the liquid storage tank farm are allowed to stay below the 100-year base flood level. The slag landfill bottom elevation would be 114 m (373 ft), and the base of liquid storage dike would be at 377 ft (Appendix C, Fig. C.14). No problem is foreseen in constructing high dike walls to prevent flood inundation of these storage areas. In the event of a 100-year flood, the slag pond would be weighted with the addition of water to resist the uplifting force on the liner from the rising groundwater table. The landfills would be constructed to provide low permeability consistent with RCRA standards.

If it were considered essential to raise the bottom of the storage tanks and the slag ponds to above the 385-ft base flood elevation, it could be done by lowering the elevation of the nonprocessing facilities (administration building, coal storage piles, etc.) to 383 ft. The processing facilities could still be maintained above the 500-year flood level (388 ft). But there is not enough soil available onsite to level the entire site above the 100-year flood elevation.

Alternatives to the proposed layout and grading plan (Fig. D.3) that were considered are as follows:

- Site the demonstration plant only on nonfloodplain areas. This alternative would severely constrain commercial expansion of the demonstration plant. This limitation is caused by the inferior subsoil conditions of the remaining lowland areas.

- Utilize an adjacent 90-acre tract of flood-free land not currently within the site boundaries. This alternative may be feasible for the commercial phase but not practicable for the demonstration phase because of delays (up to 11 months) which would be necessary for additional environmental monitoring and plot plan rearrangements and would not materially change the floodplain/wetlands impacts of the proposed action.

- Grade the plant site area to above the 500-year flood elevation. Although this alternative is feasible, it would still result in floodplain encroachment and would require fill materials to be brought in from off-site at considerable added expense (approximately $30 million, in 1980 dollars).

- Alter the proposed grading plan by raising the base of the slag ponds and liquid storage areas above the 100-year flood elevation. This plan would require that nonprocess areas be lowered to 117 m (383 ft). If off-site fill were used, however, these elevations would not have to be lowered. The liquid storage area and the slag disposal area will be diked above the 500-year flood elevation to mitigate the flood danger. The threat of uplifting forces on the slag pond base from a high groundwater table can be mitigated by weighting the top side of the liner with additional water. In these mitigating measures, the cost of filling these areas is not justified.

2.3.3 No action

2.3.3.1 No DOE action – project terminated

If the decision is made to choose the alternative of terminating the contract to go forth with the demonstration project, the SRC-I process may not be demonstrated in the near future and the opportunity to obtain the intended environmental, technical, and economic data on the SRC-I process at near-commercial scale would be greatly reduced. If the proposed SRC-II demonstration plant project is carried out, that project could provide information of a generic nature similar to that which would be obtained from SRC-I such as hydrogen production via gasification; ash and slag disposal; pressure letdown; large-scale oxygen production; wastewater treatment; solid-liquid separation; and high-temperature and -pressure handling of hydrocarbon, hydrogen, and oxygen mixtures. However, the conceptual designs for each of the two SRC demonstration plants have unique features such as solid-liquid separation and wastewater treatment. Demonstrating both technologies would provide a valuable diversity of information and operating experience about alternative designs. The Exxon Donor Solvent and H-Coal pilot plants have been constructed and are currently in the mechanical shakedown and testing phase. These plants could also contribute generic information for advancing the SRC-I technology (Sect. 1).

The adverse impacts on the physical and biological environment and the socioeconomic conditions in the region would not occur if the no action alternative is chosen.

Another aspect of the no action alternative is that the private sector may decide to commercialize the SRC-I technology. If commercialization takes place without the benefit of a demonstration plant, it is likely that development would proceed in a less controlled manner, with large-scale technical and environmental problems solved during the operation of the plant rather than during the design and demonstration of the plant.

2.3.3.2 No DOE action – project continues under other sponsorship

If DOE withdraws from the project and if the proposed action continues under other sponsorship at the proposed site, the project could, but would not necessarily, result in the same environmental impacts as the proposed action. The project under other sponsorship would be required to comply with all appropriate environmental requirements. Before issuance of appropriate permits, EPA and COE would perform necessary NEPA reviews.

The proposed action discussed in this FEIS includes certain monitoring and mitigation measures that exceed legal requirements and that may not be undertaken if the project proceeds under other sponsorship. These measures include the long-term environmental and health research plan outlined in Appendix Z.2 and ecological, traffic, and other socioeconomic monitoring and mitigation measures.

The major impact associated with this no action alternative would be the unacceptable social impacts to local communities if effective traffic mitigation measures are not undertaken. Other major social impacts would occur because of cumulative effects with other projects if the construction schedule is delayed by transfer of sponsorship from DOE to other parties. A benefit of the project continuing under other sponsorship would be increased tax revenues.

If ICRC continues with the project without DOE involvement, ICRC has indicated that, although it is not required to do so, it currently intends to carry out the monitoring and mitigation measures described in Sects. 4.5 and 4.6, with the exception of the following: socioeconomic measures and the long-term environmental and health research plan in Appendix Z. ICRC has committed to develop a traffic monitoring and mitigation plan, although not necessarily the specific program identified in Sects. 4.5 and 4.6. The effectiveness of this yet-to-be-developed ICRC plan cannot be evaluated at this time.

2.3.3.3 Delay the action

Another possible alternative available to DOE is delay of the project and the EIS process until the design for the plant has been finalized and until ongoing environmental and health studies have been completed. It has been suggested that this course of action would give DOE a more comprehensive data base to assess the likely environmental impacts of the project and to decide whether to proceed with it. This alternative might also enable DOE to assess more completely the adequacy of the mitigation measures that will be implemented to ameliorate the adverse impacts associated with the project.

On the other hand, it is estimated that plant design will not be finalized until late 1982. Moreover, some of the research necessary to determine the full extent of the environmental impacts of the demonstration plant must await actual construction, operation, and monitoring of the plant; other ongoing studies will require a substantial amount of time before definitive results can be reported and evaluated. It must be remembered that one of the objectives of this project is to obtain information regarding the environmental and ecological effects of a technology that is unproven and heretofore untested at this scale. This information, along with the effectiveness of environmental control systems, must necessarily be developed in stages. Therefore, even if the EIS were to be delayed until final design is complete, many unknowns would remain concerning actual environmental and health effects.

After seriously considering this delay alternative, DOE has concluded that it is not reasonable because it would mean that a major, irreversible, and irretrievable commitment to the project would be made without benefit of an EIS, perhaps foreclosing other options. By preparing an EIS now, DOE can gain valuable information that can be used to determine whether it should proceed with actions leading to construction and operation of the proposed plant.

REFERENCES FOR SECTION 2

1. Office of Water and Waste Management, *Lining of Waste Impoundment and Disposal Facilities,* SW-870, Washington, D.C., September 1980.

2. "Interest in Baghouses on Upswing," *Power,* 86-88 (February 1980).

3. Environmental Protection Agency Symposium on FGD, Session 6, Houston, Tex., Oct. 28, 1980.

3. DESCRIPTION OF THE EXISTING ENVIRONMENTS*

3.1 INTRODUCTION

Descriptions of the existing environments at the proposed Newman, Kentucky, site and two alternative sites at Equality, Kentucky, and Ravenswood, West Virginia are presented in this section. These descriptions focus on the significant features of the sites (without the proposed plant) to provide the reader with the environmental data needed to understand the impacts of constructing and operating the proposed plant; the data are presented in Sects. 3.2, 3.3, and 3.4. Section 3.2 describes the existing environment at the proposed site, and Sects. 3.3 and 3.4 describe the existing environments at the Equality and Ravenswood sites. The description of the proposed site includes data obtained from an extensive, one-year baseline monitoring program. Alternative sites are described in terms of existing information available to the public. Each of the sections is divided into four basic subsections: (1) land; (2) water; (3) air; and (4) economic, social, and cultural features. These four subsections are further divided by specific environmental categories. For example, the land subsection for the proposed site (3.2) is presented in the following manner:

3.2.1 Land
3.2.1.1 Land use and development
3.2.1.2 Geology and soils
3.2.1.3 Vegetation and wildlife

In addition, within the text, each of the above subsections may be broken down into several additional subcategories. The subcategorization for the proposed and alternative sites are identical. The water section contains information on surface water hydrology, groundwater hydrology and quality, and surface water quality and aquatic ecology. The air sections contain information pertaining to meteorology, air quality, and noise. The economic, social, and cultural features sections contain information on population; housing; labor and income; public services; transportation; and historical, cultural, and archaeological features.

3.2 PROPOSED SITE — NEWMAN, KENTUCKY

3.2.1 Land

Information about the proposed site in the areas of land use and development, geology, soils, and seismicity, and vegetation and wildlife is presented in this section.

3.2.1.1 Land use and development

The proposed SRC-I site is located in northwestern Kentucky in northwestern Daviess County, some 9 km (5.6 miles) south of the Ohio River, which is also the Indiana border. Situated on the Daviess-Henderson county border, the site is predominantly rural. At the present time, some 90% of total land in Daviess and Henderson counties is used for agriculture.

The nearest community to the site is the hamlet of Newman, Kentucky, situated about 1 km (0.6 mile) northward. The three nearest population centers of significant size are Owensboro,

*This chapter is based largely on information from the applicant's Environmental Report but also includes information from independent sources such as the open literature and data held by other knowledgable agencies.

county seat of Daviess County, 19 km (12 miles) to the east; Henderson, county seat of Henderson County, about 26 km (16 miles) to the west; and Evansville, Indiana, about 27 km (17 mi) to the northwest. Owensboro and Henderson are connected by U.S. Highway 60, a primary east-west route.

The site lies entirely in Daviess County and borders Henderson County on the west, the Green River to the south, Martin Creek to the east, and the Louisville and Nashville Railroad on the north (Fig. 3.1). Site topography is relatively flat, ranging in elevation from 113 to 119 m (370 to 390 ft) above mean sea level (MSL). The Green River, at about 106 m (350 ft) MSL is at the base of a 12-m (40-ft) bluff. All local streams drain into the Green River, which flows northwest into the Ohio River.

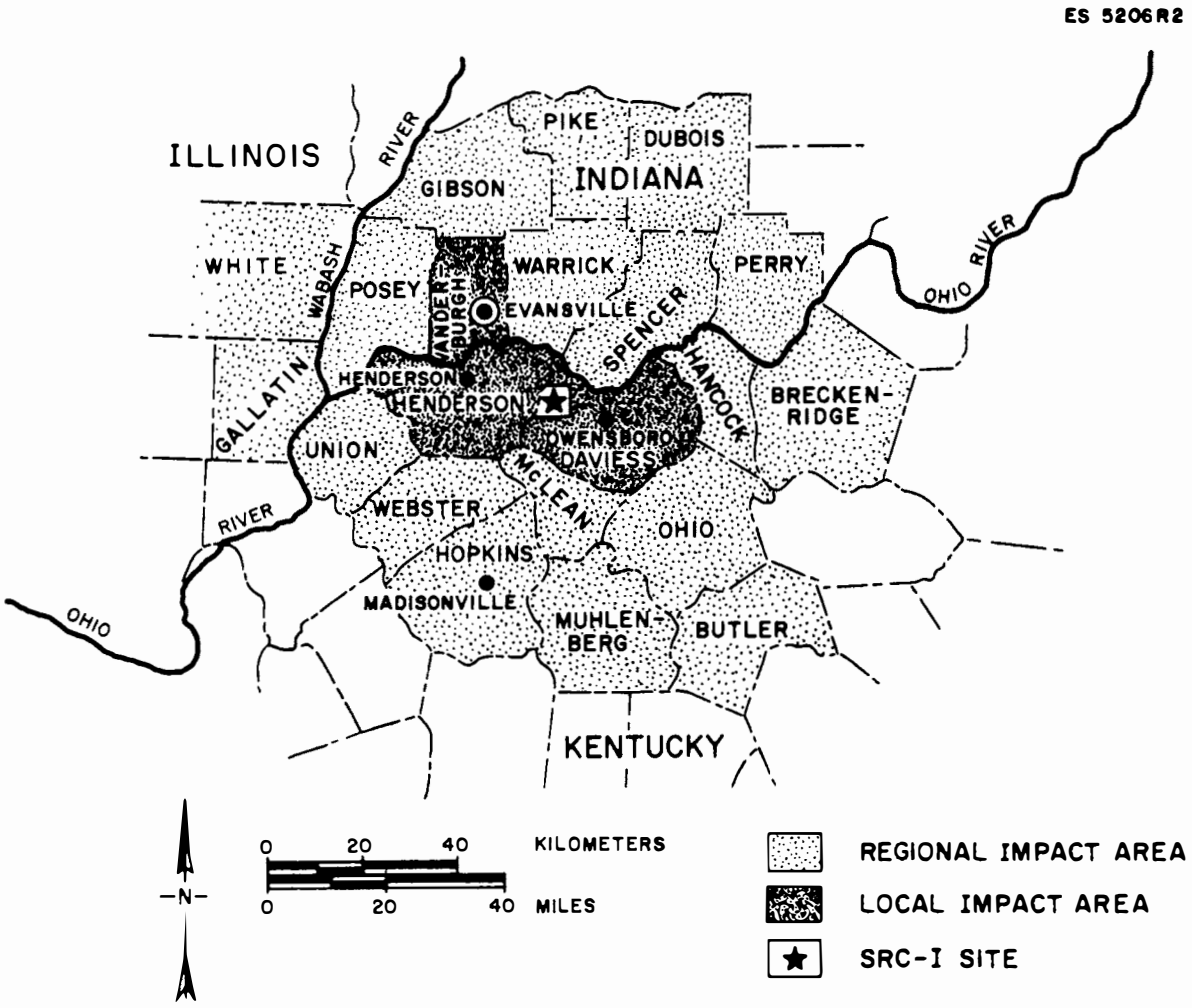


Fig. 3.1. SRC-I study areas.

The site area has been used intensively for agricultural purposes for over 100 years. Once an uncontrolled floodplain, the site is now drained by artificial ditches and stands mostly as cleared, relatively dry fields. Narrow bands of trees still line the banks of Martin Creek and the Green River.[1]

Soils on 91% of the site are classified as prime farmland by the U.S. Soil Conservation Service (Appendix X).[2,3] Additional soil information is included in Appendix L. Land use patterns for

the proposed site are depicted in Fig. 3.2 and listed in Table 3.1. Eighty-nine and one-half percent of onsite land is used for agriculture, and 85.1% of the land within 3.2 km (2 miles) is agricultural. On site, the principal crops grown are soybeans and tobacco; soybeans are widely produced in the site area. Principal crops in the region are corn, soybeans, and wheat. Daviess County ranks second in Kentucky in soybean production and third in corn. Henderson County ranks second in corn and fourth in soybean production, according to the 1974 U.S. Census of Agriculture. Trends in both counties have been toward fewer, but larger, farms; however, total farm acreage has declined overall (L. Matheny, Owensboro Metropolitan Planning Commission, personal communication, June 11, 1979).

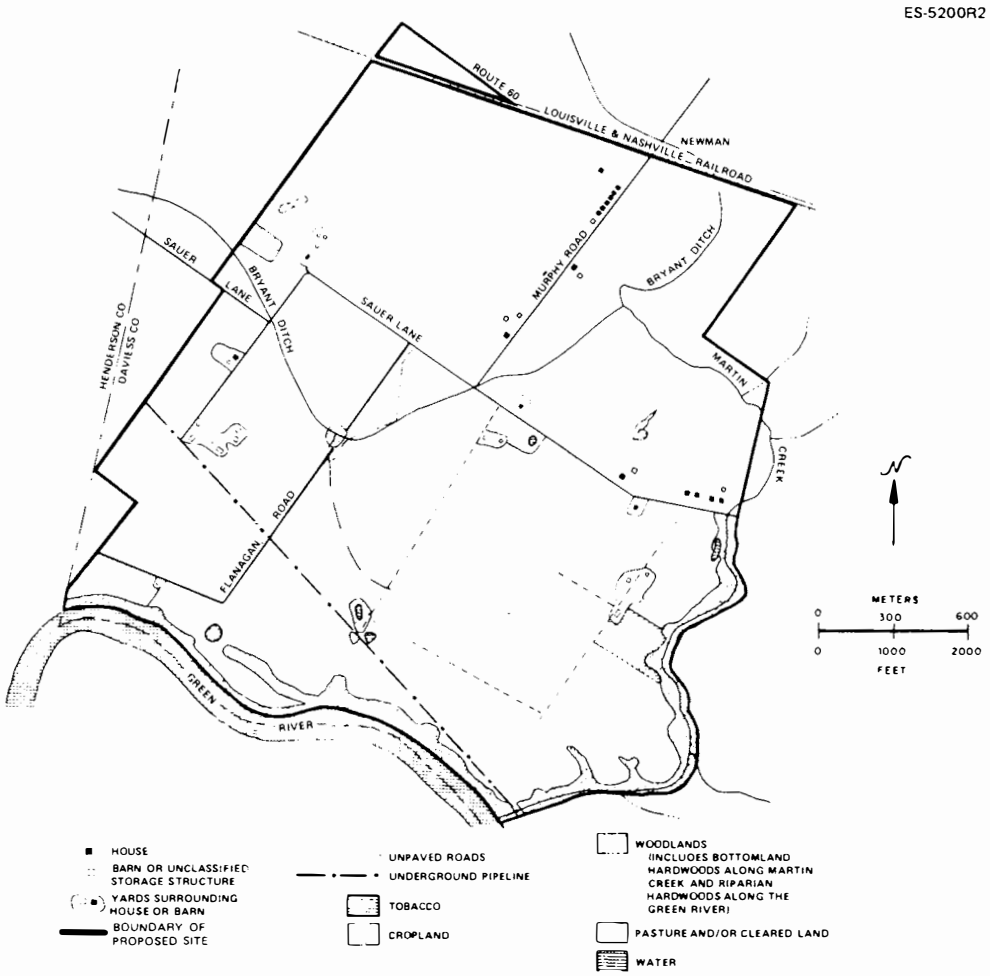


Fig. 3.2. Present land use of proposed site. Source: Dames & Moore field data, 1979.

3.2.1.2 Geology and soils

Physiography and surficial geology

The proposed site is located in the Western Kentucky Coal Field, which lies in the southern tip of the Illinois Basin. Regionally, the physiography is characterized as hilly, having moderate relief, with gently sloping hillsides and broad floodplains in the major stream valleys. The site and its immediate surroundings consist of flat to gently rolling terrain of the Green and

Table 3.1. Existing land uses for proposed site and adjacent area[a]

Land use category	Proposed site			Local area		
	Hectares	Acres	Percentage	Hectares	Acres	Percentage
Agricultural uses						
Pasture and/or cleared	26	64	4.3			
Cropland	507	1253	84.5			
Tobacco	4	10	0.7			
Total agricultural	537	1327	89.5	2765	6832	82.2
Woodland	40	99	6.7	358	885	10.6
Water	<1	<2	0.2	195	481	
Residential (including houses, barns, and yards)	8	20	1.3	40	99	1.2
Roads	14	35	2.3			
Wildlife management	0		0	3	7	0.1
Marshland	0		0	2	5	0.1
Commercial	0		0	1	3	<0.1
Institutional	0		0	<1	1	<0.1
Total	600	1482	100.0	3365	8313	100.0

[a] "Adjacent" refers to the area within 3.2 km (2 miles) of the site.

Source: Site land uses based on Dames & Moore field data, 1979, and on DOE staff calculations from aerial photographs; local area land uses from Dames & Moore field data, 1977.

Ohio River floodplains (Fig. 3.3). River channels are incised in the floodplain alluvium to a depth of about 10 to 15 m (30 to 45 ft). All surface runoff from the site enters the Green River; the eastern part of the site drains to Martin Creek, and the western portion drains to Bryant Ditch, which flows to Richland Slough and ultimately to the Green River. Flows in Bryant Ditch and Martin Creek are intermittent.

Bedrock underlying the region is of Pennsylvanian Age and consists of interbedded shales, siltstones, sandstones, and coal (Fig. 3.4). During Pleistocene glaciation, increased precipitation and glacial meltwaters caused the major rivers of the region to erode deep channels in the relatively soft bedrock. These channels filled with sand and gravel derived from glacial outwash and surface erosion, forming the broad Ohio River alluvial plain. Borings on the site penetrate approximately 40 m (130 ft) of sand and gravel before reaching bedrock. The nearest bedrock outcrops are in the hills about 8 km (5 miles) southwest of the site.

Geologic structure

Pennsylvanian bedrock of the Western Kentucky Coal Field is in the southern tip of the Illinois Basin, one of the major structural features of the eastern midcontinent. Within the region, faulting and folding have been historically significant, the most recent events being minor earthquakes focused in the New Madrid and Wabash Valley fault zones. Figure 3.5 shows regional geologic structural elements. Bedrock dip at the site reflects the regional westerly trend with minor local flexures superposed. Local dip, according to subsurface data, is about 6 m/km (30 ft/mile) (ref. 4).

The Rough Creek Fault zone is about 24 km (15 miles) south of the site, the Wabash River Fault zone is about 64 km (40 miles) west of the site, and the Curdsville Fault zone is about 8 km (5 miles) southeast of the site. Location of the Curdsville zone is shown in Fig. 3.4. Seismic events in the New Madrid and Wabash zones reflect minor movements of faults west of the site. The Rough Creek and Curdsville zones lack the recorded seismic history of the New Madrid and Wabash zones and have not been identified as source zones of significant seismic activity.

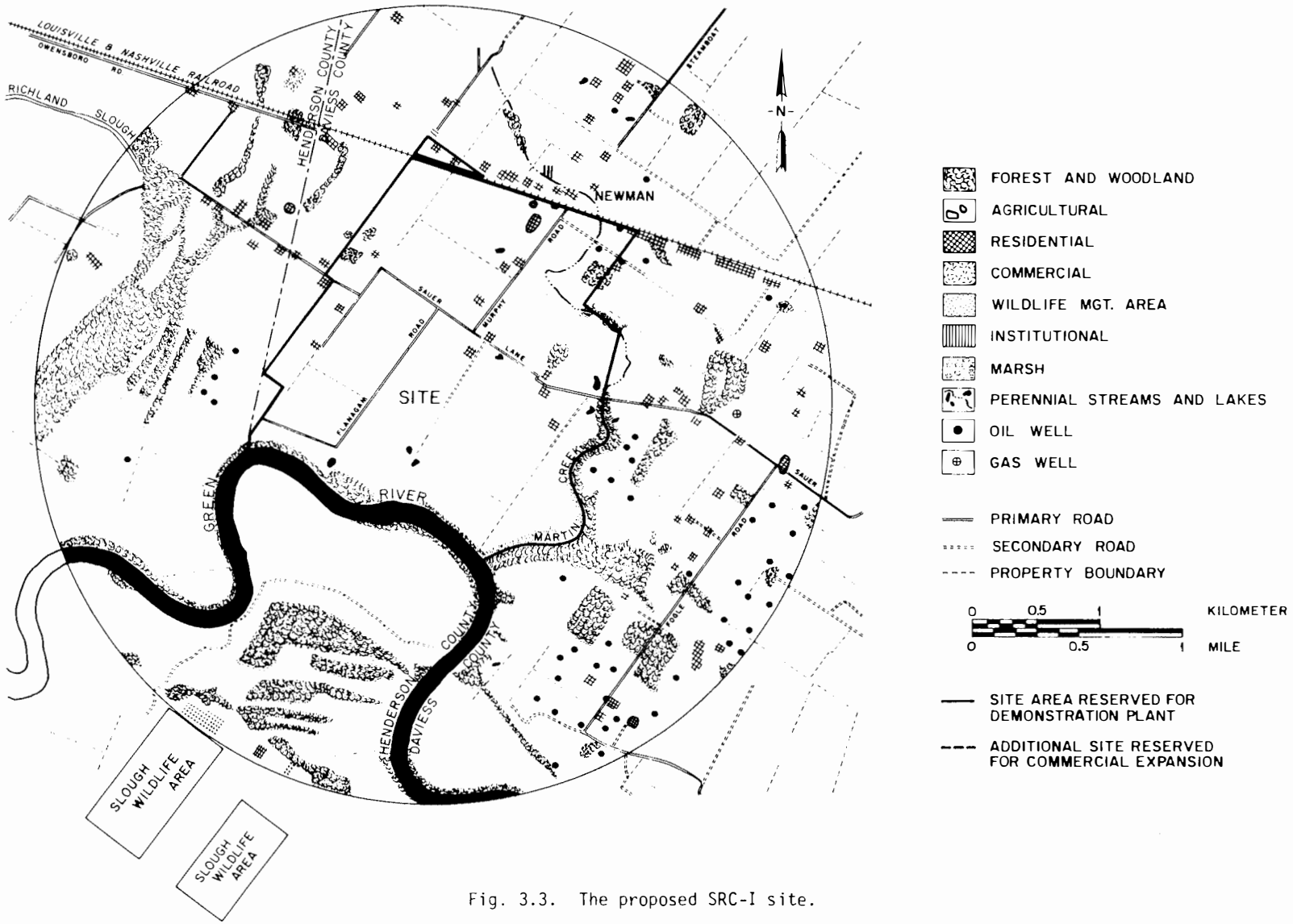


Fig. 3.3. The proposed SRC-I site.

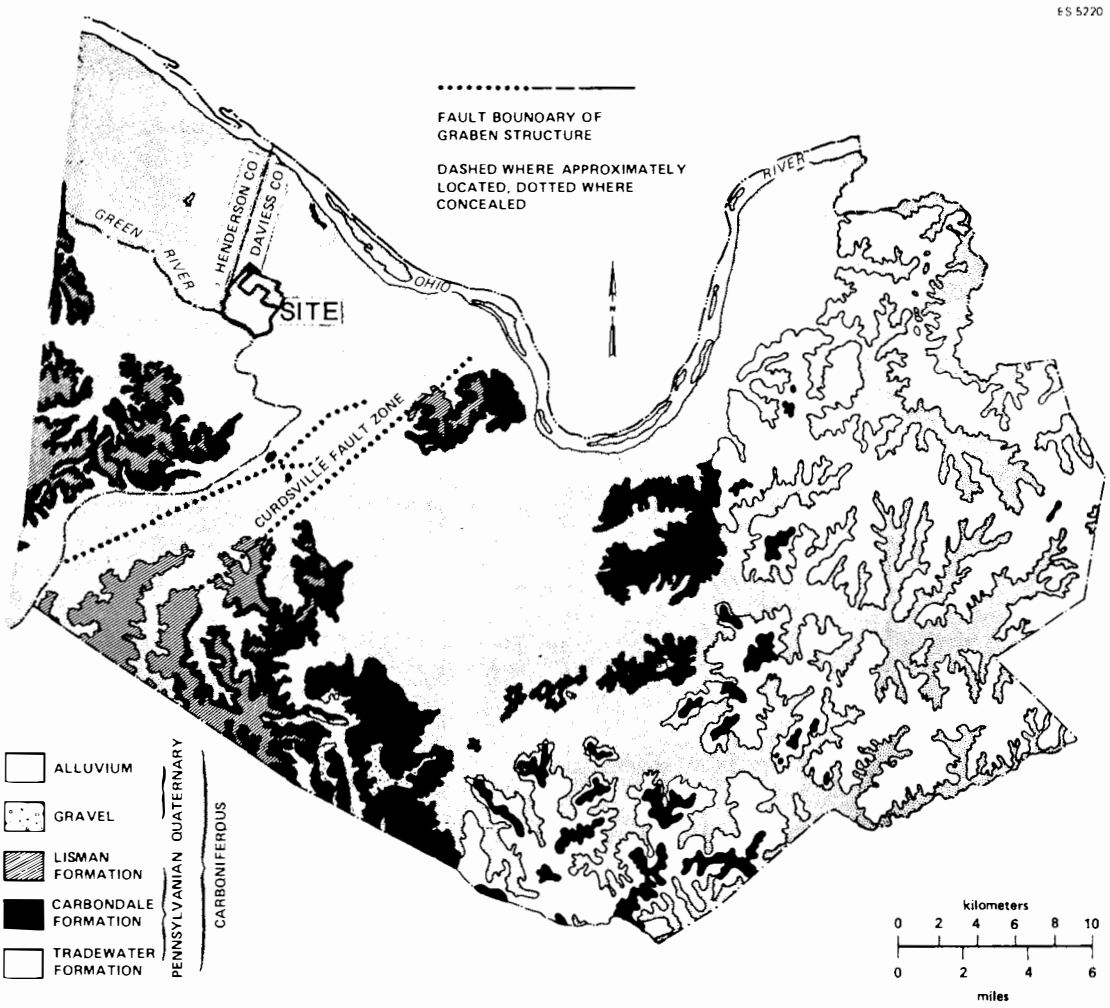


Fig. 3.4. Soils map of the area. Source: ER, Fig. B.3.

Seismic risk

For the purpose of designating relative earthquake hazard in various parts of the United States, the seismic risk zone map has been compiled (see Appendix L). The risk classification ranges from zone 0 through 3; in zone 0, damage to buildings is not anticipated, and in zone 3, major destructive earthquakes may occur with risk of major damage to structures. The site is located on the boundary between risk zones 2 and 3. The basis for the relatively high risk classification in this region is the continued seismic activity related to the New Madrid, Wabash Valley, and St. Genevieve Fault zones to the west. The New Madrid earthquakes of 1811-1812 were the most severe seismic events recorded in the United States (estimated epicentral Modified Mercalli intensities were XI-XII); however, seismicity in the region since those events has been of much lower magnitude. Generally, well-designed and well-constructed buildings are not damaged by earthquakes with Mercalli intensities less than about VIII. Earthquakes of Modified Mercalli Intensity V or greater that have affected the Owensboro-Henderson area are listed in Appendix L.

From a historical perspective, five earthquakes have affected the site with intensities of VI or greater since the 1811-1812 events; intensity VII is the maximum recorded intensity. Intensities of the major shocks of the 1811-1812 earthquakes are estimated to have been VII to VIII in the vicinity of the site.

ES-5205R

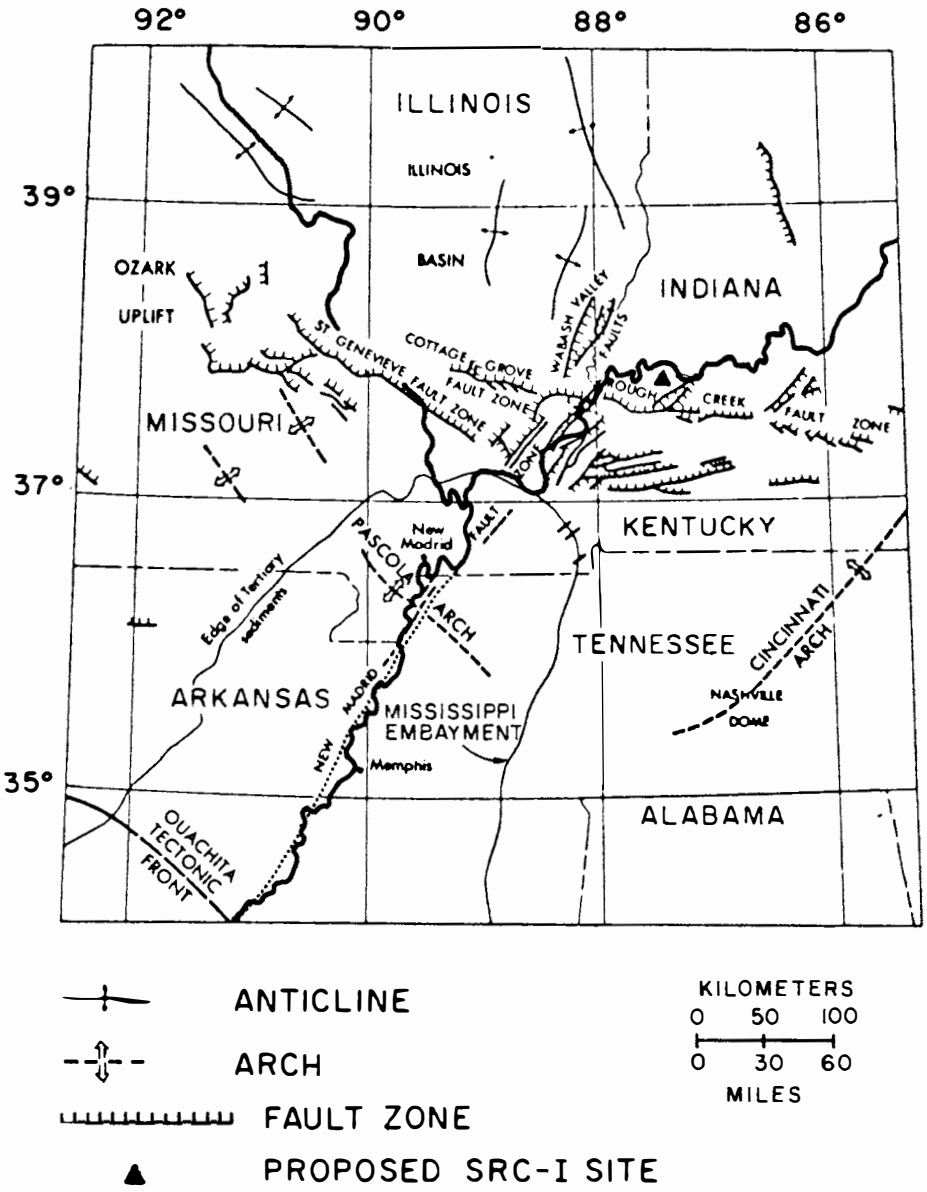


Fig. 3.5. Regional geologic structure and fault map. W. J. Hinze and L. W. Braille, *A Tectonic Overview of the Central Midcontinent,* Report NUREG-0382, U.S. Nuclear Regulatory Commission, 1977.

Horizontal ground acceleration, with respect to natural gravity, is a measure of the intensity of seismic disturbances. The maximum acceleration anticipated at the site resulting from recurrence of a New Madrid earthquake would be approximately 25% that of gravity. Such an event could result in severe damage to ordinary structures and light damage to specially designed and built structures (Appendix L, Fig. L.6).

Estimation of recurrence frequency of major earthquakes is based on statistical analysis of historic records. The recurrence interval for severe earthquakes in the New Madrid zone is

estimated to be 666 years by Russ and 1000 years by Nuttli and Herrmann.[5] Five earthquakes of intensity VI or greater affected the Henderson-Owensboro area in the 162-year period between 1812 and 1974. Assuming an even distribution, an intensity VI or greater event would have occurred once every 32 years. The actual intervals between these events range from 4 to 53 years with a mean of one event in 29 years. During the same time period, intervals between earthquakes of intensity V or greater range from a few months to 43 years, with a mean recurrence interval of one event in 12 years.

Engineering properties of alluvium

Results of subsurface investigations and soil testing are summarized graphically in Fig. 3.6.[4] Three general types of alluvial material are present beneath the site: surficial silty clay and silt soils, a variable lens of loose sand, and dense sand with gravelly beds. During field investigations, the penetration resistance of materials in each of these zones was measured. The most significant finding was the low-density, loose sand zone. This wedge, or lens-shaped body of material, is beneath the southern half of the area to be developed in the demonstration phase; its thickness ranges from less than 3 m (10 ft) to approximately 11 m (35 ft). This zone is important because construction of a sound foundation will require preconsolidation of loose materials beneath some plant areas before construction.

Under unconsolidated conditions, this zone is of concern in the foundation because it could cause differential settlement of structures and some restricted zones may be potentially liquefiable under earthquake accelerations of 0.15 g. Differential settlement results from gradual compaction of loose soil materials under load conditions. Liquefaction is failure of saturated soils caused by seismic shaking or other vibration that causes pore pressure to exceed confining pressure resulting in flotation of soil particles. Liquefaction results in loss of soil-bearing capacity, and in extreme cases, the soil may flow as a viscous liquid. Assessment of the potential for liquefaction of site soils is included in the geotechnical report of ATEC Associates of Kentucky, portions of which are included in Appendix L.

Mineral resources

Mineral resources of the area are coal, petroleum, sand, and gravel. Table 3.2 is a list of coal seams that occur in the stratigraphic interval underlying the site. Test borings indicate no significant thicknesses of these seams at the site; however, drilling records from gas and oil wells in the general area report coal at depth. Coal has been mined in the Bon Harbor Hills to the east and in the hills south of the Green River valley. Any coal that underlies the site is below the water table, making mining by existing methods infeasible.

Table 3.2. Coal seams of the local area

Seam	Thickness
No. 13	Less than 30 cm (12 in.)
No. 12	Thin to locally absent
No. 11	58 to 96 cm (23 to 38 in.)
No. 9	92 to 155 cm (36 to 60 in.)

Source: W. G. Johnson, *Geologic Map of the Reed Quadrangle, Kentucky-Indiana*, U.S. Geological Survey, 1972.

Seven small oil fields have been discovered and developed in the local area. Oil production for 1978 was 403,388 bbl for Daviess County and 715,783 bbl for Henderson County (Appendix L). Production figures for natural gas are not available. Twelve exploratory wells drilled on the site were dry, and it is assumed that no petroleum reserves exist beneath the site. Several producing wells are located east of the site across Martin Creek. Appendix L contains additional information on local petroleum production.

No sand or gravel has been mined from the site, although reserves of potentially mineable sand underlie the site. Sand and gravel have been produced by dredging along the Ohio River.

Soils

Surficial soils on the site are silty loams predominantly belonging to the Elk-Otwell-Ginat Association. Typically, soils are level to gently sloping, deep, well drained to poorly drained, medium-textured, and slightly acidic.[2] These soils formed on the thick sand and gravel alluvial deposits. Terrace soils are thick, with loamy surface horizons well suited for agriculture. Soils on most of the site are classified as prime farmland by the U.S. Soil Conservation

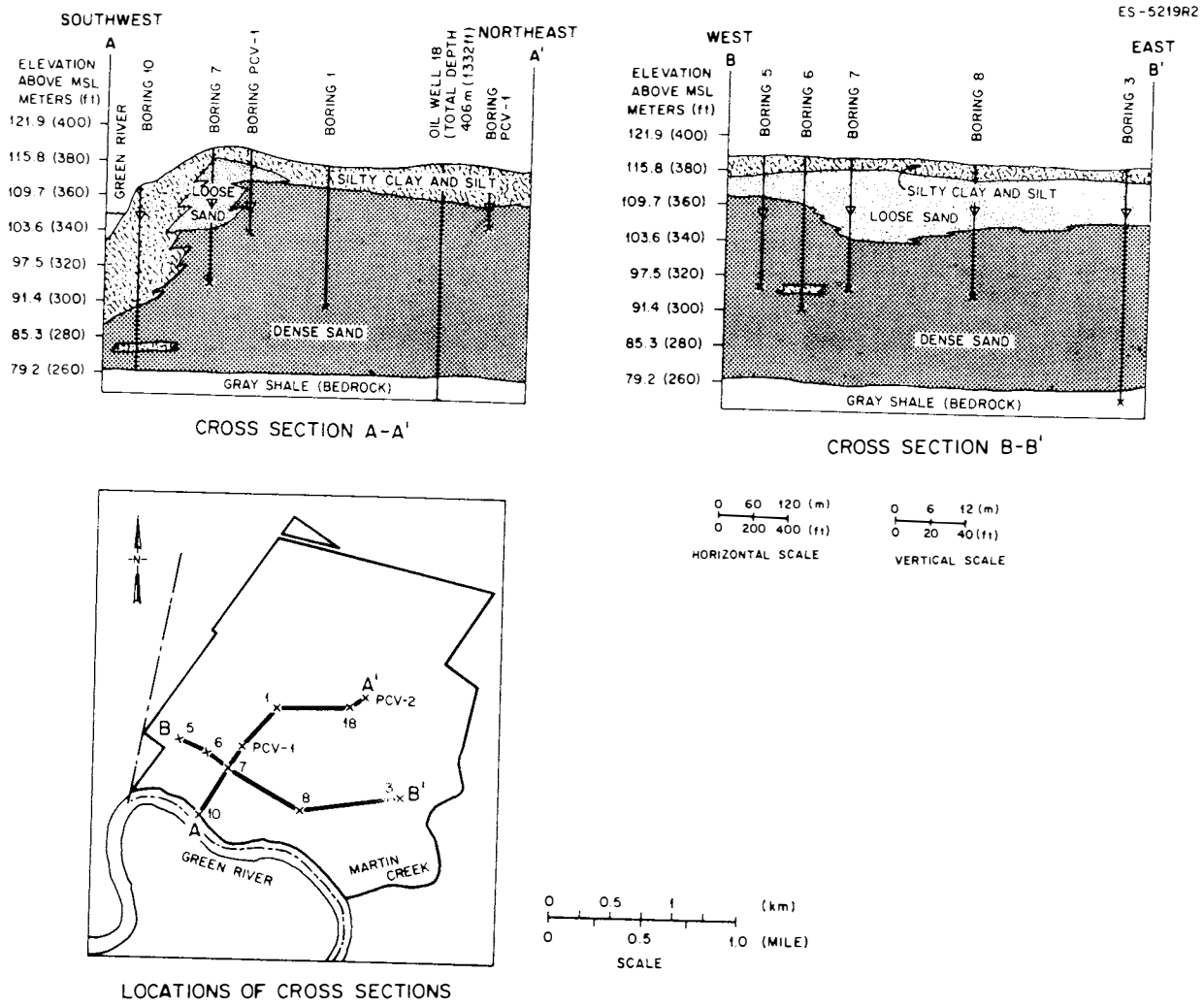


Fig. 3.6. Generalized cross sections on the site. Source: ATEC Associates, *Preliminary Geotechnical Engineering Study, 2000 TPD Solvent Refined Coal Facility*, prepared for Wheelabrator Cleanfuel Corporation and Kentucky Center for Research, 1977.

Service.[2] Figure 3.7 shows the distribution of prime agricultural soils on the site. Additional information about soils is included in Appendix L.

3.2.1.3 Vegetation and wildlife

Vegetation

Before European settlement, the site area was covered by a mixed-mesophytic hardwood forest in which oak, hickory, tulip tree, maple, American beech, and sweet gum were common. Through time, logging and clearing for agriculture gradually reduced the original forest, except in areas maintained for timber production and unsuited for croplands, such as areas of steep relief, poor soil, impeded drainage, seasonal flooding, or poor accessibility. Western Daviess County has extensive alluvial swamps, especially along the lower reaches of the Green and Ohio rivers.[6] Elements of both the oak-hickory forest and the southern floodplain forest are present.[7]

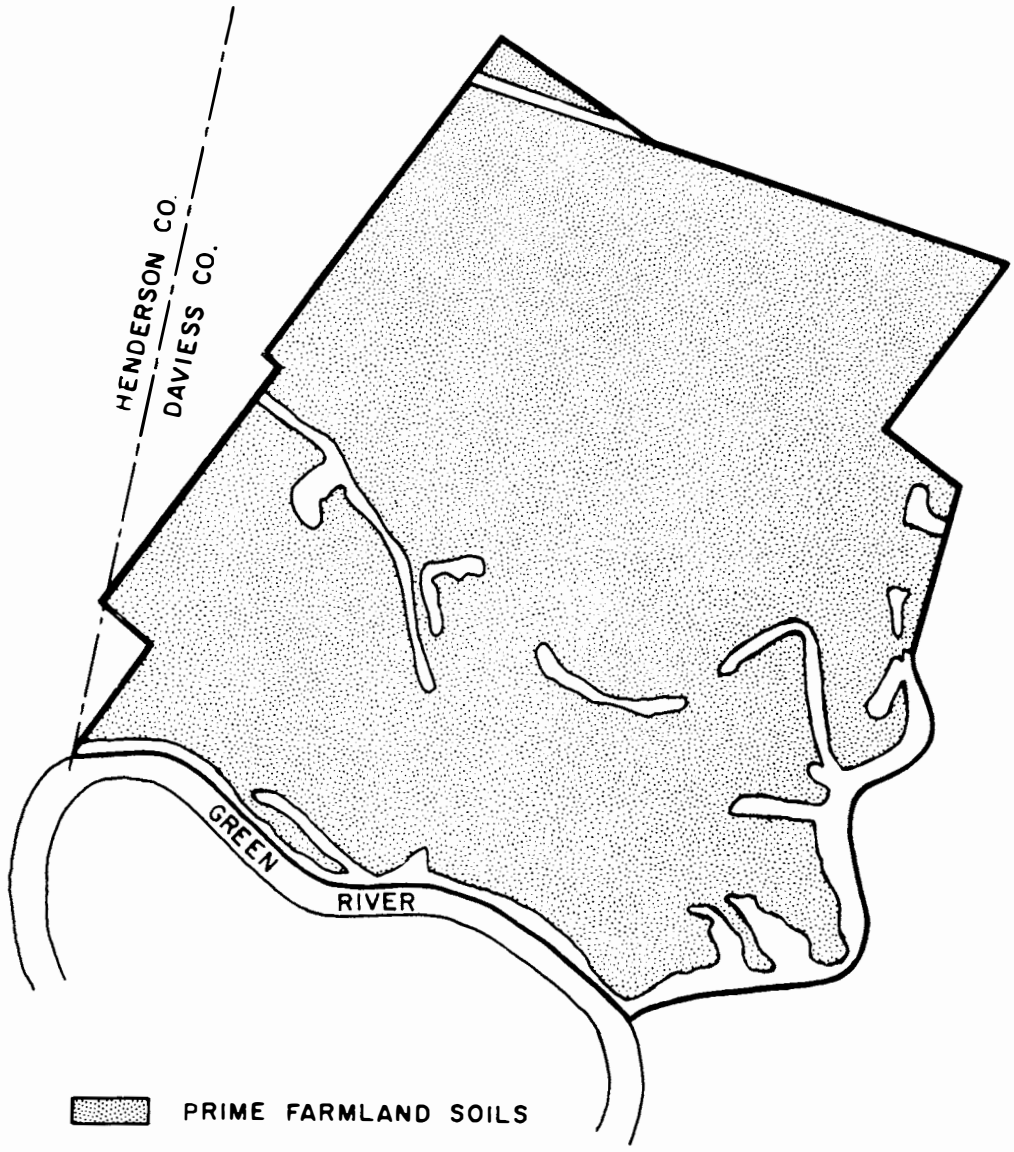


Fig. 3.7. Distribution of prime farmland soils in the site.

Original forests on the site have been largely cleared for agriculture. Existing vegetation and cover types on the site are shown in Figs. 3.2 and 3.3 and acreages of each in Table 3.3.

The riparian forest along the Green River, which is seasonally flooded, is dominated by silver maple and sugarberry, with more minor amounts of pignut hickory, white ash, sycamore, sugar maple, and shagbark hickory. The total of 32 species of overstory trees recorded in this forest indicates very high diversity. Thirty-one species of ground-cover plants (mostly herbaceous with a few woody seedlings) were recorded in this forest.

The bottomland forest along Martin Creek is dominated by silver maple and sweet gum. Other abundant tree species (in order of decreasing importance) are shagbark hickory, red oak, mocker-

Table 3.3. Vegetation and cover types on the proposed site

Cover type	Hectares	Acres	Percentage
Cropland, soybeans and tobacco (1969)	511	1263	85.2
Pastureland, tame and fallow	26	64	4.3
Woodlots	10	25	1.6
Riparian forest, Green River	15	37	2.5
Bottomland hardwoods, Martin Creek	15	37	2.5
Fencerow	7	17	1.2
Ponds	<1	<2.5	<0.2
Residential and roads	15	37	2.5
Total	600	1482	100.0

nut hickory, river birch, pignut hickory, and black walnut. This forest is also highly diverse; a total of 30 species of trees were recorded, including a few cypress trees. Thirty-two species of ground-cover plants were recorded in this forest.

About 2 km west of the proposed site is a 256-ha bottomland hardwood forest designated as Richland Slough. Because of the highly developed overstory and abundance of mast-producing trees, this area represents a rich biotic resource and high-quality wildlife habitat. Bryant Ditch, which drains the western portion of the site, makes up about one percent of the slough's total watershed (Sect. 4.2.2.1).

Wildlife

Many mammal species present on site are those that tolerate or prefer agricultural or other disturbed habitat. Reduction of native wildlife habitats due to logging, grazing, and intensive agricultural practices is for the most part responsible for the relatively low diversity and abundance of wildlife at the site. Sixteen species of mammals, including six rodent, five furbearing, and five game species, were observed during 1977-1978 field investigations. Twenty-three additional species range over the site.[8]

Small rodents (shrews, mice, and moles) and some furbearers (oppossum and skunk) occur in all the habitat types on the site. The chipmunk (rodent), gray fox and raccoon (furbearers), and squirrels and deer (game species) occur in wooded habitat. The cottontail rabbit, woodchuck, and red fox occur in fields, fencerows, and open habitat. Available habitat appears to be the chief limiting factor for most furbearers and other mammals on the site.

The swamp rabbit, a species that has declined significantly as a result of loss of floodplain forests primarily to agriculture, was not observed on the site. However, it probably occurs in bottomland forests in the area. On the site, the narrow strip of forest on the banks of the Green River does not provide suitable habitat for swamp rabbits, whereas the forest along Martin Creek appears to be more suitable.

The only big game species found in the vicinity is the white-tailed deer, which is not common (D. Mosely, Kentucky Department of Fish and Wildlife, personal communication, October 1977). A few deer move through the site along the riparian and bottomland hardwood habitats. Available habitat is too restricted to permanently support many deer.

Habitats in the site area provide cover, feeding, roosting, and nesting sites for many species of birds. During field studies, 106 species were observed, of which 38 are permanent residents, 33 are summer residents, 21 are transients, and 14 are winter residents. The riparian and bottomland hardwood habitats generally support the greatest abundance and diversity of birds. The site's pastures and croplands are extensively used by large numbers of starlings, grackles, blackbirds, crows, and cowbirds in late summer and fall but are poor habitat for most wildlife species.

Bobwhite and mourning dove are the only upland game birds of the site area. Doves are common, but quail are uncommon because of lack of suitable habitat.

At the site itself, habitat for waterfowl is very limited. The area along Martin Creek provides some nesting habitat for wood ducks, and a few ducks use the Green River and the small ponds on the site. Two waterfowl areas are located near the site, the Sloughs Wildlife Management Area (SWMA), 2 km south-southwest of the site, and the Richland Slough, 1 to 2 km west of the site. The SWMA is a 75-ha (185-acre) unit managed for waterfowl by the State of Kentucky. Waterfowl use this area primarily during flooding in the late winter and early spring. The area is open to public hunting in accordance with statewide regulations (B. Burnley, Kentucky Department of Fish and Wildlife Resources, personal communication, December 1, 1980). The Richland Slough is a privately owned wetland area. Both areas are used by several species of migrating and overwintering ducks, and probably support breeding populations of wood ducks.

Although 69 species of amphibians and reptiles (herptiles) have ranges that encompass the site,[9] only 10 species (4 amphibians and 6 reptiles) were observed at the site during field surveys. Three small ponds on the site provide good habitat for several herptile species.

Threatened and endangered species

The U.S. Fish and Wildlife Service (USFWS) was contacted by DOE (see Appendix I for the correspondence) about Federally protected fauna and flora in accordance with the Endangered Species Act of 1973 (PL85-624, 1958; 16 U.S.C. 661-666) and indicated that the Indiana bat might occur on the site. Subsequent surveys found the Indiana bat in the riparian forest along Martin Creek but not along the Green River. (See Appendix K for Biological Assessment and Appendix I for the Biological Opinion of the USFWS.) No breeding colony of Indiana bats was found, although a colony could have been present.

One other mammal species and two bird species might occur on the site: the gray bat, the bald eagle, and the Arctic peregrine falcon.[10] The range of the gray bat includes Kentucky, but it hibernates and breeds in caves. Therefore, it is unlikely to occur on the site because there are no caves and it was not found during bat surveys in forests along Martin Creek and the Green River and at two onsite ponds. The eagle and falcon would be expected only as extremely infrequent visitors to the site.

No species of plants having Federal status as threatened or endangered were observed at the site; and no plant species on the Federal list[10] are reported in Kentucky.[11] The Kentucky Nature Preserves Commission is currently examining its files to see if any threatened, endangered, or rare species occur on or near the proposed site (D. Harker, Kentucky Nature Preserves Commission, personal communication, December 1, 1980).

Several species of wildlife currently on the Audubon "Blue List"* were commonly observed at the site.[12] These included the marsh hawk, American kestrel, eastern bluebird, red-headed woodpecker, yellow-billed cuckoo, loggerhead shrike, and yellow warbler. The red-headed woodpecker was commonly observed in the onsite forests during all seasons of the year. The kestrel was observed in openland habitats during all seasons. The remaining species were common during at least one season.

3.2.2 Water

This section presents information about the proposed site in the areas of surface water hydrology, groundwater quality and hydrology, and surface water quality and aquatic ecology.

3.2.2.1 Surface water hydrology

The site is located on the combined alluvial plain of the Ohio and Green rivers on the north bank of the Green River. Normal pool elevation of the Green River in this stretch is 107.4 m (349 ft) as controlled by Lock and Dam No. 1 located about 16 km (10 miles) downstream. Channel depth at the site is about 3 m (9 ft), and its width is about 61 m (200 ft). Regulated river flow below Lock No. 2 at Calhoun, about 69 km (43 miles) upstream from the site, is 11.3 m^3/s (400 cfs) (B. Layman, U.S. Corps of Engineers, Louisville District, personal comunication,

*The "Blue List" lists bird species whose populations have experienced significant decline in recent years and that may become threatened with extinction if the decline continues.

1977). Estimated 7-d, ten-year low flow of the Green River at its confluence with the Ohio River is about 11.2 m^3/s (394 cfs).[13] The maximum discharge recorded at the Calhoun gage was 5890.6 m^3/s (208,000 cfs) on January 27, 1937, which is the flood of record for the Green River.[14] A flood in 1898 may have exceeded this discharge, but no accurate records are available.

Evaluation of site flooding potential due to floods of 100-year frequency and greater requires consideration of flood elevations of the Ohio and Green rivers because their floodplains coalesce at the site. Site flooding can be caused both by independent or simultaneous flooding of the two rivers. Floodway modeling indicates that the elevations of the 100-year flood on the Green River alone would be 116.62 m (382.5 ft). The 100-year flood level resulting from combined flooding of the Green and Ohio Rivers would be 117.38 m (385 ft). Appendix E contains a description of the modeling and results. Figure 3.8 shows the extent of flooding of the proposed site in the event of a 100-year frequency flood; under existing conditions, approximately half of the site would be inundated. Figure 3.9 shows the extent of flooding in the event of a 500-year flood.

Site drainage is depicted in Fig. 3.10. Cultivation and man-made structures have altered surface drainage patterns on the site. Surface water from the eastern third of the site drains toward Martin Creek on the site's eastern boundary. Martin Creek then flows directly to the river. The northwestern portion of the site drains to Bryant Ditch, a man-made channel maintained by draglining. Both intermittent creeks are usually dry during summer and fall. Bryant Ditch drains to Richland Slough to the west of the site. The slough then drains to the Green River. The southern portion of the site drains directly to the Green River. There are also six small ponds on the site, each less than 0.3 ha (1 acre). The site drainage will be altered by construction activities. However, until site grading plans are completed, an accurate drainage pattern cannot be specified.

3.2.2.2 Groundwater hydrology and quality

Hydrology

Alluvial sands and gravels beneath the site contain a valuable aquifer which is widely developed in the region as a potable water supply and which supplies water to local residents through domestic wells. The alluvium is a combined deposit of sediment from the Ohio and Green rivers, and the alluvial aquifer is in hydrologic connection with both rivers where channel bank and bed deposits are permeable. Recharge to the aquifer is provided primarily by infiltration of river water and secondarily by precipitation infiltration. Two piezometers were installed and read by ATEC Associates to determine groundwater levels beneath the site during September and October 1977. Water table elevations are being monitored by Dames and Moore on a continuing basis using eight additional piezometers that were installed in April 1980. Monitoring results for the period beginning April 1980 through February 1981 indicate that groundwater elevations at the center of the site are consistently higher than those near the Green River. Contours drawn on the piezometric surface are useful in interpreting the direction of groundwater flow. Piezometric surface maps have been drawn for each monitoring date. Figure 3.10 is a conceptual drawing showing the general directions of groundwater movement beneath the site, based on monitoring data available in April 1981. The arrows on Fig. 3.10 suggest that groundwater beneath the central part of the site moves to the south and southeast to discharge into the Green River on the eastern lobe of the meander or near the mouth of Martin Creek.

Hydrographs have been plotted for each of the ten piezometers and for the Green River to detect possible interaction between the groundwater level and river stage. The hydrographs showed that the piezometers nearest to the river did respond to high river levels during November 1980 and February 1981. The area in which groundwater response to river level fluctuations were observed is shown on Fig. 3.10, and an area of probable interaction between the river and the alluvial aquifer is indicated. It is expected that prolonged flooding of the Green River would result in increased groundwater levels beneath at least the southern half of the site, if not all of the site.

The direction of groundwater flow beneath the southwestern corner of the site cannot be determined from the available information. Additional piezometers are proposed to gather the missing data in this area before construction begins. Permeability of the alluvial sands is moderate to high, estimated to be about 15 m/d (367 gpd/ft^2) based on grain size analyses performed by ATEC. Aquifer transmissivity is estimated to be about 452 m^2/d (36,700 gpd/ft). Combined information from the bedrock topography map (Appendix L, Fig. L.3), boring logs from onsite investigations,[5] and water table measurements indicate that the saturated thickness of alluvium is 31 m (100 ft) or more.

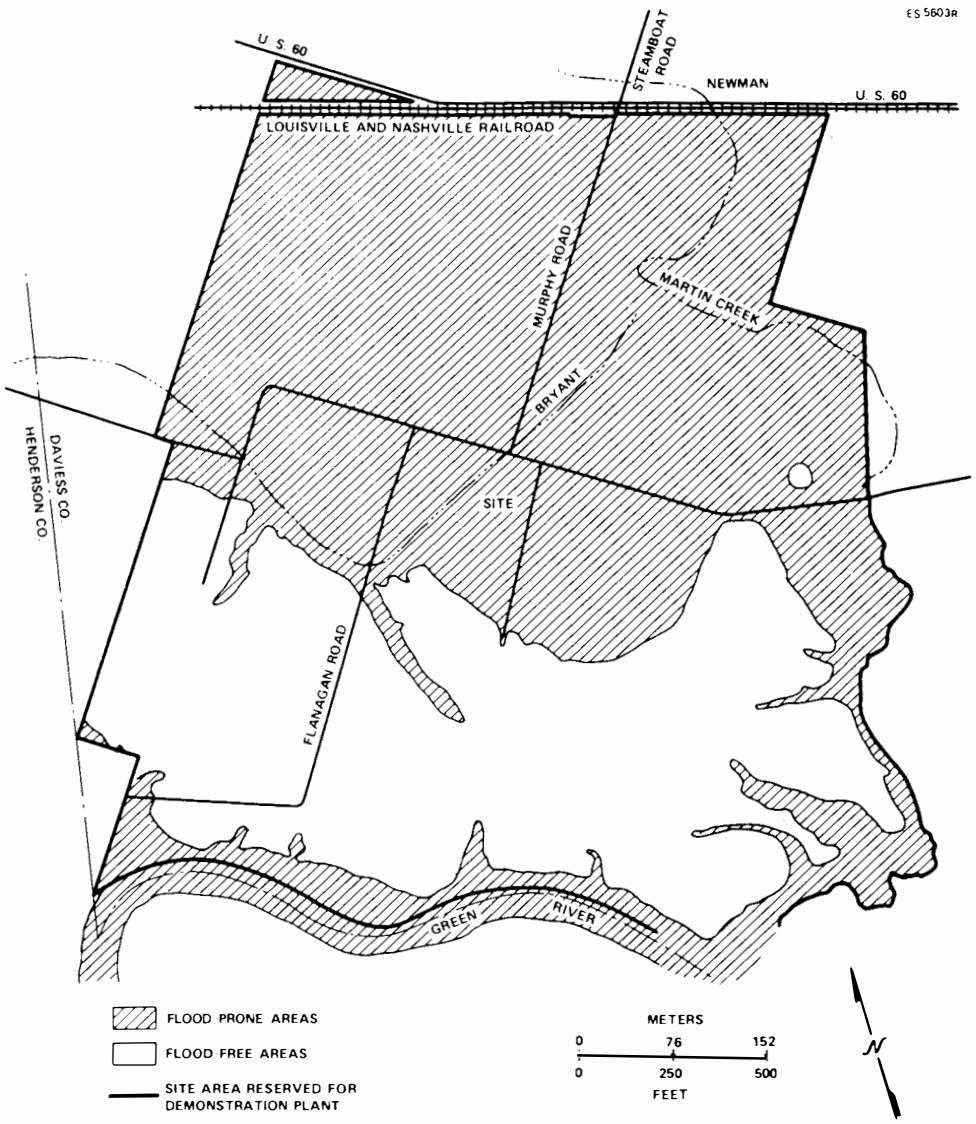


Fig. 3.8. Limits of approximate 100-year flooding on the site. Source: Data from calculations of N. M. Whittle, U.S. Army Corps of Engineers, Louisville District, personal communication, April 2, 1980.

Bedrock beneath the site also contains sandy zones that may yield small amounts of water. However, the saline/fresh water interface (1000 mg/liter total dissolved solids) occurs at a depth of about 58 m (188 ft) below the surface,[15] and waters produced below this depth would probably be too heavily mineralized for consumption. The residential areas shown in Fig. 3.3 use groundwater, by way of individual wells, as the principal source of water.

Water quality

Groundwater sampling and analyses have been carried out as part of the baseline environmental monitoring. Table 3.4 is a summary of groundwater quality on site. Tabulations of water quality analyses are included in Appendix N.

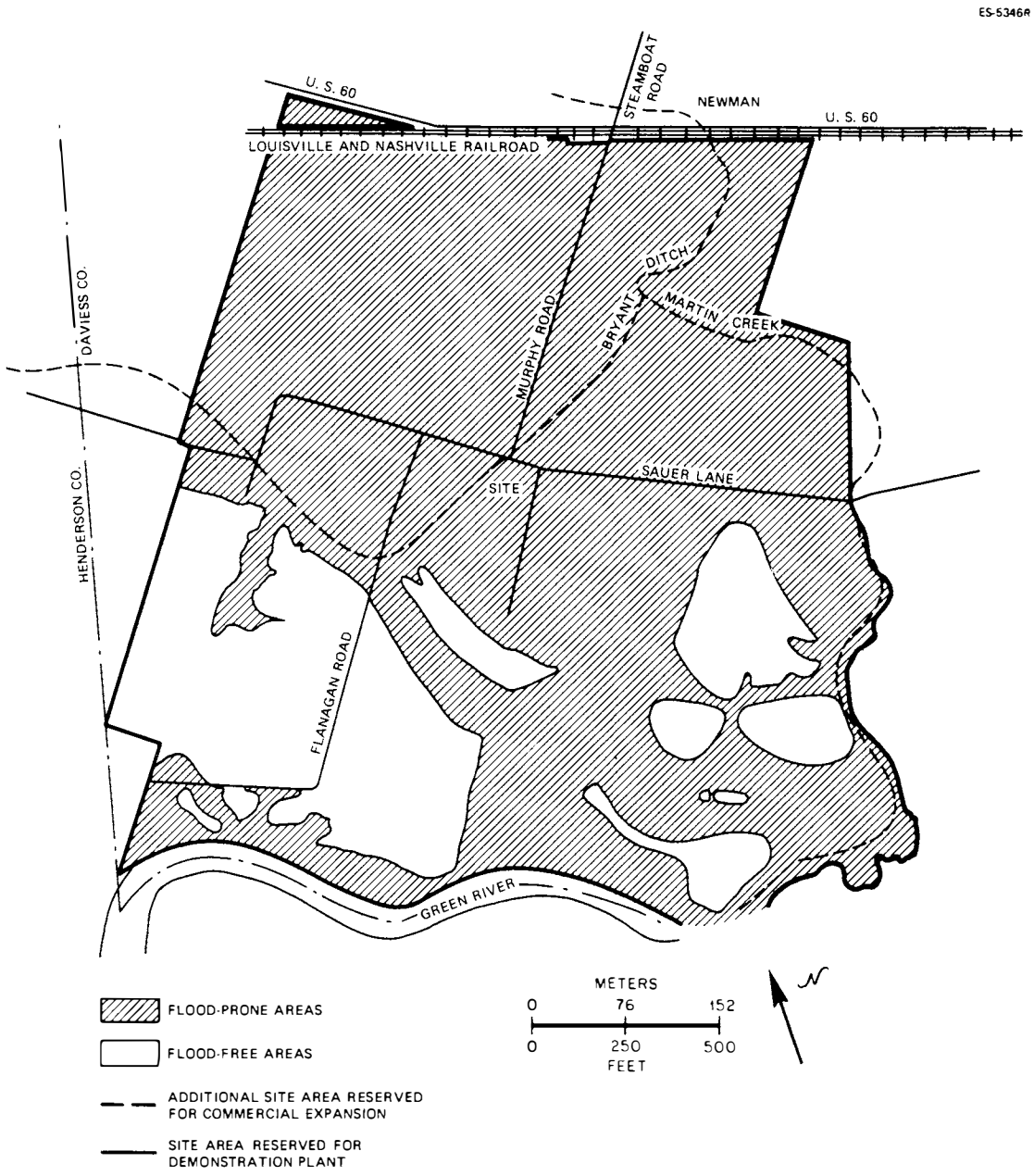


Fig. 3.9. Limits of an approximate 500-year flood on the proposed Newman site.

Water from the alluvial aquifer is a calcium-, sodium-, magnesium-bicarbonate-type. The water is hard to very hard, contains high total dissolved solids, and ranges from slightly acidic to alkaline. Mean values of the measured parameters are in compliance with EPA's *Primary and Proposed Secondary Drinking Water Regulations* with the exception of manganese, which is present at about twice the recommended concentrations for the secondary regulations. Individual measurements of lead, manganese, mercury, and selenium were in excess of recommended concentrations on at least one occasion.

ES-5740

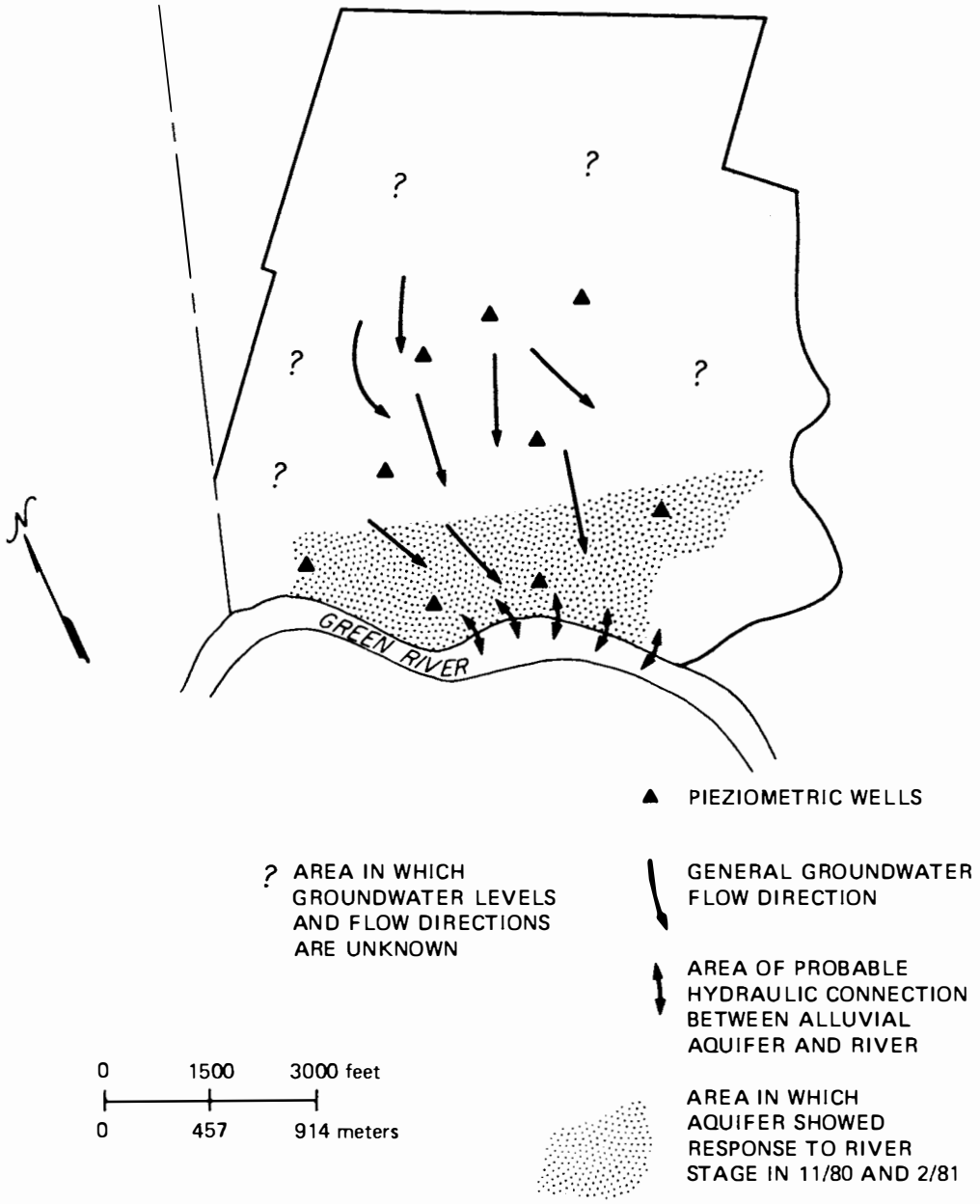


Fig. 3.10. Groundwater hydrologic setting.

Table 3.4. Summary of significant onsite water quality analyses, 1977 and 1979[a]

Parameter	Drinking water standards		Maximum value	Minimum value	Mean	Standard deviation	Number of samples[d]
	USEPA[b]	Kentucky[c]					
Alkalinity			321	102	265	78	10
Arsenic	0.05		0.012	<0.002	0.0057	0.0034	20
Barium	1.0	1.0	0.31	0.07	0.17	0.08	10
Boron			1.49	<0.001	0.54	0.563	20
Cadmium	0.01		0.0069	0.0005	0.0019	0.0015	20
Calcium			80	20	60	22	10
Chloride	250	250	36	0	8.6	14	10
Chromium, total	0.05	0.05	0.0051	<0.0010	0.0016	0.0010	20
Copper		1.0					
Fluoride	1.4–2.4	1.0	1.78[e]	0.26	0.57	0.45	10
Hardness, total			368	142	297	72	10
Iron, soluble	0.3		0.233	0.014	0.024	0.069	20
Lead	0.05	0.05	0.344[e]	<0.001	0.038	0.077	20
Magnesium			38	7.5	32	10	10
Manganese	0.05	0.05	0.335[e]	0.001	0.096[e]	0.106[e]	20
Mercury	0.002	0.002	0.0036[e]	<0.0001	0.0013	0.0027	20
Nitrate, as N	10	10	8.6	0.3	4.4	5.6	10
pH (units)	6.5–8.5		7.78	6.89	7.4	0.25	10
Selenium	0.01	0.01	0.0194[e]	<0.0005	0.005	0.005	20
Silver	0.05	0.05	0.0037	0.0003	0.0014	0.0010	10
Sodium			59	16	32	14	10
Sulfate	250	250	60	20	43	12	10
Total dissolved solids	500	750[f]	484	162	384	88	10
Zinc		5.0					

[a] Data from ER, Appendix F, Tables F.3, F.4, and F.5, values in mg/liter unless otherwise noted.
[b] Environmental Protection Agency primary and proposed secondary standards.
[c] Kentucky standards for domestic water supplies.
[d] Samples taken from 11 wells (Nos. 1 through 10 and No. 23 on Fig. F.3 in ER, Appendix F.)
[e] Value exceeding standard.
[f] Not to exceed 500 mg/liter monthly average or 750 mg/liter maximum.

Bedrock underlying the site consists of interbedded shales and sandstones. The elevation of the top of the bedrock is approximately 80 m (260 ft), and shale was encountered in the three test borings into the bedrock. The saline/fresh water interface occurs at about elevation 61 m (200 ft).[15] It is improbable that a potable water source could be developed from these bedrock aquifers without treatment to reduce salinity.

3.2.2.3 Surface water quality and aquatic ecology

Surface water quality

Bodies of water that may be affected by the construction and operation of the proposed SRC-I facility are the Green River and onsite or near-the-site locations, including Martin Creek, Bryant Ditch, six onsite ponds, and Richland Slough. With the exception of Richland Slough and part of Bryant Ditch in Henderson County, these bodies of water are located in Daviess County, Kentucky.

Green River. The drainage basin of the Green River has been described in Sect. 3.2.2.1. The Commonwealth of Kentucky classifies the river for multiple uses, including public use, warmwater habitat for aquatic life, and recreation. The Green's main stem, the water source for the proposed project, falls under the jurisdiction of water quality standards formulated by the State of Kentucky (402 KAR Part 5:031, effective December 1979). Applicable usage standards are summarized in Appendix H, Table H.1. Also included in this table are regional (developed by the

Ohio River Valley Water Sanitation Commission as uniform criteria for the Ohio's main stem)[16] and Federal (developed by EPA) water quality criteria.

The Green River is generally considered to have good water quality.[16] The river's main stem from its mouth to the Green River Dam at mile point 304.7 has been classified as "effluent limited" with respect to conventional pollutants.[13] "Effluent-limited segments" are those in which the application of effluent limitations (best practicable technology for industry and secondary treatment for publicly owned works) will allegedly result in the achievement of desired water quality standards. For toxic pollutants, EPA may require more stringent effluent limitations and treatment requirements than those defined as best practicable technology.

This river system receives a wide variety of point and nonpoint source pollution, including municipal and domestic sewage effluents, industrial discharges from manufacturing and processing, sediment, runoff from agricultural and animal husbandry practices, and mining and oil production wastes.[17] In the reaches of the Green River upstream from the proposed SRC-I facility, the majority of wastewater entering the river is cooling water from the Robert Reid Power Station northeast of Sebree, Kentucky (mile point 41.2). The most serious water quality problems result from nonpoint sources. Pond River and Pond Creek, which enter the Green at mile points 55.1 and 97.3, respectively, are streams containing large amounts of dissolved and suspended materials. Characteristic mine drainage and high-sediment load in these tributaries are the result of pollution from strip mining in McLean, Ohio, and Muhlenberg counties. More than half of the Green's annual sediment load of 16,323,000 t is estimated to come from these mining operations.[18] Heavy sediment loads, coupled with continual barge traffic, have produced severe turbidity in the river.

The proposed SRC-I facility will be located on the Green River, about 30 km (19 river miles) upstream from its confluence with the Ohio. River water will be used for the plant's cooling and process units and will serve to transport and assimilate the plant's treated wastes when discharge occurs. Recent water quality data are available for the Green River from the Ohio River Valley Water Sanitation Commission (ORSANCO) monitoring station at Sebree, Kentucky (mile point 41.3), and from the U.S. Geological Survey station at Beech Grove, Kentucky (mile point 49.1). In addition, USGS historical data are available from Lock and Dam No. 1 at Spottsville, Kentucky (mile point 9.1), and Lock and Dam No. 2 at Calhoun, Kentucky (mile point 63.1). Selected summaries of these data are presented in Appendix H. Water quality of the river immediately adjacent to the projected site was characterized by a site-specific baseline monitoring program conducted from 1977 through 1979. Sampling locations, shown in Fig. 3.11, were chosen to characterize the river upstream of the proposed plant site (No. 1, mile point 20), below the projected plant effluent discharge (No. 2, mile point 18.6), and far enough downstream from the discharge to be in an area of total mixing (No. 3, mile point 17).

Site-specific data, summarized in Table 3.5, agreed favorably with previous data generated in studies of the Green River. River waters were sufficiently oxygenated, neutral, turbid, and moderately hard to hard, with a considerable part of the hardness attributable to noncarbonate sources. Biochemical oxygen demand (BOD) values were within the expected range for natural river systems. Nutrient concentrations (nitrogen and phosphorus), although not excessively high, were sufficient to support algal blooms. Water quality of the Green was generally acceptable; however, concentrations of some chemicals were often higher than recommended. Water quality standards that were violated in selected reaches of the river are summarized in Table 3.6. Site-specific data and those collected at other locations indicated that the river contained levels of iron, manganese, and occasionally lead that would be considered unacceptably high for domestic water supplies. Concentrations of copper have consistently exceeded Kentucky water quality standards for protection of aquatic life. Levels of silver and mercury have intermittently exceeded these standards; levels of zinc, phenol, cyanide, and cadmium have occasionally exceeded the standards (Table 3.6). Historical data from Lock and Dam No. 2 have also indicated that water temperatures occasionally exceed the 31.7°C specified in the Kentucky standards.[19]

Water samples collected in the reaches of the Green River adjacent to the proposed plant site were analyzed for levels of 16 individual polynuclear aromatic (PNA) compounds. Background concentrations of these compounds are of interest because of their potential for emission during the operational phase of coal conversion processes. No PNA compounds were detected in these samples.

Bottom sediment samples, collected in the Green River at locations shown in Fig. 3.11, were analyzed for both inorganic and organic chemical constituents; results are summarized in Table

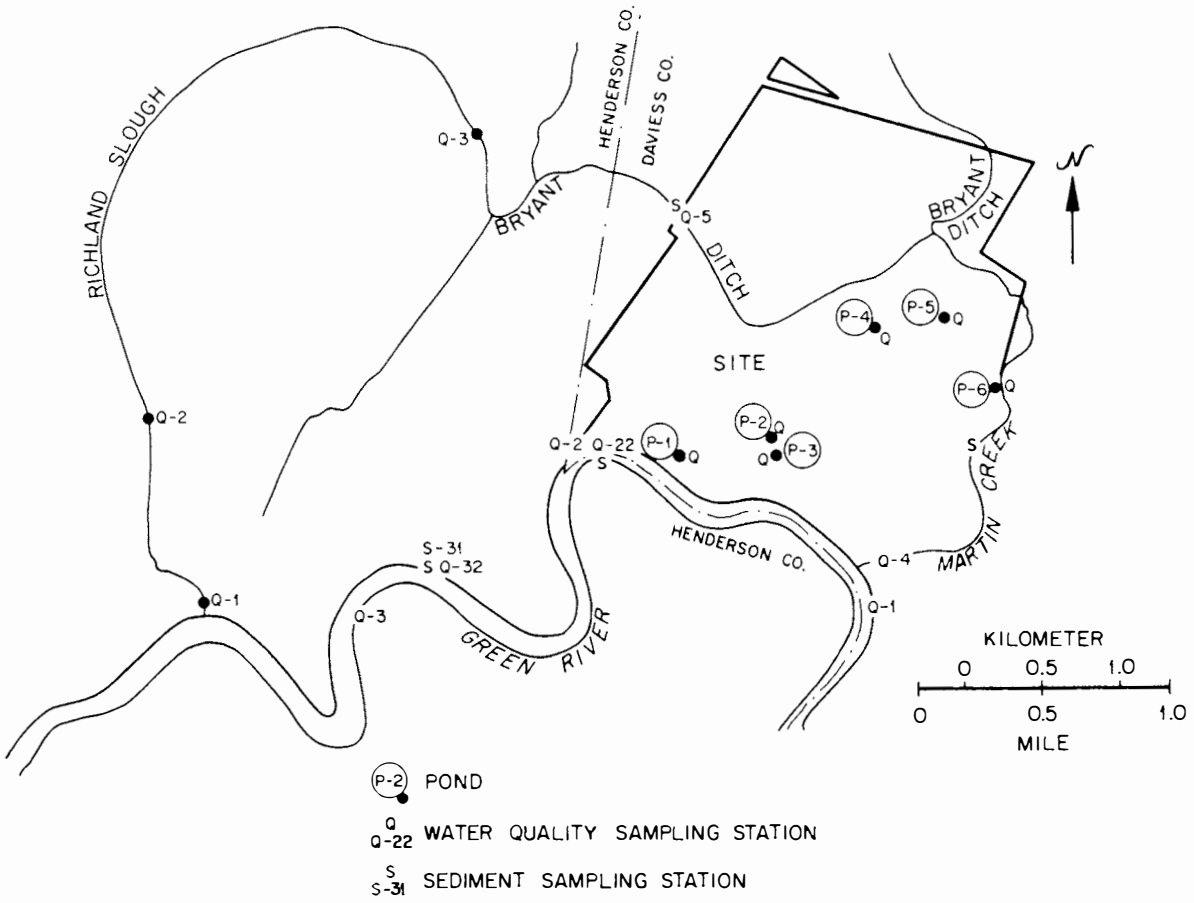


Fig. 3.11. Surface water quality and sediment sampling locations on or near the proposed SRC-I site. Source: ER, Appendix E, Part I, Figs. E.4 and E.5.

3.7. Natural metal concentrations in sediments are dependent upon the type of geologic parent material in the drainage basin. Near the SRC-I site, the surficial parent material is composed primarily of limestone, shale, and coal deposits. Concentrations of trace elements in these materials are presented in Appendix H. With the exception of boron and cadmium, the average concentrations of trace elements in Green River sediments (Table 3.7) are within the ranges of the trace elements contained in the parent materials. Anthropogenic activities or localized differences in parent material composition may account for the enrichment of the sediments with boron and cadmium. Although PNA compounds were not detected in the water column, they could be quantified in the river sediments. These compounds are insoluble and, once adsorbed to particulate materials, may settle out and become concentrated in the sediments. When compared with benzpyrene concentrations in various marine sediments,[20] most individual PNA compounds appeared to be present in relatively low concentrations (Table 3.7). However, one sediment sample was particularly enriched with benzo(a)anthracene (4.78 mg/kg dry weight). Because this compound was not detected in other samples, its occurrence in the sediment may be highly localized. Few comparisons can be made because of the paucity of literature on PNA concentrations in sediment. Concentrations of benzpyrene as high as 15 mg/kg dry weight have been detected in sediments collected on the French Channel coast.[20]

Onsite or near-the-site bodies of water. During the site-specific baseline monitoring program, water and sediment samples were collected in Martin Creek and Bryant Ditch at the locations

Table 3.5. Summary of the water quality data collected during baseline monitoring of the Green River and onsite streams

Water quality parameters[a]		Location of sampling station and date of sampling		
		Green River, Stations Q-1, Q-2, and Q-3 1977–1979	Martin Creek, Station Q-4 1977–1978	Bryant Ditch, Station Q-5 1978
Dissolved oxygen	Average[b]	8.6		
	Range	4.6–11.8	7.5; 11.2	9.3; 11.0
Temperature, °C[c]	Average	15.9		
	Range	4.8–26.5	0.8; 16.5	1.0; 16.0
pH	Average	7.0	6.8	
	Range	5.9–7.8	6.3–7.3	6.6; 8.3
Total dissolved solids	Average	213	164	
	Range	157–300	47–292	90; 168
Total suspended solids	Average	48	19	
	Range	12–108	12–30	19; 111
Total alkalinity, as $CaCO_3$	Average	80	53	
	Range	63–102	14–77	13; 67
Total hardness, as $CaCO_3$	Average	131	94	
	Range	98–180	43–178	41; 131
Sodium	Average	5.5	5.3	
	Range	0.7–11.3	2.7–10.5	1.8; 3.7
Chloride	Average	10.6	14.2	
	Range	6.4–21.3	3.2–29.5	3.2; 3.5
Sulfate	Average	59		
	Range	25–125	8.0; 120	10; 28
Biochemical oxygen demand, 5-day	Average	2.0	2.0	
	Range	1.0–4.0	1.0–3.0	2.0; 5.0
Cyanide	Range	<0.002–0.002	<0.002	<0.002
Phenol	Range	<0.005–<0.01	<0.005; <0.01	<0.01
Nutrients				
Ammonia	Average	0.20	0.13	
	Range	0.09–0.59	0.10–0.21	0.07; 0.40
Nitrate	Average	1.10	0.96	
	Range	0.62–1.68	0.23–1.7	0.25; 4.2
Phosphorus	Average	0.09	0.08	
	Range	0.05–0.16	0.05–0.13	0.05; 0.18
Trace elements, (μg/liter)				
Arsenic	Range	<0.4–4.0	<0.4–8.0	<1.0; 4.0
Barium	Average	53	69	
	Range	20–88	19–109	15; 55
Cadmium	Average	1.6	1.5	
	Range	1.0–2.6	1.0–1.8	1.2; 2.0
Chromium, total	Average	4.8	41	
	Range	2.1–10	3.0–113	2.7; 3.4
Iron, dissolved	Average	143	221	
	Range	62–258	70–339	130; 272
Lead	Range	<1.0–7.1	<1.0–18	<1.0; 7.4
Manganese	Average	231	392	
	Range	89–475	76–639	100; 124
Mercury	Range	<0.1–3.3	<0.1–1.3	<0.1; 7.5
Selenium	Range	<1.0–6.1	<0.5–2.0	0.25; 7.5
Silver	Average	0.78	0.5	
	Range	0.04–3.2	0.04–1.0	0.02; 0.79

[a] Presented as mg/liter unless otherwise specified.

[b] No averages computed for parameters for which some of the data consisted of approximate (e.g., < or >) values or when only two samples were taken.

[c] Values may be somewhat misleading because sampling was not conducted during all seasons of a year.

Source: Data compiled from ER, Appendix E, Tables E-6, E-7, E-8, E-9, and E-10.

Table. 3.6. Summary of water quality standards violated in selected reaches of the Green River

Location of sampling station	Date of sampling	Chemical constituent	Number of samplings	Standards violated[a]		
				Number of times	Percentage of total	Concentration range
Sebree, Ky.[b] Green River, MP 41.3	1977–1980	Copper	26	25	96	2–70 μg/liter
		Iron	33	30	91	0.09–18.0 mg/liter
		Lead	38	9	24	7–140 μg/liter
		Manganese	17	17	100	0.110–0.720 mg/liter
		Mercury	35	3[c]	9	0.1–23 μg/liter
		Phenol	41	2[c]	5	<0.2–16 μg/liter
		Zinc	39	3	8	8–260 μg/liter
Proposed SRC-I site near Newman, Ky.[d] Green River, MP 16.7–20	1977–1979	Iron (dissolved)	9	Uncertain[e]		0.6–0.26 mg/liter
		Manganese	9	9	100	0.089–0.47 mg/liter
		Mercury	8	2[c]	25	1.0–5.0 μg/liter
		pH	9	2	22	5.9;6.3
		Phenol	6	Uncertain[f]		<0.01 mg/liter
		Silver	9	5	56	0.04–3.2 μg/liter
Proposed Syngas site near Baskett, Ky.[g] Green River, MP 1.5	1978–1979	Cadmium	8	2[c]	25	<2–40 μg/liter
		Copper	8	6	75	<2–80 μg/liter
		Cyanide	8	6[c]	75	<0.01–0.2 mg/liter
		Iron	8	8	100	1.65–7.7 mg/liter
		Lead	8	2	25	10–50 μg/liter
		Manganese	8	7	88	0.03–1.0 mg/liter
		Mercury	8	2[c]	25	<0.2–6.9 μg/liter
		Phenol	8	5[c]	63	<0.5–20 μg/liter
		Silver	8	Uncertain[f]		<5–17 μg/liter
		Zinc	8	5	63	0.07–0.26 mg/liter

[a] See Tables H.1 and J.7.

[b] Data are from ORSANCO Quality Monitor, Ohio River Valley Water Sanitation Commission, Cincinnati, for January 1978 through October 1980.

[c] The Kentucky Standards of 2 μg mercury per liter, 12 μg cadmium per liter, 5 μg cyanide per liter, and 5 μg phenol per liter were used, rather than the most stringent Environmental Protection Agency criteria.

[d] Data are from ER, Appendix E, Tables E-6 through E-10.

[e] Dissolved iron rather than total iron was measured; the standard/criterion (0.3 mg/liter) was developed for total iron.

[f] Inadequate analytical sensitivity.

[g] Data are from Environmental Report for Synthesis Gas Demonstration Plant near Baskett, Ky. (W. R. Grace and Co. and DOE), Appendix 4B, Table 4B.4-1.

specified in Fig. 3.11. Data are summarized in Tables 3.5 and 3.7. In general, the concentrations of aqueous chemical constituents in samples collected at these locations were within the ranges reported for the Green River. However, on one occasion, the concentration of chromium in Martin Creek and nitrate in Bryant Ditch exceeded that in the Green River (Table 3.5). The source of chromium in Martin Creek is unknown; however, it is likely that the higher nitrate level in Bryant Ditch reflected the input of agricultural runoff. Two PNA compounds, dibenzothiophene (0.47 μg/liter) and fluoranthene (0.06 μg/liter), were detected in Martin Creek. These compounds may have been contaminants from the oil well operations located in the creek's drainage area. Relatively few PNA compounds were detected in sediment samples collected in Martin Creek and Bryant Ditch (Table 3.7). Their concentrations (0.001 to 0.033 mg/kg) were low in comparison with levels found in coastal marine sediments.[20] Like sediments from the Green River, those from the tributary stations contained iron, manganese, boron, and zinc as the predominant (by weight) inorganic components, suggesting a similarity in the parent materials from which portions of these sediments were derived.

Limited data collected from Richland Slough at locations shown in Fig. 3.11 indicated that the waters were acidic (pH values ranging from 5.4 to 5.8) and contained levels of dissolved oxygen lower than those recorded for the river and tributary stations (3.0 to 6.5 mg/liter).

Samples to determine chemical constituents were not collected from the onsite ponds.

Table 3.7. Summary of analyses performed on sediment collected in 1979 from the Green River and onsite bodies of water

Chemical constituent[a]	Location of sampling station		
	Green River, Stations 31, 32, and 22	Martin Creek, upstream from Station 4	Bryant Ditch Station 5
Inorganic chemicals			
Antimony	9.0	11.8	5.9
Arsenic	0.9	2.6	1.2
Beryllium	1.1	1.5	2.0
Boron	598.1	208.0	134.9
Cadmium	1.1	0.9	1.1
Chromium	21.5	17.5	24.4
Copper	11.8	18.2	15.6
Iron	21,900.0	15,155.0	13,757.5
Lead	8.3	12.7	14.3
Manganese	1,029.2	1,031.0	2,003.5
Mercury	0.051	0.140	0.141
Nickel	19.4	27.2	13.3
Selenium	0.1	0.1	0.1
Vanadium	36.5	42.5	41.1
Zinc	80.9	92.9	55.6
Polynuclear aromatic hydrocarbons (PAH)			
Dibenzothiophene	0.008		
Fluranthene	0.014		
Pyrene	0.025	0.001	0.029
Benzo(c)phenanthrene	0.006		
Diabenzo(a,h)anthracene	0.007		
Chrysene	0.292		
Benzo(a)pyrene	0.002	0.001	0.033
Benzo(b)fluoranthene	0.019		
Dibenzo(a,c)anthracene	0.010		
Benzo(a)anthracene	1.195		
Orthophenylenepyrene	0.009		

[a]Expressed as mg/kg of dry weight. Each value is the average of three or more samples.
Source: Data from ER, Appendix E, Tables E-13, E-14, and E-15.

Aquatic ecology

Aquatic environments that may be affected by the construction and operation of the proposed SRC-I facility are selected reaches of Green River, onsite or near-the-site tributary drainages, and six onsite ponds.

Green River. Surface water quality of the Green River has been described in the previous section. Of the wide variety of pollutants entering this river system, sediment has most significantly affected the aquatic environments. Habitats of benthic organisms and fish-spawning areas have been destroyed by excessive sedimentation. Limited distribution of aquatic macrophytes along the banks of the Green River downstream from Lock and Dam No. 3 (mile point 108.5) has also been attributed to high sediment loading.[18] The shearing effects of continual barge traffic may adversely affect other aquatic organisms as well.

Aquatic life resources of the Green River have been described in numerous studies (e.g., see ref. 21, Sect. 4.2.1.1.1). The majority of these studies were conducted upstream from the location of the proposed SRC-I facility. A site-specific baseline monitoring program was conducted to provide data on this portion of the river. Sampling locations, shown in Fig. 3.12, were chosen to correspond to those stations established for the monitoring of surface water quality. Results of the sampling efforts are summarized in Table 3.8. In general, the aquatic

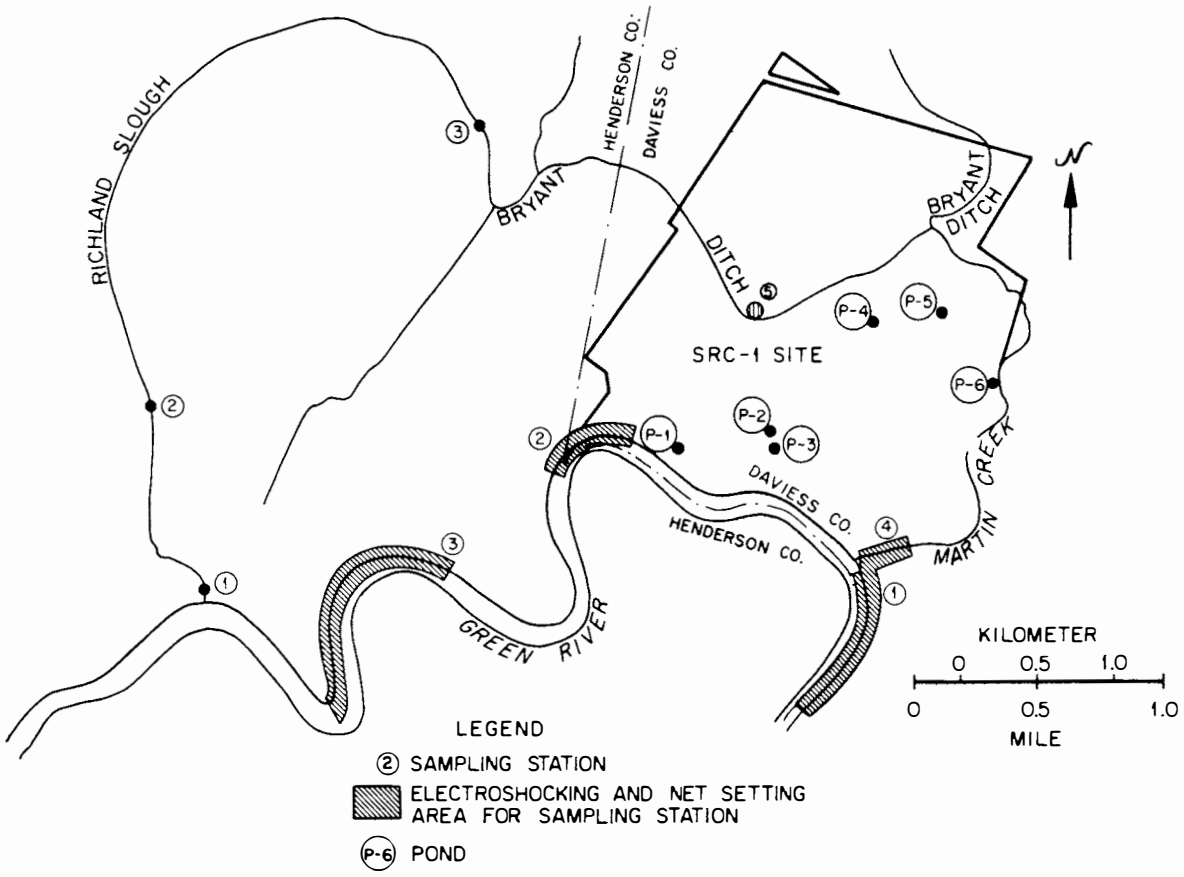


Fig. 3.12. Aquatic biology sampling locations on or near the proposed SRC-I site. Source: ER, Appendix G, Part I, Fig. G.1.

biota of this portion of the Green River were facultative or pollution-tolerant taxa. Low productivity may be attributed to the water quality problems discussed in Sect. 3.2.2.3.

Fairly diverse populations of phytoplankton were collected in the Green River during 1977-1978. As previously described for reaches upstream and downstream of the proposed site,[19,21,22] diatoms were the dominant phytoplankton in near-the-site Green River samples. Some seasonal trends were evident in the site-specific collections; blue-green algae, present in low numbers during the fall, became much more abundant in the spring. Many of the species found in the Green River are considered tolerant of organic pollution.[23]

Other primary producers (aquatic macrophytes) were not found in the reaches of the Green River adjacent to the proposed plant site. As observed by the U.S. Army Corps of Engineers,[18] suitable habitat for these plants did not exist along the riverbanks.

Although cladocerans, copepods, and protozoa were collected during baseline monitoring, rotifers dominated the zooplankton in the fall and spring samples. Copepod nauplii became more numerous in the spring (Table 3.8). Other investigations have found similar organisms in the Green River.[23,24,25] These zooplankters appear to be characteristic of turbid, river-reservoir waters.

Table 3.8. Summary of the sampling conducted during baseline monitoring of aquatic biota in the Green River

Aquatic organisms	Season during which sampling was conducted					
	Fall 1977	Winter 1978	Spring 1978	Spring 1979	Summer 1979	Fall 1979
Phytoplankton						
Total number of taxa collected	55		45			
Density, units/ml	1946–2970		907–2493			
Composition[a]	Diatoms; green algae and euglenoids also present		Diatoms; blue-green algae also present			
Zooplankton						
Total number of taxa collected	14		14			
Density, organisms per liter	6.5–10.7		29.8–53.2			
Composition	Rotifers		Rotifers and copepod nauplii			
Benthic macroinvertebrates						
Total number of taxa collected	21	19	18			
Density, organisms/m^2	702–1212	128–479	211–798			
Composition	Midge larvae, tubificid worms, and the Asiatic clam	Midge larvae, tubificid worms, and the Asiatic clam	Midge larvae, tubificid worms, and the Asiatic clam			
Macrophytes	Not observed during surveys made of the Green River					
Adult fish						
Total number of species collected	19	6	14	6		10
Composition	Gizzard shad and skipjack herring; emerald shiner, flathead catfish, and blue catfish also caught	Gizzard shad; goldeye, small-mouth buffalo, and freshwater drum also caught	Gizzard shad and emerald shiner; carp, channel catfish, and smallmouth buffalo also caught	Gizzard shad, white bass, carp, and bluegill		Gizzard shad, carp, and channel catfish
Ichthyoplankton						
Density, organisms/100 m^3				(See Table J.5)	(See Table J.5)	(See Table J.5)
Composition				Shad, herring, carp, buffalo, crappie, white bass, and fresh-water drum	Freshwater drum, bluegill, shad, herring, catfish, shiners, and carp	Carp, bluegill, and shiners

[a]Composition is generally expressed in terms of numerical dominance.

Source: Information summarized from ER, Appendix G, Tables G-3, G-5, G-8, G-11, G-12, G-13, and G-17.

Benthic invertebrates collected at the river stations also typified organisms found in silty environments. The soft riverine substrate appeared to be unfavorable for many types of aquatic invertebrates. Samples were dominated by tubificid worms, midge larvae, and the Asiatic clam. Other mollusks were sampled during a supplementary baseline monitoring study conducted in September 1977. A total of 27 brail drags yielded only four individual mussels, which belonged to two mud-tolerant species.

Most of the fishes collected in the Green River are associated with silty, slow-moving waters or are known to have relatively wide ecological tolerances. Forage fish were the most numerous. Game and predatory fishes were also caught, but in lower numbers. Fish species collected during baseline monitoring were among those included on a comprehensive list of Green River fishes sampled in four lock chambers from 1960 to 1963.[26] Species lists for site-specific collections and those included in ref. 26 are in Appendix J. The reaches of the Green adjacent to the proposed plant site are not fished commercially, nor is sport fishing extensive.

Extensive sampling of ichthyoplankton from late March through mid-October 1979 indicated that the highest densities between mile points 16 to 20 occurred from mid-May to early July. Taxa collected were those found as adults either near or upstream from the site. A species list is included in Appendix J. Ichthyoplankton were generally more abundant in the protected near-shore reaches of the river (Table J.5). However, at the site of the proposed raw water intake, it appears that the ichthyoplankton densities near the shore are similar to those in midchannel (Table J.6 and Fig. J.1). This may be the result of mixing by the river currents and the lack of protective habitat along the scoured outer bank of the river bend.

Tissue samples from representative Green River fish were analyzed for PNA compounds, phenol, arsenic, selenium, cadmium, and lead; results are summarized in Table 3.9. Various PNA compounds were detected in both muscle and liver tissue; the highest concentrations were in the liver. Although no liver impairment or other ill effects were observed, it is uncertain if these levels were sufficiently high to cause concern. Tissue phenol levels approached concentrations high enough to cause tainting of flesh. Arsenic and selenium were not detectable in the fish tissue. Although present at detectable concentrations, both cadmium and lead were within the range reported for uncontaminated locations.[27]

Table 3.9. Maximum concentrations of chemicals present in tissue samples from representative Green River fishes[a]

Chemical[b]	Type of tissue		Whole fish[c]
	Muscle	Liver	
PAH[d] compounds, μg/kg			
Benzo(a)pyrene	360	3,140	
Benz(a,h)anthracene	447	5,100	
Benzo(a,h)phenanthrene		2,550	
Benzo(b)fluoranthene	1,560	11,470	
Benzo(j)fluoranthene	18,640		
Benzo(c)phenanthrene	3,740	89,100	59
Benzo(g,h,i)perylene		580	
Chrysene	144,500	10,900	399
5-methyl chrysene	92	37	5
Dibenzanthracene	9,130	6,900	
Dibenz(a,c)anthracene	240	300	
Dibenzothiophene	37,280	590	
Fluoranthene	6,650		671
2-methyl naphthalene	709	20,960	83
Pyrene	670	25,400	
o-phenylene pyrene	11	1,230	
Other chemicals		Tissue not specified	
Phenol, mg/kg	11.3	9.9	
Arsenic, μg/kg	<10	<10	
Cadmium, μg/kg	116	74	
Lead, μg/kg	540	131	
Selenium, μg/kg	<5	<5	

[a] Representative Green River fishes included river carpsucker, smallmouth buffalo, bluegill, white bass, carp, white crappie, gizzard shad, black crappie, channel catfish, flathead catfish, sauger, and freshwater drum.

[b] Analyses reported on an "as is" basis; i.e., no correction made for dry weight of tissue sample.

[c] These analyses performed only on green sunfish collected from Bryant Ditch.

[d] Polycylic aromatic hydrocarbons.

Source: Information summarized from ER, Appendix G, Tables G.32–G.35.

Onsite or near-the-site locations. Bodies of water located on or near the proposed SRC-I facility were also sampled for aquatic biota during the baseline monitoring program. Sampling locations are shown in Fig. 3.12. Results of these sampling efforts, summarized in Table 3.10, indicated that densities of aquatic organisms in these bodies of water were as much as an order of magnitude greater than populations in the Green River. Species composition, particularly that of fishes, was also different. Onsite ponds were almost exclusively inhabited by members of the sunfish family. Richland Slough contained a number of game fish species and is considered to be a popular fishing area for bass, crappie, bluegill, and catfish. Tributary fish populations could be classified into three major groups:[28] (1) those completing their life cycle in the creek and not normally found within the river, (2) those with permanent populations in both the creek and river, and (3) those using the creek during only parts of the year or

Table 3.10. Summary of the sampling conducted during baseline monitoring of aquatic biota in the bodies of water on or near the SRC-1 site

Aquatic organisms	Sampling stations							
				Ponds				
	Martin Creek	Bryant Ditch	Richland Slough	P-1	P-2	P-3	P-5	P-6
Phytoplankton								
Number of quarters sampled	3	1						1
Total number of taxa collected	68	18						11
Density, units/ml	4,327–20,990	26,310						302
Composition[a]	Cryptomonads and diatoms	Cryptomonads; euglenoids and diatoms also numerous						Cryptomonad and a green alga
Zooplankton								
Number of quarters sampled	3	2		1				
Total number of taxa collected	27	17		10				
Density, organisms per liter	71–129	17–40		194				
Composition	Rotifers and copepod nauplii	Rotifers and copepod nauplii		Rotifers, protozoans, and copepod nauplii				
Benthic Macroinvertebrates								
Number of quarters sampled	4	3		1				
Total number of taxa collected	16	17		8				
Macrophytes								
Composition	None present	None present	Small duckweed and big duckweed		Stonewort	Pickerelweed, horned pondweed, and water purslane	Small duckweed, spike rush, and false loosestrife	Big duckweed
Adult fish								
Number of quarters sampled	3	3	1	2	None present	None present	1	1
Total number of taxa collected	10	6	13	3			3	1
Composition	Mosquitofish and spotfin shiner	Sunfish and shiners	Black crappie, gizzard shad, black bullhead, and white crappie	Green sunfish and bluegill			Green sunfish and black bullhead	Green sunfish

[a]Generally expressed in terms of numerical dominance.

Source: Information summarized from ER, Appendix G, Tables G-4, G-6, G-7, G-9, G-10, G-14, G-15, and G-16.

parts of their life cycle. The two dominant fish species in Martin Creek, the mosquitofish and the spotfin shiner, have been reported in other small streams within the Ohio River drainage area and can be considered representative of the fishes in group 1 (ref. 28). Other fishes such as gizzard shad, carp, emerald shiner, bluegill, and white crappie, which were collected both in Martin Creek and the Green River during baseline monitoring, belong to group 2. Sauger may use Martin Creek only as spawning habitat (group 3) if the creek's water levels are sufficiently high. Richland Slough may also provide habitat for species that have no identifiable spawning areas near the site.

The proposed site is located in a region where the floodplains of the Ohio and Green rivers coalesce. Although locally important, the aquatic habitats on or near the site are not particularly unique to this geographical region. Of the bodies of water sampled, Richland Slough provides a variety of habitats not found elsewhere within the site vicinity.

Endangered species

The Green River Basin has one of the most diverse mussel faunas in the country.[29] Two mussels found in the Green River, the pink mucket pearly mussel (*Lampsilis orbiculata orbiculata*) and the rough pigtoe pearly mussel (*Pleurobema plenum*), are currently included on the U.S. Fish and Wildlife Service List of Endangered and Threatened Wildlife.[11] Their distribution, however, is far upstream from the site of the proposed SRC-I facility.[30] Results of brailing investigations conducted during baseline monitoring indicated that suitable habitat for these organisms did not exist in the reaches of the river adjacent to the proposed plant site. Other endangered species of mussels in Kentucky (tuberculed blossom pearly mussel, Cumberland bean pearly mussel, and tan riffle shell mussel) are not found in the Green River.[11] Peripheral fish species (those considered rare or threatened in Kentucky but more abundant elsewhere) were not collected during baseline monitoring (see Appendix J).

3.2.3 Air

This section presents information about the proposed site in the areas of meteorology, air quality, and noise.

3.2.3.1 Meteorology and air quality

Meteorology

The climate in the vicinity of Newman, Kentucky, is continental. The region lies within the path of easterly moving storms and is thus subject to wide extremes of temperature and precipitation.[31]

The nearest climatological station is Dress Regional Airport in Evansville, Indiana, 30 km (18 miles) northwest of the site. The normal mean monthly temperature at the airport ranges from 1°C (33°F) in January to 26°C (78°F) in July.[32] Temperatures measured on the site between November 1977 and November 1978 show a similar climate. The lowest temperature recorded was -18.4°C (-1.1°F) in January; the highest was 35.7°C (96.3°F) in June.

Onsite 10-m wind speeds and directions recorded from October 12, 1977, through October 20, 1978, are presented in Fig. 3.13. The average wind speed, regardless of direction, was 3.1 m/s (6.9 mph). The two most prevalent wind directions were from the southeast through south (27% occurrence) and west through northwest (23% occurrence). Compared with historical conditions at Dress Regional Airport, the onsite data have somewhat stronger southeasterly and westerly components.

Annual precipitation at Evansville averages 106.4 cm (41.9 in.); March experiences the highest mean precipitation, 11.9 cm (4.7 in.), and October the lowest, 6.4 cm (2.5 in.).[32] Precipitation in the form of snow or sleet can occur from October through April. Mean annual snowfall amounts to 32.8 cm (12.9 in.), with the highest mean monthly snowfall of 8.1 cm (3.2 in.) occurring in January and February.[32]

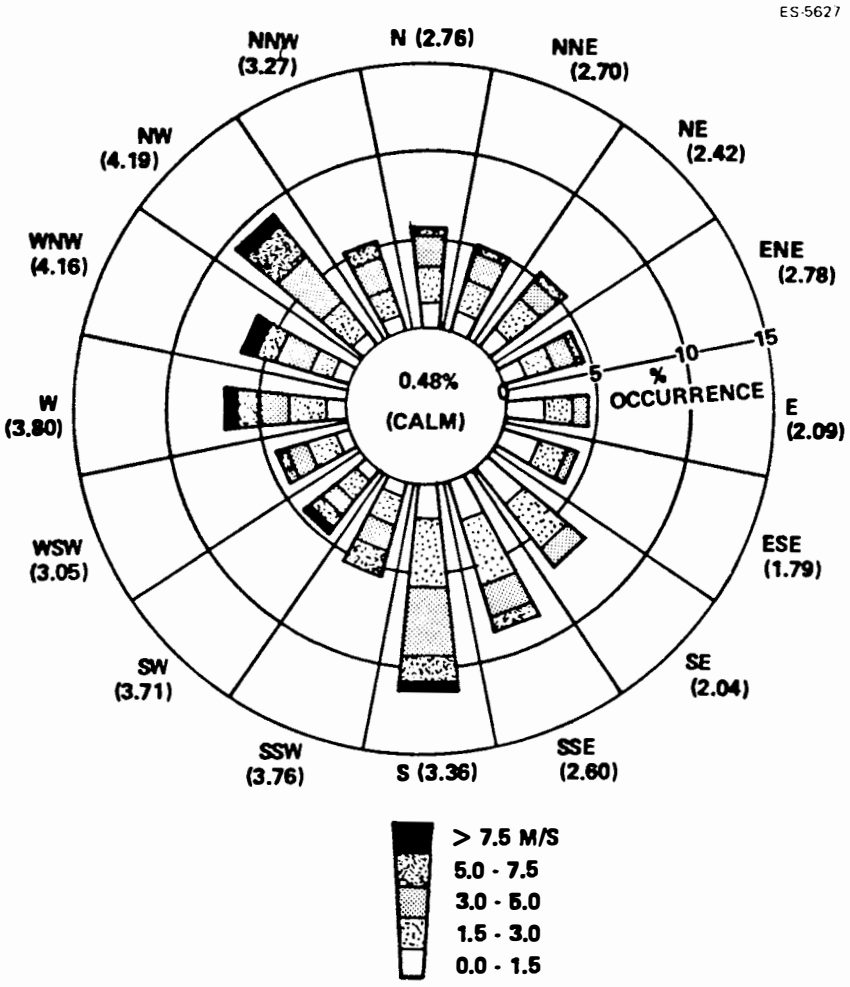


Fig. 3.13. Wind direction and speed, frequency of occurrence on site, October through December 1977. Source: Dames & Moore field data, 1977.

Air quality

The proposed project site falls within a Class II area with regard to the prevention of significant deterioration (PSD) of air quality under the provisions of the 1977 amendments to the Clean Air Act. Moderate growth of new emissions sources is allowed in PSD Class II areas. The nearest Class I area, where new sources would be severely restricted, is Mammoth Cave National Park, 120 km (75 miles) southeast of the project site.

The proposed site is located in the Evansville-Henderson-Owensboro Interstate Air Quality Control Region (AQCR77). Daviess County, in which the proposed site is located, is designated attainment for all air pollution categories. Henderson County, located next to the proposed site, is also designated attainment for all categories. The cities of Owensboro and Henderson are designated nonattainment for both sulfur dioxide and total suspended particulates (TSP). Kentucky has also requested that EPA redesignate the cities of Owensboro and Henderson as attainment for sulfur dioxide based on compliance of sources in those cities and on the three most recent years of monitoring data.

Table 3.11 summarizes the available air quality data and the Kentucky Ambient Air Quality Standards.[33] The Kentucky Division of Air Pollution Control (KDAPC) data for the most recent one-year period show the highest values for the KDAPC monitoring sites in each of three areas: Henderson, Owensboro, and a group of three rural sites located 19 to 31 km (12 to 20 miles) southwest of the proposed site. These rural sites are in the communities of Robards, Webster, and Niagara; all three are within 8 km (5 miles) of a coal-fired generating station. Data generated from both annual periods of monitoring on the proposed site are also shown in Table 3.11.

Table 3.11. Summary of air quality data for the proposed SRC-I site and surrounding area

Parameter[a] ($\mu g/m^3$)	Kentucky air quality standards		Kentucky Division of Air Pollution Control data, 4/79–3/80			Air quality data from monitoring of proposed site	
	Primary	Secondary	Henderson	Rural	Owensboro	10/77–10/78	5/79–4/80
Sulfur dioxide							
3-h		1300	440 (346)	406 (299)	558 (535)	588 (568)	1006 (883)
24-h	365		217 (160)	149 (128)	265 (136)	173 (138)	281 (190)
Annual average	80	60	29	24	26	19	20
TSP[b]							
24-h	250	150	226 (209)	244 (147)	232 (188)	189 (146)	137 (94)
Annual average	75	60	83	62	88	48	42
Nitrogen dioxide							
Annual average	100	100	43	21	39		16
Carbon monoxide							
1-h (mg/m^3)	40	40	12 (9)		6 (6)		1.8 (1.7)
8-h (mg/m^3)	10	10	5 (4)		4 (2)		1.2 (1.2)
Ozone							
1-h	235	235	210 (210)		208 (208)	221 (203)	
Reduced sulfur							
1-h							366 (323)

[a] Highest measured concentrations and second highest concentrations (in parentheses) are given in $\mu g/m^3$.

[b] Total suspended particulates.

Source: *Ambient Air Quality Summary Statistical Analysis, April 1979–March 1980,* Commonwealth of Kentucky, Division of Air Pollution Control, Frankfort, Kentucky, 1979.

Air quality data measured at the site are representative of the air quality in and around the site. Maximum sulfur dioxide concentrations presented in Table 3.11 are well within the corresponding primary and secondary air quality standards. None of the TSP data presented in Table 3.11 have been adjusted to eliminate the contributions of particles which are fugitive, rather than industrial, in origin. One possible excursion beyond the 24-h secondary TSP standard was measured at the site during the first year of monitoring. Subsequent microscopic analysis of the particulate sample indicated that about 90% by weight of the collected particles were soil minerals classifiable as fugitive dust; thus, no excursion beyond the TSP secondary standard actually was measured at the site. It should be noted that one excursion beyond the standard is allowed before a violation of the standard has occurred. The standard for 24-h average TSP is not to be exceeded more than once per year, therefore the second highest concentration is also given in Table 3.11, since it is the second highest that determines whether a violation of the standard has occurred. Major sources of sulfur dioxide and TSP within 20 km (16 miles) of the site are concentrated mostly in the Henderson and Owensboro urban areas. The sources nearest the project site are in a complex on the Ohio River 10 km (6 miles) to the northwest.

Nitrogen dioxide and carbon monoxide concentrations are well within the air quality standards. Ozone concentrations measured at the site are very similar to those measured by KDAPC.

Particulate samples from April 1979 through April 1980 were analyzed for 16 separate poly-aromatic hydrocarbons (PAH), 13 trace elements, and sulfates. For the 13 of 16 PAHs detected,

maximum concentrations ranged from 0.006 to 0.870 ng/m^3. Measured trace element concentrations are within the expected concentration ranges for nonurban environments. Sulfate levels ranged from 7.1 to 24.6 μg/m^3 with a mean of 11.6 μg/m^3.

3.2.3.2 Noise

Ambient noise levels were measured at noise-sensitive areas surrounding the proposed site. The noise survey was conducted to provide documentation of the existing baseline noise conditions in the vicinity of the site. Figure 3.14 shows the noise monitoring locations. The sound survey results are summarized in Table 3.12. The ER, updated Appendix K, includes detailed noise measurements and techniques.

Table 3.12. Ambient sound levels at noise-sensitive locations surrounding the SRC-I site

Sound measurements are in decibels

Location	L_d[a]	L_n[b]	L_{dn}[c]
1	59.4	50.0	59.6
2	53.5	47.0	55.1
3	61.8	47.0	60.5
4	62.1	52.0	62.0
5	46.4	43.0	50.1

[a] Daytime levels (time averaged).
[b] Nighttime levels (time averaged).
[c] Combined day-night levels (a 10-dB correction factor was added to the nighttime sound level).

Principal noise sources in the area were identified during the survey as road and railroad traffic, wind through foliage, and bird and insect noise. The principal noise occurring at location 2 was from local road and rail traffic. At location 3, the sound of a farm tractor in the fields was audible. At locations 4 and 5, the sound of grain dryers at a nearby silo was audible.

Day-night sound levels (L_{dn}) exceed 55 dB except at location 5. These levels are typical of, or better than, levels in an old urban/residential area. The day-night sound levels meet EPA's short-term goals of 65 dB or less but exceed the long-term goals of 55 dB or less identified as necessary to protect the public health and welfare at residential locations. Figure 3.15 gives examples of typical outdoor L_{dn}-average noise levels for various locations.

3.2.4 Economic, social, and cultural features

This section identifies and characterizes key socioeconomic conditions of the proposed SRC-I site near Newman, Kentucky, and the surrounding area, including population, economic base, labor force characteristics, income, housing, public services and finance, transportation, and archaeological features.

This discussion focuses on three geographical regions: the immediate area, defined as the plant site and land within a 3.2-km (2-mile) radius of the site; the local impact region, defined as Daviess and Henderson counties in Kentucky and Vanderburgh County in Indiana; and the regional impact area, which includes the preceding counties plus Breckenridge, Butler, Hancock, Hopkins, McLean, Muhlenberg, Ohio, Union, and Webster counties in Kentucky; Dubois, Gibson, Perry, Pike, Posey, Spencer, and Warrick counties in Indiana; and Gallatin and White counties in Illinois (see Fig. 3.16).

The immediate area has been selected because some potential impacts, such as those upon scenic quality, archaeological resources, and historic structures, are highly site-specific and would

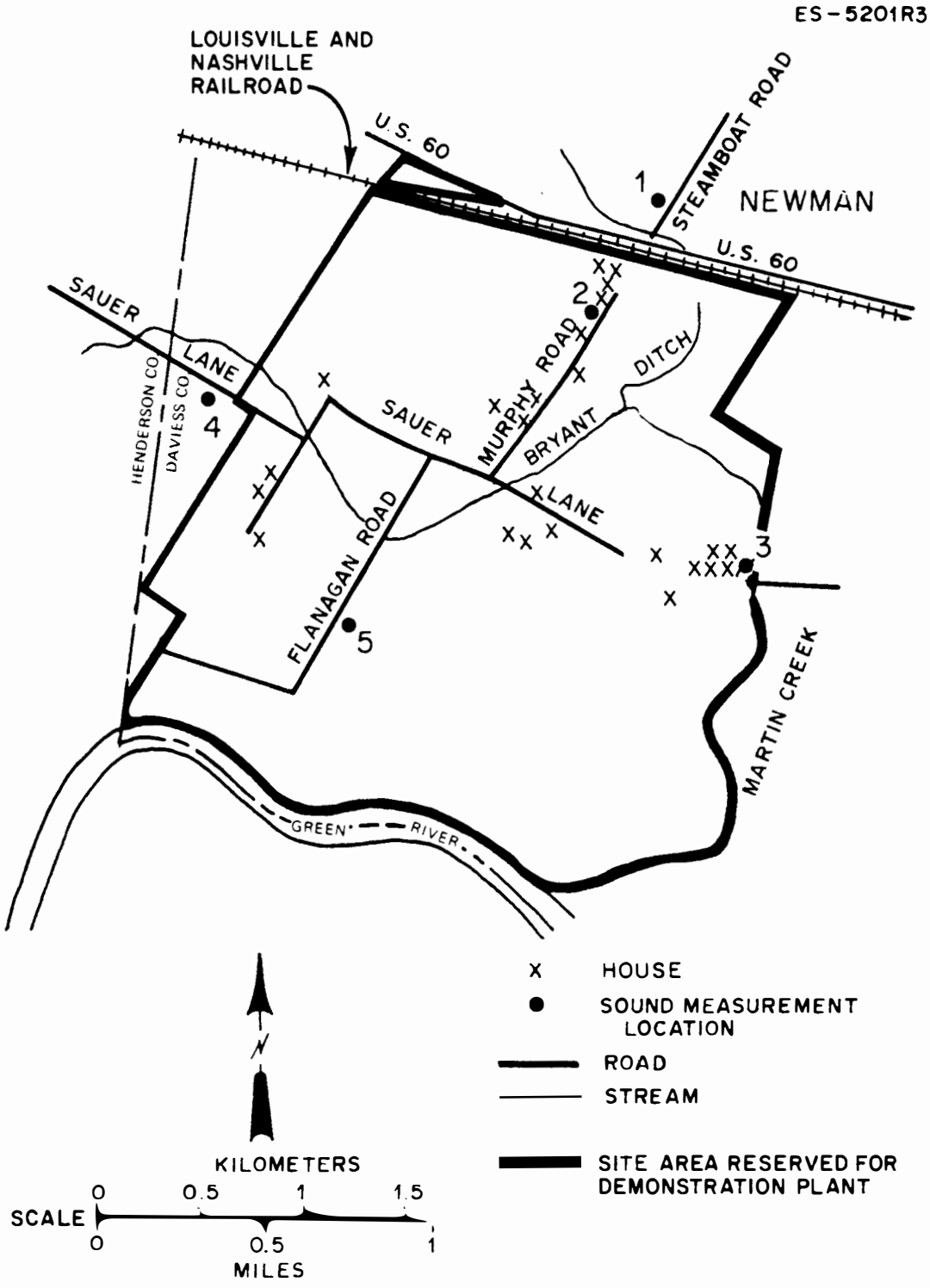


Fig. 3.14. Sound measurement locations on or near the proposed site. Source: Dames & Moore field data, 1977.

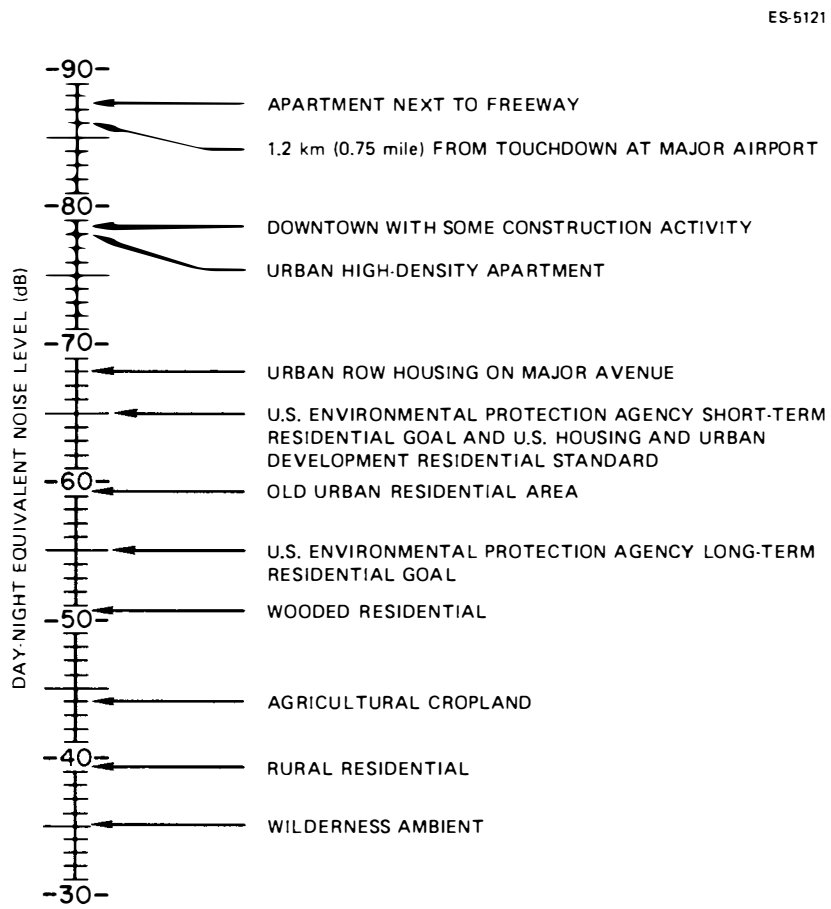


Fig. 3.15. Examples of outdoor day-night average sound levels in dB measured at various locations. Source: U.S. Environmental Protection Agency, *Protective Noise Levels — Condensed Version of EPA 550/9-79-100*, Washington, D.C., November 1978.

be confined to this area. The local impact area is the area most likely to experience impacts related to worker relocation, traffic, and demand for additional public and private services, among others. The regional impact area represents the area within a greater but still reasonable commuting distance of the plant site for construction workers. Principal population centers in the local impact area include Owensboro and Henderson in Kentucky and Evansville in Indiana. For work-force analysis purposes, the regional impact area is divided into two commuting zones (60 and 90 mins). Because most of the socioeconomic impacts are projected to occur in Daviess, Henderson, and Vanderburgh counties, they receive the primary attention in the socioeconomic sections of this statement.

3.2.4.1 Population

The immediate area is estimated to have a population of approximately 400 people, of which about 60 reside on the proposed site. Also within the immediate vicinity is the community of Newman, less than 1 km (0.6 miles) north of the proposed site, which is estimated to have a population of about 300. Within 8 km (5 miles) of the immediate area via U.S. Highway 60 lie other small unincorporated communities including Stanley (estimated population 302) and Reed (estimated population 123). Spottsville/Beals (estimated population 433), Baskett (estimated

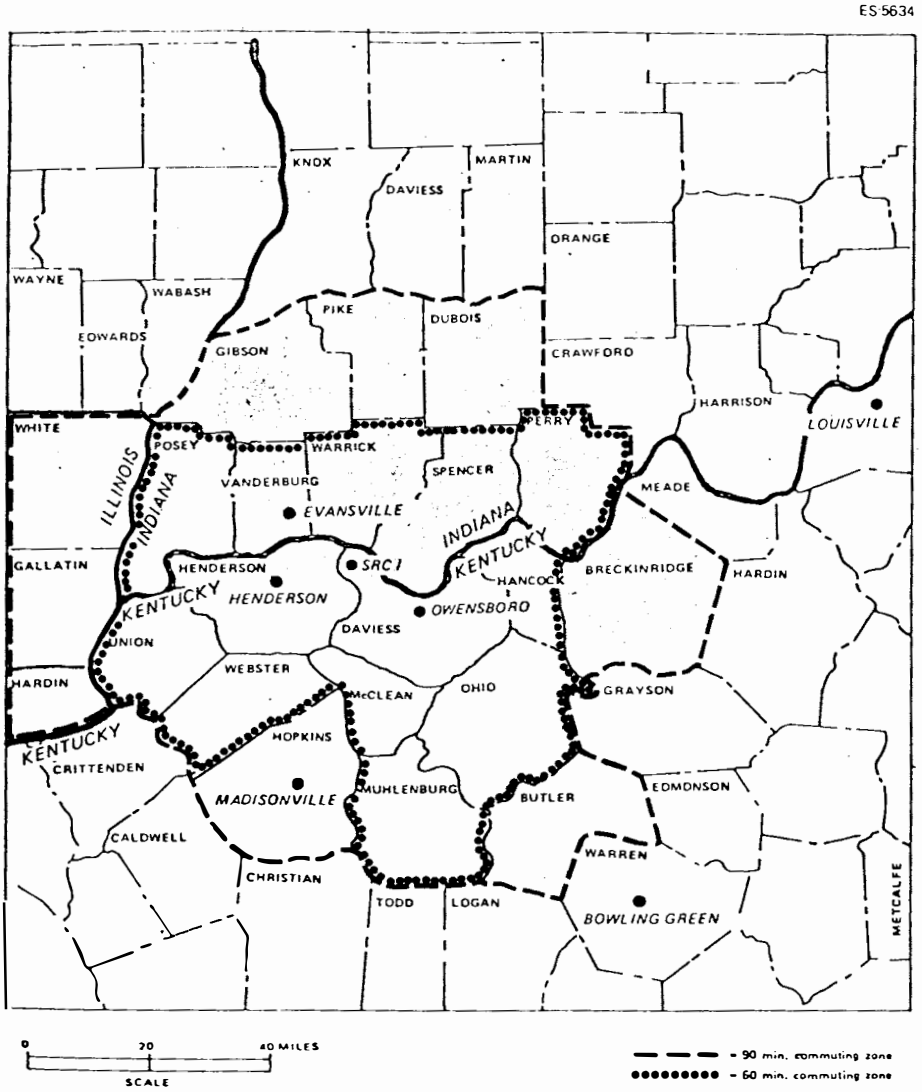


Fig. 3.16. Commuting zones within 60- and 90-min areas.

population 353), Carlinburg (estimated population 52), and Birk City (estimated population 52) are also relatively near the site. These communities are devoid of industry, have a minimum of retail establishments, provide no services to their residents, and are all located in areas zoned A-R (rural agriculture).

The proposed site is in Daviess County and adjacent to Henderson County. Vanderburgh County, Indiana, is situated immediately north of Henderson County across the Ohio River. The two nearest urban areas are the cities of Owensboro, about 16 km (10 miles) southeast of the proposed site, and Henderson, about 22 km (14 miles) west. Evansville, Indiana, is the largest city in the region and is located about 27 km (17 miles) northwest of the proposed site across the Ohio River.

In general, population levels of these counties and cities remained fairly constant between 1970 and 1975, as indicated by either small population increases or decreases during this period (see Table 3.13). While Daviess and Henderson counties both exhibited average annual

Table 3.13. Historical population growth characteristics for counties and principal urban areas in the SRC-I local impact area

Location local impact area	1970 population	Average annual change, 1960-1970	1975 population	Average annual change, 1970-1975	1980 population (preliminary)	Average annual change, 1975-1980
Cities						
Evansville (Vanderburgh County, Indiana)	138,764	-0.2	133,566	-0.8	129,000	-0.7
Owensboro (Daviess County, Kentucky)	50,329	1.7	60,788	0.2	53,839	-2.3
Henderson (Henderson County, Kentucky)	22,976	3.1	22,832	-0.1	24,778	1.7
Counties						
Vanderburgh	168,772	0.2	162,848	-0.7	166,723	0.5
Daviess	79,448	1.2	80,733	0.3	85,702	1.2
Henderson	36,031	0.7	36,616	0.3	39,941	1.8
Tricounty area	284,251	0.5	280,197	-0.3	292,366	0.9

Sources: *ER*, Vol. 2, Table L.1 and U.S. Bureau of the Census, December, 1980.

growth rates of 0.3% between 1970 and 1975, Vanderburgh County, Indiana, experienced a population decline during the same period at the average annual rate of -0.7%. However, as indicated by preliminary 1980 census figures, population growth rates in Daviess and Henderson counties have been accelerating. Daviess County experienced a growth of 1.2% annually between 1975 and 1980, while Henderson county's rate of annual growth approximated 1.8% during the same period. In Vanderburgh County, the trend in population decline experienced during the period 1970 and 1975 has reversed, as evidenced by preliminary 1980 census figures, which show the county to contain a population of approximately 167,000, constituting an average annual rate of growth since 1975 of a modest 0.5%. Historical population growth characteristics for all counties and principal urban areas in the tri-county area are presented in Table 3.12.

Population growth is anticipated over the next 20 years for two of the three counties in the local impact region (see Table 3.14). Daviess and Henderson counties are expected to grow at an average annual rate of 2.3 and 1.2%. Vanderburgh County, on the other hand, is expected to lose population at an average annual rate of 0.8%.

Table 3.14. Population estimates and projections for Daviess, Henderson, and Vanderburgh counties

	1970	1975	1980	1985[a]	1990[b]	1995[c]	2000[b]
Daviess	79,486	80,733	85,702	96,400	107,000	116,200	125,300
Henderson	36,031	36,733	39,941	42,200	44,400	47,100	49,800
Vanderburgh	168,772	162,848	166,723	158,700	150,600	145,000	139,300
Tricounty area	284,289	280,314	292,366	297,300	302,000	308,300	314,400

[a] Interpolated from preliminary 1980 census estimates and projections supplied by references in footnote "b."

[b] Green River Area Development District, *GRADDATA* (Owensboro, 1980); and Indiana State Board of Health, *Indiana County Population Projections, 1980-2000* (Indianapolis, 1978).

[c] Interpolated from projections supplied in footnote "b."

3.2.4.2 Economic base

Regional economy

The manufacturing sector is the largest employer in each of the main impact counties (see Table 3.15). Manufacturing in 1979 employed, respectively 23.2%, 33.4%, and 29.5% of the counties' labor forces. Manufacturing is not dominant in the region since employment in wholesale and retail trade follows closely behind manufacturing (24.9%, 22.6%, and 26.6%, respectively), reflecting the three counties' role as a regional trade center. Moreover, manufacturing employment has declined considerably in relative employment between 1974 and 1979 (Table 3.15), with the largest employment growth occurring in the services industries. Trade as an employer has experienced only modest growth between 1974 and 1979. Clearly, Vanderburgh County with 65.7% of the total three-county employment in 1979 is the major economic influence at present. However, employment growth in the five years ending in 1979 has been largest in Henderson County, Kentucky (59%), followed by Daviess (20%) and Vanderburgh (13%), respectively.

In both Daviess and Henderson counties, the total employment work force is expected to increase at about the same rate as the population. Economic projections for Daviess County predict a proportional increase in professional and service employment and an absolute and proportional decrease in manufacturing employment by 1995. The "chemicals, petroleum, coal, and rubber" manufacturing industrial category is the only manufacturing category projected to increase significantly by 1995. Agricultural employment is also expected to decrease.

In Henderson County, both an absolute and a proportional increase in manufacturing sector employment from 1975 to 1995 are projected. Service sector employment should increase also, but agricultural employment will probably decline. By 1995, Henderson County's economy should be slightly more service oriented.

The distribution of employment by occupation for the regions dominated by the three main impact counties is shown in Table 3.16. The Vanderburgh–Spencer County area of Indiana clearly dominates the Henderson–Daviess County area in terms of total employment, but the occupational distributions of both regions are remarkably similar and well balanced.

Agriculture

Nationwide trends for at least the past three decades have resulted in a strong tendency toward fewer but larger farms. Between 1969 and 1974, Daviess and Henderson counties followed this trend.

Daviess County livestock production has been relatively diversified in recent years, but Henderson County production has consisted largely of cattle and hogs. Between 1964 and 1976, hog and pig production decreased substantially in both counties and in the State as a whole.[1]

Tobacco, corn, hay, and soybeans were the major crops in both Henderson and Daviess counties in 1977. The counties ranked among the top five counties in Kentucky in both soybean and corn production. Daviess County also ranks among the State's top ten counties in production of dark, air-cured tobacco, laying hens, hogs and pigs, and cattle and calves.

Mining

Coal, petroleum, and sand and gravel are produced in the region surrounding the proposed site.

The mining of known coal deposits beneath the proposed site is currently economically unfeasible. Coal mining in Daviess and Henderson counties totaled 539,107 tons in 1977, which accounted for only 3% of regional coal production. Two new underground coal mines planned for Henderson County are expected to produce some 1.6 million tons per year. There is no active coal mining in Vanderburgh County at present.

There are active oil wells near the site, but no wells have produced on the site since 1979. Oil production in the two Kentucky counties, although declining markedly, totaled 1,119,171 bbl and accounted for nearly 20% of the State's total production in 1978. Production data are not available for natural gas.

Table 3.15. Distribution of employment by major industry group, 1974[a] and 1979

Industrial Classification	Daviess County, Kentucky				Henderson County, Kentucky				Vanderburg County, Indiana			
	1974		1979		1974		1979		1974		1979	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Mining	434	1.8	812	2.8	182	2.0	474	3.3	260	0.4	499	0.6
Contract construction	1,566	6.4	2,151	7.3	385	4.3	580	4.1	4,268	5.8	5,268	6.3
Manufacturing	8,490	34.7	6,816	23.2	3,701	41.4	4,749	33.4	29,368	39.7	24,689	29.5
Transportation and other public utilities	1,594	6.5	2,470	8.4	703	7.9	858	6.0	4,129	5.6	3,815	4.6
Trade, wholesale and retail	6,353	26.0	7,315	24.9	1,961	21.9	3,215	22.6	18,956	25.6	22,220	26.6
Finance, insurance, and real estate	868	3.6	1,172	4.0	293	3.3	478	3.4	2,552	3.4	3,288	3.9
Services	5,155[b]	21.1	8,485[b]	28.9	1,655	18.5	3,829[b]	26.9	13,778	18.6	17,456[b]	20.9
Nonclassifiable establishments	199	0.8	150	0.5	60	0.7	30	0.2	569	0.8	N.A.	
Government	[c]		[c]		[c]		[c]		N.A.		6,324	7.6
Total covered employment	24,436	100.0	29,371	100.0	8,940	100.0	14,212	100.0	73,935	100.0	83,560	100.0

[a] Week ending March 12, 1974.
[b] Includes government employment.
[c] Included in Service industry columns; may not add due to independent rounding.
Source: Indiana Employment Security Division and Kentucky Department of Human Resources.

Table 3.16. Distribution of employment by major occupation group, SRC-I regions in Kentucky and Indiana, 1976

Occupation group	Henderson-Daviess counties area[a]		Vanderburgh-Spencer counties area[b]	
	Number	Percent	Number	Percent
Professional and technical	8,239	13.4	20,330	13.0
Managers, officials, proprietors	4,663	7.6	12,770	8.1
Sales workers	2,940	4.8	8,890	5.7
Clerical	9,580	15.6	27,340	17.4
Crafts and kindred	9,793	16.0	21,430	13.7
Operations and semiskilled	13,452	21.9	32,060	20.4
Service workers	7,970	13.0	22,510	14.3
Laborers and other unskilled	4,679	7.6	11,540	7.4
Total	61,316	100.0	156,980	100.0

[a]Also includes Hancock, Ohio, McLean, Webster, and Union counties in Kentucky.

[b]Also includes Posey, Warrick, Perry, Dubois, Pike, Gibson, Knox, Daviess, and Martin counties in Indiana.

Sources:

1. Indiana Employment Security Division, *Indiana Occupational Projections 1976-1982*, March 1980.

2. Kentucky Department of Human Resources, *Occupational Outlook for Nonagricultural Wage and Salary Workers 1976-1982*, 1980.

Sand and gravel reserves on the proposed site are estimated at 115 x 10^6 m^3 or 150 x 10^6 yd^3. About 1.4 x 10^6 tons of sand and gravel were produced in Daviess and Henderson counties in 1977; most of this tonnage came from Daviess County.

Area economic infrastructure: multipliers

Multipliers are a convenient way of measuring the total economic effect from the introduction of projects like SRC-I. A multiplier measures the total growth in an economic characteristic, such as employment, income, or expenditure, that results from an initial change in new capital investment in an area. The most complete accounting of multiplier effects from changes in demand for products and labor for SRC-I can be made with the aid of input-output tables. Such tables measure the exchange in inputs among industry sectors resulting from the project investment.

Multipliers are based on average economic conditions that exist in the economy in the absence of SRC-I. If the SRC-I project changes the input-output responses in local industries, some alteration in the multiplier level may occur. For example, boomtown conditions produce secondary employment and income responses in some sectors that may temporarily exceed typical input-output responses that occur in more normal settings. This situation occurs most frequently in industry sectors that supply goods and services to the household sector in communities that are far below average with respect to the level of economic infrastructure development.

In material supply industries, inputs are imported if they cannot be supplied by the area economy. However, in isolated areas, the direct supply of goods and services to the new household sector cannot be imported from outside the impact area. If the site area is deficient, expansion must take place to ensure that a certain quality of life will be met. Frequently, in boomtown situations, temporary expansion is quite large; multipliers ranging from 4.5 to 7.0 have been calculated. In other areas commuting opportunities and access to a larger economic infrastructure results in multiplier responses that are considerably lower for the site county.

A set of personal consumption expenditure multipliers for counties in the SRC-I areas are displayed in Table 3.17. These multipliers are associated with the expenditures by the household sector. They are appropriate for estimating total expenditure impacts of SRC-I payroll

Table 3.17. SRC-I multiplier analysis regions

Region number	Region		Household consumption expenditures multiplier
1	Henderson	Kentucky	1.904
2	Daviess	Kentucky	2.057
3	Hancock	Kentucky	1.219
4	Ohio	Kentucky	1.595
5	McLean	Kentucky	1.559
6	Webster	Kentucky	1.620
7	Union	Kentucky	1.622
8	Muhlenburg	Kentucky	1.755
9	Vanderburgh	Indiana	2.277
10	Posey	Indiana	1.770
11	Warrick	Indiana	1.646
12	Spencer	Indiana	1.691
13	Perry	Indiana	1.696
14	Butler	Kentucky	2.064
	Breckenridge	Kentucky	
	Hopkins	Kentucky	
	Dubois	Indiana	
	Pike	Indiana	
	Gibson	Indiana	
	White	Illinois	
	Gallatin	Illinois	
15	Aggregate of Regions 1 through 13		2.456
16	Aggregate of Regions 1 through 14		2.479

expenditures in a 70-mile radius of the plant site. These multipliers were estimated with a procedure which adjusts national input-output coefficients to fit the county industry composition (Appendix T). The regionalization procedures tend to correct overestimation of multipliers for material supply industries that are not present in the local economy, but corrections for above-average responses to changes in the household sector demands are not attempted. Thus, the multipliers in Table 3.17 represent expected total expenditure impacts in the county economies from expenditures by the labor force households. These multiplier levels may be conservative relative to boomtown relationships but the SRC-I site is located in an area in which boomtown responses are very unlikely due to SRC-I alone. Substantial population and well-developed community infrastructure exist in the SRC-I area. Consequently, the multipliers in Table 3.17 are deemed more appropriate for use in the impact section of this statement (Sect. 4.2.4.2) for estimating total expenditure impacts by county during the SRC-I construction phase. Although these multipliers may not state the actual multiplier effect, it is expected that these estimates will be closer to the actual multiplier than the somewhat more crude multipliers calculated from boomtown studies.

Construction labor employment in the SRC-I area

The existing regional supply of labor according to specific types of skills necessary for SRC-I construction is presented in Table 3.18. These numbers, derived from county-level state estimates of construction employment in 1979 and adjusted to reflect the 1978 U.S. average ratio of relevant construction crafts, include all craftsmen employed within a 90-min commuting time, or a 116-km (70-miles) radius of the site.

Table 3.18. Estimated employment of construction workers by craft in the 90-min,116-km (70-mile) zone around Newman, Kentucky, 1979

Craft	Number employed
Insulators	168
Boilermakers	203
Bricklayers/stonemasons	607
Carpenters	2,529
Concrete finishers	558
Electricians	1,090
Ironworkers	368
Laborers	1,415
Millwrights	84
Operating engineers	1,002
Painters	471
Pipefitters	983
Teamsters	488

Source: Oak Ridge Associated Universities, *Construction Labor Assessment for SRC-1 at Phase Zero*, 1980, Tables 1-5, p. 21.

Economic conditions in the SRC-I area

One of the indicators most often used to measure the economic viability of an area is the rate of unemployment. Unemployment data for the SRC-I region for the last six years are displayed in Table 3.19.

The statistics indicate that Henderson County has until recently experienced a higher rate of unemployment than the Kentucky State average. Daviess County has shown a drop in the unemployment rate recently to a level below the Kentucky State average. Vanderburgh County, Indiana, has generally had the lowest unemployment rate of the three counties. Unemployment in the regional area as a whole was less than the Kentucky average. These rates do not include underemployment, which is a chronic problem in the region (R. Sights, Green River Area Development District, personal communication, June 6, 1979).

Another general indicator of economic health and vitality is per capita income. Per capita income for all counties in the local impact area and several counties in the regional impact area for selected years between 1950 and 1977 are listed in Table 3.20. Between 1970 and 1975, percentage per capita income growth in the regional area was highest in Ohio, Spencer, and Hopkins counties and lowest in Vanderburgh, Daviess, and Hancock counties. Two of these latter three counties are among those with the highest incomes. In 1975, Vanderburgh, Hopkins, Henderson, and Daviess counties had the highest 1975 per capita incomes in the regional area. Variance in per capita incomes among the counties in Table 3.20 substantially reflects the urban-rural mixture of the region.

3.2.4.3 Housing

Preliminary census data indicates that, in 1980, Henderson, Daviess, and Vanderburgh counties had 16,267, 31,631, and 63,345 total housing units, respectively. Although data describing the distribution of renter- and owner-occupied dwelling units for 1980 is currenty unavailable, earlier studies indicate that approximately one-third of all housing units in Daviess and Henderson counties are rental units and that the preponderance of these are in the urban areas of Owensboro and Henderson.[34]

Estimation of the number of housing units available for occupancy in each county was accomplished using a number of assumptions. For Henderson County, the preliminary 1980 census

Table 3.19. Civilian labor force and unemployment for local impact counties of Kentucky and Indiana and U.S. average, selected years, 1973 to 1980

Thousands

Area	1973	1975	1978	1979	October 1980
Daviess County, Kentucky					
Labor force	36.0	34.7	37.7	37.9	40.7
Unemployed	1.5	2.9	1.9	2.1	3.0
Percentage unemployed	4.1	8.3	5.1	5.5	7.3
Henderson County, Kentucky					
Labor force	15.4	15.5	16.8	18.6	19.2
Unemployed	0.7	1.5	1.0	1.0	1.4
Percentage unemployed	4.8	9.7	6.0	5.4	7.0
State of Kentucky					
Labor force	1377.0	1409.0	1556.0	1563.0	1657.4
Unemployed	51.0	103.0	82.0	87.0	129.0
Percentage unemployed	3.7	7.3	5.3	5.6	7.8
Vanderburgh County, Indiana					
Labor force	76.8	76.3	87.0	79.9	77.5
Unemployed	2.6	5.4	4.3	4.5	5.4
Percentage unemployed	3.4	7.0	5.0	5.6	7.0
State of Indiana					
Labor force	2329.0	2395.0	2577.0	2610	2597.3
Unemployed	101.0	206.0	146.0	167.0	223.8
Percentage unemployed	4.3	8.6	5.7	6.4	8.6
U.S. average	4.9	8.5	6.0	5.8	7.6[a]

[a]August 1980.

Sources: ER, vol. 2, Table L-2, p. L-13: Kentucky Department of Human Resources; and Indiana Employment Security Service.

Table 3.20. Per capita income in the SRC-I regional area for selected years, 1950 through 1977, by counties

Area	1950	1959	1965	1970	1974	1975	Percentage increase 1970 to 1975 (dollar increase)	1977[a]
Kentucky								
Daviess	1,366	1,911	2,482	3,407	4,822	5,277	55	6,926
Henderson	1,044	1,627	2,435	3,307	4,903	5,426	64	7,074
Webster	633	1,289	1,853	2,952	4,204	4,750	61	5,740
Union	805	1,344	1,980	3,027	4,391	4,719	56	5,826
McLean	629	1,468	2,161	2,791	3,878	4,356	56	4,937
Ohio	544	1,068	1,555	2,437	3,910	4,639	90	5,984
Hancock	567	1,228	1,487	2,584	3,432	4,015	55	5,563
Muhlenberg	613	1,446	1,726	2,982	4,329	4,895	64	6,407
Hopkins	1,005	1,614	1,798	3,404	5,279	5,769	69	5,726
(City of Owensboro)	1,366	1,911	2,482	3,407	4,822	5,277	55	6,926
Indiana								
Vanderburgh	1,577	1,953	2,747	3,819	5,485	5,882	54	7,564
Spencer	764	1,138	1,843	2,698	4,329	4,931	83	6,085

[a]U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, April 1979, Vol. 59, No. 4.

Source: ER, Vol. 2, Table L.7, p. L-26.

indicated an overall vacancy rate of 5.3% but did not describe the extent of deteriorated or dilapidated housing. However, a 1974 study by the Southwest Indiana and Kentucky Regional Council of Governments showed that approximately 13% of the total housing stock was in a state of serious disrepair. Assuming a constant rate of disrepair, of the 16,267 total housing units in Henderson County, it is estimated that approximately 750 units are currently available for occupancy after omitting the proportion of units identified as uninhabitable without major renovation. For Daviess County, housing availability was determined in a similar manner. A 1977 report by the Owensboro Metropolitan Planning Commission indicated that approximately 12% of the total housing stock was seriously substandard. Preliminary 1980 census data indicate an overall vacancy rate of 3.6% or approximately 1140 units available for occupancy. After omitting the proportion of units identified as uninhabitable without major renovation, it is estimated that slightly in excess of 1000 dwelling units are currently available. Vanderburgh County, which is running an apartment vacancy rate of approximately 2.4% (ref. 35), is estimated to have approximately 2600 housing units available for residence. This figure was based upon preliminary 1980 census information indicating a 4.9% overall vacancy rate (or approximately 3100 dwelling units) and assuming that 15% of these would be in seriously substandard condition. From these calculations, the staff estimates that the three-county area has approximately 4300 vacant housing units. This estimate may be somewhat high if disproportionate shares of the vacant units are among those classified as dilapidated or in disrepair. This possibility cannot be verified because of unavailable data. Average prices for FHA-insured single-family houses in Daviess and Henderson counties range from $27,200 for existing housing to $32,000 for new construction.[36]

Transient lodging opportunities are abundant in the three-county area as well. Henderson, Daviess, and Vanderburgh counties contain approximately 500, 1100, and 1700 hotel/motel rooms, respectively. Utilization of these facilities fluctuates with the season and level of activities bringing visitors to the area (Henderson County Chamber of Commerce; Owensboro Tourist Commission; Convention Visitors Bureau; personal communications, December 4, 1980), and it is estimated that approximately one-third of these units are available on any given night (Green River Area Development District, written communication, February 26, 1981).

Mobile home zoning ordinances for the cities and counties in Kentucky are fairly liberal and enhance the viability of using these units to supplement conventional dwellings on both permanent and temporary bases. However, in Indiana, ordinances are more stringent. The Owensboro/Daviess County Ordinance allows mobile homes to be located in all agricultural (A-R and A-U), multifamily residential (R-2MF and R-3MF), inner-city residential (R-4DT), and planned mobile home park (MHP) zones. In A-R (rural agriculture) and A-U (urban agriculture) zones, mobile homes must comply with County Health Department standards for water and sewer connections. An A-R minimum lot size is one acre per mobile home, and for A-U it is a half acre. Density may not exceed one mobile home per ten-acre tract where land is not subdivided into lots. Mobile home parks are restricted to areas of not less than ten acres and density may not exceed eight mobile homes per gross acre. There are no mobile homes in Owensboro, and a recent survey by the Green River Area Development District indicates that there are only 31 existing lots in mobile home parks available in Daviess County. There is, however, sufficient land in designated zones within the county to accommodate substantial new mobile home development (Mr. Rick Hiten, Green River Area Development District, personal communication, April 23, 1981). With more land zoned as A-R and A-U than any other category, there are few areas in the county where mobile homes are prohibited. Usage of mobile homes increased by 662 units from 1970-1978, and this increase accounted for 8% of the total housing units started during that period.

The Henderson County Zoning Ordinance permits mobile homes to be located in both the city and the county. Mobile homes are permitted on private land in the county with only one major restriction: without sewer hookup, the unit must occupy 5 acres. In the city, where sewer and water hookups are available and required, the limitation is 2 acres per unit on private land. Mobile home parks are permitted in the city and the county. Mobile home use increased by approximately 1000 units from 1979 to 1978, and this increase accounted for 17% of the total housing units started during that period.

In Vanderburgh County, Indiana, mobile homes are restricted to existing parks, and none are permitted on private land. Mobile home parks are listed under a special use (SU-8) classification rather than an identified zone. This means that conditions such as acreage, density, lot size, etc., would be determined after application for an SU-8 classification. Application for SU-8 classification may be submitted for all zoning districts except R-1 (single family dwellings), R-2 (certain professional/businesses), R-3 (duplexes), F-1 (floodway), and AIR

(airports). The Evansville Zoning Ordinance is patterned, almost verbatim, after the county ordinance, even to the designation of SU-8 as a mobile home park classification and zoning districts in which SU-8 as a mobile home park classification may be requested. In Vanderburgh County, mobile homes do not constitute as important a housing mitigation under present ordinances as they do in Kentucky.

3.2.4.4 Public services and finance

Schools

Residents of Henderson, Daviess, and Vanderburgh counties are currently provided educational services by five school districts and a large number of private and parochial schools. With the exception of the Owensboro Diocese school system (Daviess and Henderson counties), all other public, private, and parochial school systems experienced large-scale enrollment decreases during the period 1968-1980. For example, the Evansville-Vanderburgh School Corporation, which provides public instruction to all of Vanderburgh County, had enrollments numbering approximately 34,000 in 1968. By 1980, the number of enrollments had declined to approximately 24,800 for an overall decrease of approximately 27%.

In response to the trend toward declining enrollments in the area, many school closures have occurred in recent years in both the public and private sectors. However, expansion is forecast for the Henderson County School System in anticipation of inmigration in response to recent high rates of employment growth in the county (Mr. Cleary, Henderson County School System, personal communication, May 23, 1979). Expansions are not currently planned in the other districts. Table 3.21 indicates the number of enrollments and estimated capacities of all school districts and private/parochial school systems in the Henderson-Daviess-Vanderburgh tri-county area for the 1980-1981 school year. As indicated, all school districts appear to have adequate excess capacity to accommodate growth in enrollment.

Table 3.21. Enrollments and school district enrollment capacities for Henderson, Daviess, and Vanderburgh counties, 1980-1981 school year

School district	1980-1981 School enrollments[a]	Current estimated capacity	Available excess capacity(%)
Owensboro independent	5,182	8,550	39.0
Daviess County	8,638	9,830	12.0
Owensboro Diocese	4,596[b]	6,900	33.0
Henderson County	7,923	9,200	14.0
Evansville-Vanderburgh School Corporation	24,839	30,000[c]	17.0
Private/Parochial (Vanderburgh County)	5,785[d]	7,500[c]	23.0
Total Tricounty area	56,962	71,980	21.0

[a]Does not include special-education students.

[b]Enrollments include Henderson County students enrolled in Catholic schools since they are under the jurisdiction of the Owensboro Diocese.

[c]Estimate based on peak district enrollment of 34,000 in 1968 and subsequent school closures. Recent contact with school corporation officials indicates "large available excess capacity."

[d]For the 1979-1980 school year.

Health care and medical facilities

Table 3.22 indicates the hospitals, number of beds, and number of primary health care personnel serving Henderson, Daviess, and Vanderburgh counties. As reflected in the number of physicians and beds per 1000 population, health care services to residents of the tri-county area are good to adequate and exceed the Federal standards of 0.3 physicians and 4.0 beds per 1000 population. Vanderburgh County in particular demonstrates favorable ratios for numbers of beds and physicians

Table 3.22. Health Services characteristics of Henderson, Daviess, and Vanderburgh counties, 1980

County	Hospital	No. beds	Beds per 1000 people	No. physicians	Physicians per 1000 people
Henderson	Community Methodist, Henderson	209	5.2	37	0.9
Daviess	Owensboro-Daviess County, Owensboro	496			
	Our Lady of Mercy, Owensboro	133			
Total		629	7.3	100	1.2
Vanderburgh	St. Mary's Medical Center, Evansville	484			
	Deaconess, Evansville	590			
	Welborn, Evansville	487			
Total		1561	9.3	250	1.5

Sources:
1. Personal communication, J. Ballard, Dec. 3, 1980.
2. Personal communication, Mrs. Upchurch, Dec. 4, 1980.
3. Personal communication, J. Breamer, Dec. 4, 1980.

to the population. Each county possesses at least one major health care facility, each of which operates at between 75 to 90% of capacity. This is an acceptable level of service and is in accordance with Federal guidelines indicating that 80% or higher utilization is an efficient operating level for hospitals. The Owensboro-Daviess County Hospital and Our Lady of Mercy Hospital serve as regional health care facilities and serve residents of Hancock, McLean, Daviess, Ohio, and Muhlenburg counties as well as nearby portions of Indiana. Our Lady of Mercy Hospital is currently projecting a $10.5 million expansion and renovation program (Mr. Michael Bouvier, Our Lady of Mercy Hospital, written communication, February 13, 1981). Special medical cases are normally handled by hospitals in Louisville or Nashville if they cannot be treated locally. Residents of the small communities surrounding the proposed SRC-I site must rely upon medical facilities, primary health care personnel, and emergency medical services in Henderson and Owensboro.

Owensboro-Daviess County Hospital provides emergency medical services to the entire county, with four ambulances staffed by emergency medical technicians (EMTs), and residents of Henderson County are provided emergency medical services through Community Methodist Hospital, which utilizes four ambulances staffed by paramedics (Michael Bouvier, Our Lady of Mercy Hospital, written communication, February 13, 1981). The Henderson-Owensboro area is also within the range of the helicopter services of Fort Campbell and Fort Knox (both in Kentucky), which have standby crews available to aid the civilian community. Vanderburgh County residents are provided emergency medical services through each of its three hospitals which all maintain emergency rooms. Ambulance services are primarily contracted between the City of Evansville and private companies and funeral homes which serve the entire county. Approximately 30 ambulance units operate in the city. Evansville also provides a team of emergency medical technicians (EMTs) and paramedics which operate through the fire department; it also maintains two ambulances.

Police and fire protection

The cities of Owensboro, Henderson, and Evansville all maintain municipal police departments. In May 1979, Owensboro and Henderson employed 85 and 38 law enforcement officers or approximately 1.6 and 1.5 officers per 1000 population, respectively. Evansville, which employed 245 uniformed police officers and law enforcement supervisory personnel in 1980, yielded an officer per 1000 population ratio of approximately 1.9 during that year. Daviess, Henderson, and Vanderburgh counties also maintain sheriffs' departments, which serve unincorporated urban and outlying county areas. All of the small population centers in the vicinity of the proposed site are served by the sheriffs' departments of either Henderson or Daviess county. In 1979, Daviess County employed 10 sheriffs' officers while Henderson County had a force of 15. Representatives of law enforcement agencies in both Henderson and Daviess counties indicate that, in general, existing manpower is sufficient to meet present community and county needs. Vanderburgh County, Indiana, maintained a full-time force of 77 sheriffs' personnel and a supplemental reserve of 50 during 1980.

Fire protection is afforded local impact area residents by either municipal or county fire departments staffed by either full-time or volunteer firemen. The cities of Owensboro, Henderson, and Evansville all maintain full-time municipal fire departments which have staffing levels of 98, 50, and 258, respectively. The number of firefighters per 1000 population in Owensboro is approximately 1.8; in Henderson, 2.0; and in Evansville, 2.0. On the basis of fire-fighting personnel, the level of fire protective services in all three cities appears adequate. The adequacy of fire protection in these cities is further reflected by fire insurance ratings given each locale. Where 1 represents the highest level of service and 10 reflects no protection service available, Owensboro, Henderson, and Evansville carry ratings of 3, 5, and 3, respectively. Fire protection available to impact area residents not living in incorporated areas is generally provided via full-time and/or volunteer county fire departments. Henderson County does not employ a full-time cadre of fire fighters but is served by 90 volunteers. Daviess County, which maintains a 9 rating county wide and a 7 rating for all structures within 1000 ft of a hydrant, sustains a full-time force of 18 fire fighters, who are supported by 248 volunteers. Fire stations are located in several of the smaller communities in Daviess County, each of which typically has a rated pumper and tanker. These units and their volunteers are all in communication via radio-dispatched systems (Michael Bouvier, Our Lady of Mercy Hospital, written communication, February 13, 1981). Vanderburgh County, which maintains a fire insurance classification of 7, does not have a full-time fire department but is served by various volunteer departments whose manpower levels are currently unknown.

Electricity

The proposed site area is served by Green River Electric Corporation. The Big Rivers Electric Corporation sells power to the Green River Electric Corporation and the Henderson-Union Rural Electric Cooperative Cooperation (RECC). The current electrical transmission and distribution system at the site is not adequate to supply all of the power needed by the SRC-I project. A proposed Baskett and Newman 161-kV transmission line and switching stations will be adequate to serve the SRC-I project. The primary purpose of the proposed new substations and 35 miles of 161-kV transmission line addition to the Big Rivers system is to serve the proposed industrial load additions to its member cooperatives, Henderson-Union RECC and Green River Electric Corporation. The proposed transmission line is addressed in the "Borrower's Environmental Report" available from Big Rivers Electric Corporation. A specific route between the Baskett and Newman substations and a specific location for the Newman substation have not yet been determined.

Other companies providing electrical service in Daviess and Henderson counties are Henderson Municipal Power and Light, Owensboro Municipal Utilities, and Kentucky Utilities Company.

Water supply

Owensboro Municipal Utilities, Henderson Municipal Water and Sewer Department, and the Evansville Water Department are the major water suppliers to Daviess, Henderson, and Vanderburgh counties, respectively. Owensboro Municipal Utilities utilizes groundwater as the major source for water via 32 wells. Design capacity of the water treatment plant is approximately 76×10^6 liters/d (20×10^6 gal/d). Average daily demand is estimated at 38×10^6 liters/d (10.0×10^6 gal/d), or 700 liters/pcd (184 gpcd); the current water distribution system is operating at approximately 52% of capacity during normal consumption. Under peak demand conditions, the plant operates at about 68% of capacity. It is estimated that approximately 22% of all Daviess County residents use private water sources (e.g., wells and cisterns). To date, no evidence of significant water table depletion has been noted.

The Henderson Municipal Water and Sewer Department sells water to the Henderson County Water District, which in turn distributes water to county residents. The Ohio River constitutes the primary source of water. Total Henderson County water demand averages 17.0×10^6 liters/d (4.5×10^6 gal/d) or 953 liters/pcd (252 gpcd). The storage capacity of the system is 25.4×10^6 liters (6.7×10^6 gals). The estimate of daily per capita usage takes into account that 20% of Henderson County residents utilize private water sources. Approximately 22.7×10^6 liters (6×10^6 gal/d) of water are treated and made available for use daily. As a result, it is estimated that the current water distribution system is operating at approximately 75% of capacity under normal demand conditions. No firm plans currently exist for system expansion. The small communities of Reed and Spottsville, which are situated proximal to the proposed

site, differ in reliance upon water supply sources. Reed provides its own water via wells, and Spottsville is supplied by the Henderson County Water District.

The Evansville Water Department supplies water to both Evansville residents and the residents living in the remainder of Vanderburgh County. The Ohio River constitutes the primary water source. Design capacity of the water distribution system is estimated at 227 x 10^6 liters/d (60 x 10^6 gal/d), while consumption averages 106 x 10^6 liters/d (28 x 10^6 gal/d), or 631 liters/pcd (167 gpcd). This indicates an excess capacity of slightly more than 53%. Even under maximum water (peak flow) demand conditions (136 x 10^6 liters/d or 36.0 x 10^6 gal/d), excess capacity approximates 40%, indicating that a substantial capability for accommodating future increases in water demand exists.

Wastewater treatment facilities

Wastewater treatment is provided to residents in the cities of Owensboro, Henderson, and Evansville via municipal wastewater treatment plants, all of which provide secondary treatment. Residents residing outside of these cities in Daviess, Henderson, and Vanderburgh counties generally utilize septic tanks and are not included in a general wastewater collection system. This is particularly true for the communities within 8 km (5 miles) of the proposed site.

Owensboro possesses a 45.4 x 10^6 liters/d (12 x 10^6 gal/d) wastewater treatment facility, which discharges its effluent into the Ohio River. Average daily flow approximates 31.3 x 10^6 liters/d (8.5 x 10^6 gal/d), or 59.6 liters/pcd (158 gpcd). This indicates an excess capacity of approximately 37% under normal operating conditions. Peak flow, which occurs four or five times per year, is about 95 x 10^6 liters/d (25 x 10^6 gal/d), or in excess of double the design capacity. System backup during periods of high rainfall and flooding in the Ohio River is typical. While no plans for expansion currently exist, feasibility planning for a new plant is under way.

Henderson Municipal Water and Sewer Department operates a 28.4 x 10^6 liters/d (7.5 x 10^6 gal/d) wastewater treatment plant which discharges effluent into the Ohio River. Average daily flow approximates 11 x 10^6 liters/d (2.9 x 10^6 gal/d), or 442 liters/pcd (117 gpcd). This constitutes an excess capacity of more than 60%. Peak flow approximates 14.4 x 10^6 liters/d (3.8 x 10^6 gal/d), well below the plant's design capacity. No expansion is currently planned.

Evansville residents are served by two wastewater treatment plants that are situated in the eastern and western portions of the city. These plants have a combined secondary treatment capacity of 146 x 10^6 liters/d (38.6 x 10^6 gal/d) and a combined primary treatment capacity of 193 x 10^6 liters/d (51.0 x 10^6 gal/d). In 1976, contributions to both facilities were approximately 70 x 10^6 liters/d (18.4 x 10^6 gal/d), or 539 liters/pcd (143 gpcd). Excess capacity of slightly higher than 50% is indicated. However, because of rapid growth on the periphery of Evansville, particularly on the north side and in the Green River Road area, interceptors in those areas may become overburdened and require upgrading. Although local officials are aware of this situation, no expansion or upgrading is currently planned.

Public finance

The major form of tax revenue available to local jurisdictions within the 21-county impact region is the property tax. Property tax rates for the Kentucky and Indiana region are presented in Tables 3.23 and 3.24. Property tax revenues from industrial or commercial properties are dependent upon these tax rates, but manufacturing machinery is subject to only a 15¢/$100 levy instead of the existing 45¢/$100 levy for nonmanufacturing machinery and equipment.

All residential property would be subject to the full taxing authority of the appropriate jurisdiction. Kentucky taxes property at full market value, while Indiana levies a tax against the assessed value of property, defined as one-third of the fair market value less depreciation.[37]

While other forms of tax revenue (liquor tax, cigarette tax, gasoline tax, and utility tax) are available to local governments, they represent only a minor part of total revenues and are therefore merely identified as possible revenue sources.

Table 3.23. Property tax rates by county for Kentucky[a]

Area/jurisdiction	County	School	State	City[b]
Daviess	14.2	24.2	27.9	45.0
Henderson	14.1	39.2	27.9	53.0
Union	14.7	29.8	27.9	
Webster	17.5	14.9	27.9	
Hopkins	15.1	38.0	27.9	
McLean	15.3	7.7	27.9	
Nuhlenberg	11.9	7.7	27.9	
Butler	21.6	11.2	27.9	
Ohio	14.0	6.9	27.9	
Hancock	17.4	26.9	27.9	
Breckenridge	17.9	15.7	27.9	

[a] All rates are in cents per $100 valuation, 1979 tax rate.
[b] In Daviess County the city is Owensboro; in Henderson County, Henderson.

Table 3.24. Property tax rates by county for Indiana[a]

Area/jurisdiction	County	School
Posey	5.325	2.71
Vanderburgh	8.296	3.466
Warrick	4.625	3.90
Spencer	4.651	2.46
Perry	5.56	2.23
Gibson	4.918	2.71
Pike	3.725	3.41
Dubois	6.215	4.44

[a] All rates are in dollars per assessed $100 valuation and represent the total average area-wide tax rate for the specific jurisdiction, 1980 tax rate. Assessed valuation is defined as one-third of the fair market value minus depreciation.

Public finance: education

Public education in the local impact area of Daviess, Henderson, and Vanderburgh counties is supported by State, local, and Federal revenues. The State of Kentucky, through the Foundation Program Fund and the Power Equalization Program Fund, provides support for education to maintain an adequate level of education throughout the state. Disbursements to school districts for the Foundation Program are based upon eligible classroom units, which approximates 27 pupils per unit. The Power Equalization Fund is based on the fair cash value of property per pupil between counties. The current property tax limitation in Kentucky, as set forth in House Bill 44, will effectively limit the contribution from local sources to education. State contributions in 1978-1979 comprised 65.5% of total revenues, with local and Federal sources accounting for 20.5% and 14.0%, respectively.

The State of Indiana provides support for education primarily through the Basic Grant and the ADA (Average Daily Attendance) Flat Grant Fund. In the 1979-1981 biennium, Basic Grant revenue constitutes almost 90% of total grant revenues, and ADA Flat Grant revenues provide approximately 4.5% of total receipts. The Basic Grant applies for grades K-12 and is earmarked for instructional salaries, other current expenses, and special and vocational education.

Current property tax limitations will also effectively limit the contribution from local sources to education in Indiana. In 1973, the Indiana General Assembly enacted legislation that froze all school general fund tax levies. Currently, 58% of total educational revenues are from the State of Indiana, 38% generated locally, and 4% comes from the Federal government. There are

indications of a steadily increasing role for the State as the primary contribution toward educational assistance (Dr. Copelen, Indiana Department of Education, personal communication, December 5, 1980).

3.2.4.5 Transportation

Highways and roads

Major highways in the regional area include U.S. Interstate 64, which runs through northern Vanderburgh County and provides excellent access to other regions, and the Western Kentucky Parkway, a toll road located at the southern end of the regional area and connecting the regional area to Lexington (east) and to Paducah, Kentucky (west).

The major north-south routes in the intermediate area are the Pennyrile Parkway (a toll road that connects the city of Henderson with Hopkinsville, Kentucky) and the Green River Parkway (which extends between Owensboro and Bowling Green, Kentucky). The Audubon Parkway and U.S. 60, the major east-west highways in the area, connect the cities of Owensboro and Henderson.

The proposed SRC-I plant site is located in northwest Daviess County adjacent to the Henderson County line, opposite the town of Newman, Kentucky. The plant site is roughly bounded by the Louisville and Nashville Railroad (L&N) right-of-way and U.S. 60 to the north and by the Green River to the south. The proposed site straddles Murphy Road approximately 9 miles west of the Owensboro, Kentucky, bypass and approximately 16 miles east of U.S. 41 at Henderson. The plant site is centered in a sparsely populated agricultural area. Few manufacturing and/or retail establishments are located in the immediate site area. Figure 3.17 shows principal transportation routes in relationship to the plant site.

At the present time, access to the plant site is essentially limited to U.S. 60 between Henderson and Owensboro, a two-lane undivided highway approximately 22 ft wide. The route alternately traverses level and moderately hilly terrain. The route includes moderate curves, many concurrent with the hills, and other curves associated with crossings of the L&N tracks (three crossings), various creeks and wetlands, and the Green River. While posted speed limits on the road are generally 45 mph, effective vehicle speeds range from 55 mph along the sparsely traveled straight and level sections to less than 25 mph at several railroad and bridge crossings.

The various small communities between Owensboro and Henderson served by U.S. 60 and their 1980 preliminary population estimates are presented in Table 3.25.

Table 3.25. Population at Henderson, Owensboro, and intermediate Route 60 points

Henderson County (west of Newman)		Daviess County (Newman and east)	
Carlinburg[a]	52	Stanley[b]	302
Reed[c]	123	Birk City[a]	52
Spottsville/Beals[c]	433	Newman[b]	311
Baskett[c]	353	Other rural	920
Other rural	7,506	Total rural[b]	1,585
Total rural[c]	8,467		
Henderson (city)[d]	24,778	Owensboro (city)[d]	53,839

[a]TERA estimate based on 2.74 persons per dwelling.
[b]From Owensboro Planning Commission.
[c]From Henderson County Planning Commission, based on 2.74 persons per dwelling.
[d]Preliminary 1980 U.S. Census.

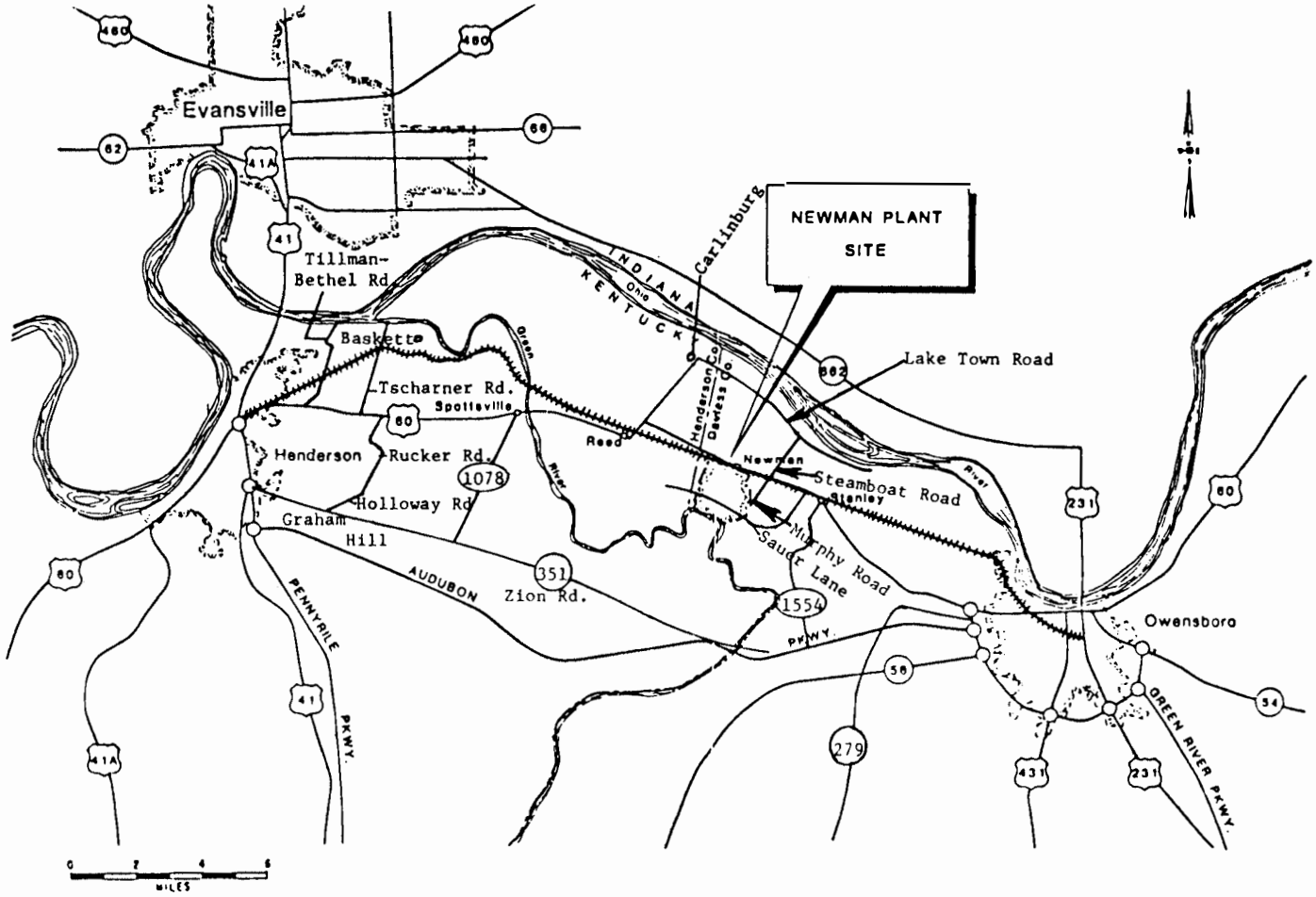


Fig. 3.17. Map of the Newman, Kentucky, SRC-I plant transportation impact area.
Source: adapted from Wilbur Smith and Associates by TERA, Inc.

The major structural flow constraints on U.S. 60 associated with certain of the above communities are

1. railroad grade crossings with 90° turn at Reed and Stanley (between those two points, which includes the plant site at Newman, the L&N tracks are south of U.S. 60),

2. Green River Bridge at Spottsville/Beals (narrow two-lane with weight limit),

3. highway bridge over L&N tracks near Henderson (bridge is narrow and feeds a hill-and-curve segment).

In addition there are numerous intersections along U.S. 60 with paved and unpaved secondary roads between Owensboro and Henderson.

A report prepared for DOE by the Radian Corporation in April 1978 noted, "Highway 60 from Henderson to Spottsville is very densely settled. School buses stop regularly on that road for children. This highway is heavily traveled now, but increased traffic might be perceived by area residents as unacceptable. Finally, the Green River Bridge at Spottsville is very dangerous, and increased traffic might be unacceptable to area residents."[38] The Kentucky DOT refers to the Spotsville Bridge as "geometrically substandard."

Table 3.26 presents nationally recognized definitions of level of service to which that for U.S. 60 should be compared.

Table 3.26. Level of service description for two lane rural road

Level of service	Description	Average overall travel speed (mph)
A	Free flow (relatively)	⩾60
B	Stable flow (slight delay)	⩾50
C	Stable flow (acceptable delay)	⩾40
D	Approaching unstable flow (tolerable delay)	⩾35
E	Unstable flow (congestion; intolerable delay)	30
F	Forced flow (jammed)	<30

Source: 1965 Highway Capacity Manual

At a D level of service, service volumes can be expected to be between 975 and 665 vehicles per hour, depending upon the precise location along U.S. 60 from Henderson or Owensboro toward the Newman site. The higher volumes can be expected nearer the two urban centers with the lowest volume at a steep incline just west of the town of Reed. At a lower level of service (level E — unstable flow), operating speeds drop to below 30 mph, but service volumes can be expected to increase slightly to a high of approximately 1200 and to a low of 780 vehicles per hour. Level E service volumes also represent an approximate maximum capacity for a road. By definition, capacity is the maximum number of vehicles which has a reasonable expectation of passing over a given section of a lane or a roadway in one direction (or in both directions for a two-lane or a three-lane highway) during a given time period (usually 1 hr) under prevailing roadway and traffic conditions.[39]

Traffic counts conducted by the Kentucky Department of Transportation (KDOT) show that traffic volumes along U.S. 60 between Henderson and Owensboro are the highest near Henderson and generally decrease as one moves east along U.S. 60, reaching a low point near the proposed plant

site; then they gradually increase moving toward Owensboro. Peak vehicle flows are expected to show a similar pattern and can be expected to range from a high of approximately 1100 vehicles per hour near Henderson to a low of approximately 250 vehicles per hour near the proposed plant site and approximately 350 vehicles per hour near Owensboro. At the present time, D level of service is maintained along the entire route, except for two short segments of U.S. 60 near Henderson.[40]

The KDOT has developed a sufficiency rating system for rural roads. This system takes into consideration a number of factors, some of which are roadway structural conditions, width, average daily traffic (ADT), passing-sight distances, drainage, and remaining life. In Henderson County, U.S. 60 was last rated by this system in 1972 and received a rating of 32 on a scale of 1 to 100. The KDOT considers a perfect rating to be 100, while roads with a rating of 50 "need to be looked at." Since 1972, there have been significant changes affecting U.S. 60, such as growth in ADT and change in remaining life. Therefore, if U.S. 60 were rated in 1980, its sufficiency rating would be even lower.[41]

Given the low sufficiency ratings and the possible construction of several synthetic fuels facilities, the state of Kentucky is considering widening and upgrading U.S. 60 between Henderson and Owensboro.

The Kentucky DOT, Division of Traffic, provided accident data for the study area for the most current one-year period, which was November 1, 1978, through October 31, 1979. A total of 60 accidents were reported in the study area (from U.S. 41 to Tscharner Road — 4 miles) during the one-year period. Nearly one-half of these accidents took place in the one-mile stretch of U.S. 60 just east of U.S. 41. This is equivalent to an accident rate of 7.1/1,000,000 vehicle miles. Although the only reported fatality occurred in this link, most of the injury accidents took place elsewhere on U.S. 60.

Railroads

The plant site adjoins the tracks of the L&N main line between Evansville, Indiana, and Louisville, Kentucky. The L&N operates four freight trains daily between Evansville and Louisville with a stop at Owensboro. No local service is provided between Owensboro and Henderson.

The L&N line has one northbound and one southbound freight stop in Owensboro on a daily basis and a north- and southbound freight stop in Henderson six days a week. Illinois Central Gulf Railroad provides north and south freight stops six days a week in Henderson and three days a week in Owensboro. All of the L&N tracks in the immediate site vicinity can carry a 7500-ton unit train.

Waterways

The Green River, a major waterway that borders the proposed plant site, has a 2.7-m (9-ft) navigable channel extending 165.7 km (103 miles) upstream of its confluence with the Ohio River. The channel width is roughly 91.4 to 121.9 m (300 to 400 ft). The Ohio River is also a major waterway, with a 2.7-m (9-ft) channel and a minimum channel width of 91.2 m (300 ft) for its entire length.

The Mead Johnson Terminal (in Evansville) and the Owensboro Riverport facility (in Owensboro) provide the area with excellent river-rail-truck access and storage service. Commercial barge lines serving Owensboro include American Commercial Barge Lines, Union Barge Line, Mississippi Valley Line, and Walker Towing Company.

The Green River is heavily used for coal transportation. In 1978, a total of 12,728 barge tows passed through Lock 1, upstream from the site. The U.S. Army Corps of Engineers requires that a 30- to 45-m wide (100- to 150-ft) clear navigational channel be maintained.

3.2.4.6 Historical, cultural, and archaeological features

Historical/architectural survey

Kentucky County, which was part of Fincastle County, Virginia, until 1776, formed a state in 1792. Daviess County was carved from Ohio County in 1815 with Owensboro as its county seat. The area being considered as the plant site became part of Daviess County in 1860.

It is believed that Kentucky had no permanent Indian settlements. It served only as a hunting ground and an occasional battleground for Indians to the north and south. In 1769, Daniel Boone entered the territory through the Cumberland Gap. He was the first Anglo-Saxon to seriously explore the area, and settlers soon followed.

A large part of Daviess County was owned by wealthy Virginians such as James Madison, James Mason, and John Bannister. As a result, a majority of the area's first settlers were squatters. William Smeathers (or Smothers) established the first permanent settlement in Daviess County.

Most of the farms were small, and tobacco and grains were the main crops. Grain-fed animals, primarily hogs, were the most important livestock.

The proposed plant site is in the Oakford Precinct, which is located in the northwest part of Daviess County. There are five significant structures in the vicinity. They are:

1. A grocery store located at the northwest corner of Route 60 and Murphy Road, built around 1900, is a good example of vernacular architecture. It is of wood frame construction and is in fairly good condition. William H. Alexander is the owner.

2. A house in good condition located on the southwest corner of Route 60 and Murphy Road is owned by Simon E. Silas. The house, built around 1900, is of wood frame construction and exhibits Queen Anne style architecture. The original owner and builder was J. H. Babe.

3. A house built around 1860 is located one-half mile west of Flanagan Road on the north side of Sauer Lane. Owned by Charles M. Dunn, the house has a wood frame and is an example of vernacular architecture.

4. A house located near the southeast corner of Murphy Road and Route 60 was constructed around 1860 of wood frame with an architecture exhibiting Eastlake influence. The house is owned by Carl Watson and is in poor condition.

5. A house located about one mile west of Newman on the north side of Route 60 was built around 1910 and is an example of Dutch Colonial Revival architecture; construction is masonry and wood frame. The house is owned by Herman Miller and is in good condition.

Some of the buildings in the area could be of State interest, but few are thought to be architecturally important. None are listed in the *National Register of Historic Places* (see Appendix U).

Paleontological survey

The site studied is 323 ha (800 acres). It is situated between the Ohio and Green rivers with Pleistocene slackwater and lacustrine sediments underlying its surface. A large amount of subsurface vertebrate bones are not likely, but discoveries in environments similar to that of the proposed site have occurred. Teeth and bones of the Pleistocene mastodon have been uncovered along the Ohio Valley. A skull and bones of Pleistocene camel were discovered near Owensboro, and bones from a ground sloth were found near Henderson, Kentucky. These discoveries indicate the possibility that vertebrate bones could also be found on the proposed plant site.

Cultural resource assessment

Daviess County is situated in the western part of Kentucky on the Indiana-Kentucky state line. The Ohio and Green rivers flow very near the proposed site's northern and southern boundaries respectively.

In western Kentucky, the late Pleistocene and Holocene geological periods showed great changes in climate. The cultural traditions for the area were archaic (8000-6000 BC to 1500 BC), woodland (1500 BC to 900-1000 AD), and Mississippian (900-1000 AD to historic epoch).

Tobacco, corn, and soybeans are the major crops. Over the past 150 years, the plant site area has been changed by agricultural practices. At one time the area was a marsh region; now, no indigenous vegetation can be seen, and a variety of crops are being cultivated.

Archaeological Services, Inc., of Lexington, was contracted in October 1977 by Dames & Moore to evaluate the impact of the construction of the proposed Newman Industrial Plant. After the survey was completed, it was recommended that no further testing be done because no deeply buried cultural deposits were revealed. Eight "occupational zones" were identified.

In 1979, the Department of Anthropology at the University of Kentucky was contracted by Dames & Moore to survey additional lands that would be affected by the proposed plant construction. No new resources were discovered on the additional lands, but it was concluded that two archaeological sites previously recorded from the 1977 survey (sites 15DA73 and 15DA74) would be affected by the proposed plant construction more than previously thought. Field work to investigate these two sites was therefore initiated. The work again revealed no buried cultural deposits. It is therefore concluded after consultation with the State Historic Preservation Officer that no historical localities within the boundary or immediately adjacent to the site are listed as potentially eligible sites for nomination to the *National Register of Historic Places* (see Appendix U).

3.3 ALTERNATIVE SITE 1: EQUALITY, OHIO COUNTY, KENTUCKY

The Equality, Kentucky, site (Fig. 3.18) is one of the two alternative sites selected for comparison with the proposed Newman site (Fig. 2.7, Sect. 2.3.2.2). Alternative sites for the proposed SRC-I project were evaluated using reconnaissance-level data. The site selection methodology is discussed in Appendix B, and the floodplain/wetlands assessment of the Equality site is in Appendix D.

3.3.1 Land

3.3.1.1 Location

The alternative Equality site consists of over 400 ha (1000 acres) located on the Green River, about 1.6 km (1 mile) west of the town of Equality in northwestern Kentucky. The entire site is within the boundaries of Ohio County, about 21 km (13 miles) west of the county seat of Hartford on the two-lane Equality access road (see Fig. 3.19). The area is described topographically in Fig. 3.20. The county's largest population center, Beaver Dam, is located 26 km (16 miles) east of the site. Other local towns of consequence are Central City and Greenville, 32 km (20 miles) and 45 km (28 miles) west, respectively, in Muhlenberg County and Livermore, 43 km (27 miles) north in McLean County. All of the above figures are road distances. The major trade center for the area is Owensboro, 64 km (40 miles) north in Daviess County (David Doctor, Green River Area Development District, personal communication, November 24, 1980). The relative sizes of the towns in the Equality site impact area are presented in Table 3.27.

3.3.1.2 Land use and development

The Equality site is located in a predominantly rural setting. Roughly 50% of the site is located in the Green River floodplain, and the other 50% is in the hills to the east of the river. About half of the floodplain is cultivated for corn production, and less than half of the hilly land is used for pastureland. Most of the remainder of the site is wooded but is not actively logged. About 320 ha (800 acres) of the entire 405-ha (1000-acre) site are classified as prime farmland, and 70 ha (175 acres) are additional soils of statewide importance. Underlying coal deposits are not currently being mined. About ten residences are currently located in the hilly portion of the site area.

Although the facility itself will be located in one relatively small section of Ohio County, a much larger area will receive land use and socioeconomic impacts as a result of this project.



Fig. 3.18. The Equality, Kentucky, alternative SRC-I site.

ES-5636

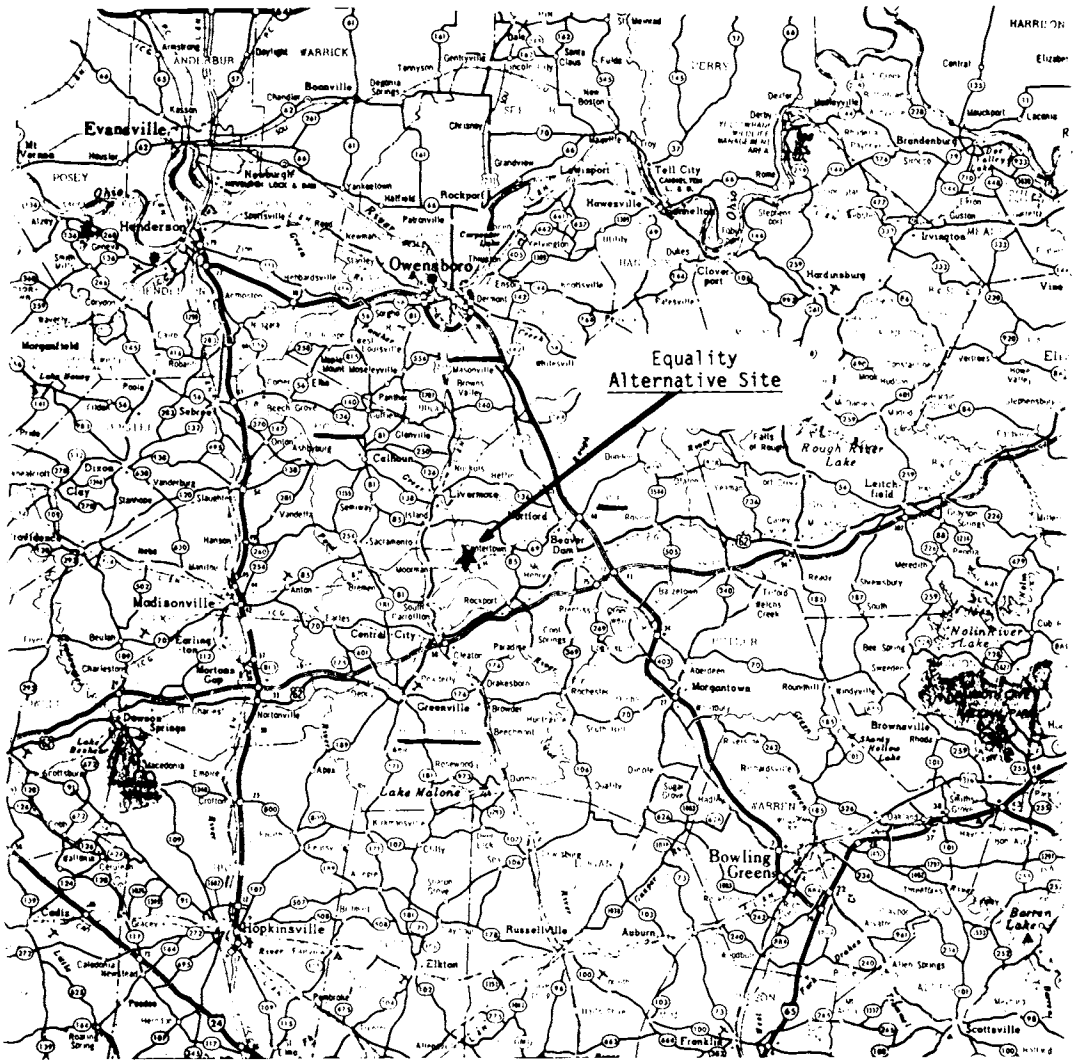


Fig. 3.19. Equality alternative site, regional location.

This larger area, referred to as the socioeconomic impact region, consists of Ohio, Muhlenberg, McLean, and Daviess counties; those jurisdictions are expected to absorb the great majority of project-related workers and accompanying impacts (Sect. 4.3.4.1).

Table 3.28 presents a picture of current land use in the impact region. Throughout the four-county impact area, varying intensities of agricultural and mining activity are present. Prime farmland on the floodplain to the north and west have produced larger-scale farming; coal stripping activities are located throughout the region.

Ohio County remains primarily active in agricultural production and has some significant coal activity, although employment in the coal industry has been declining in recent years (Rick Hiten, Pennyrile Area Development District, personal communication, November 26, 1980). Land uses in the more metropolitan county of Daviess to the north are characteristic of that area's

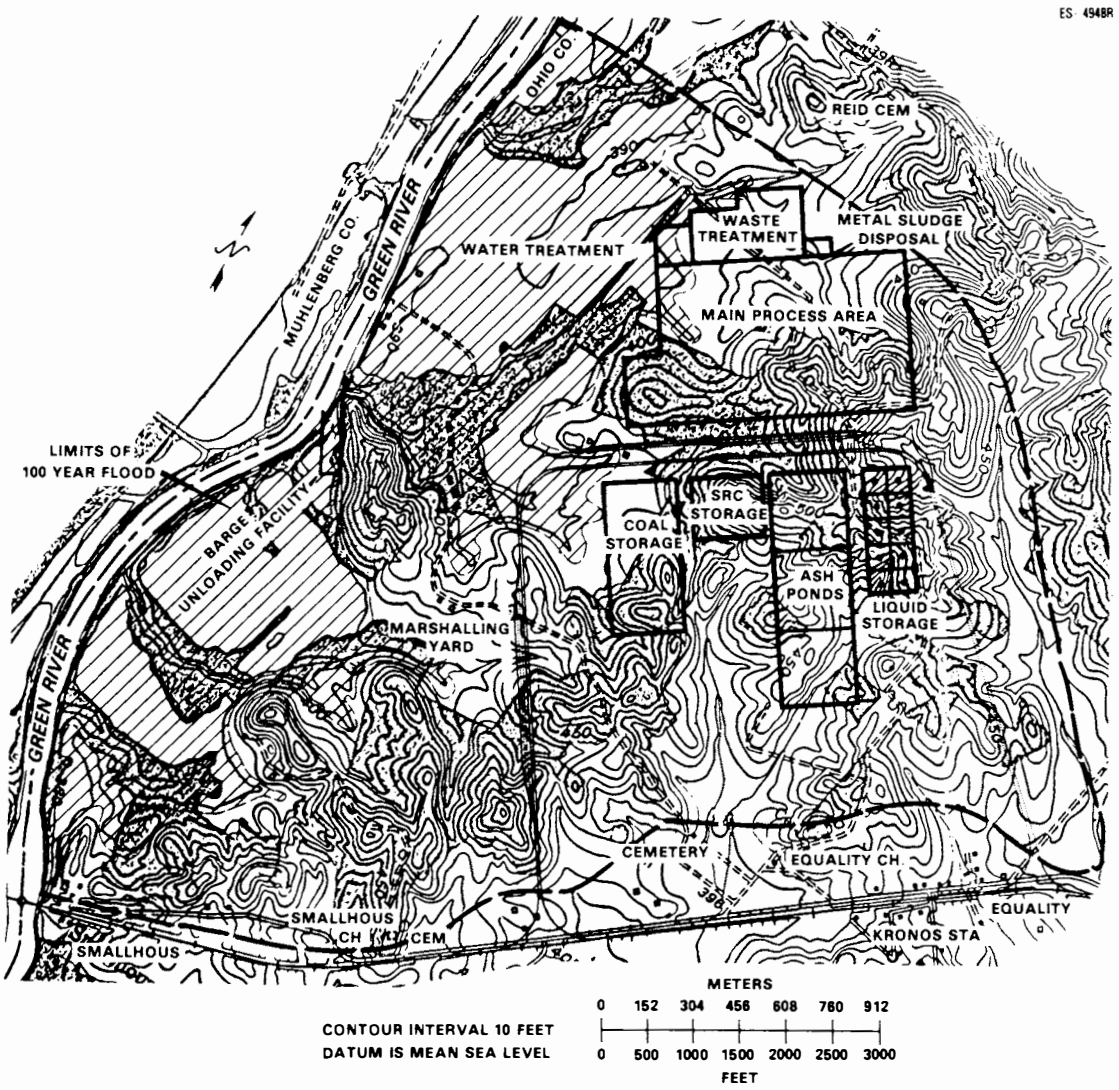


Fig. 3.20. Topography and general setting of the Equality, Kentucky, alternative site.

greater industrialization, especially in and around Owensboro. McLean County is still predominantly agricultural with small amounts of coal mining activity. Muhlenberg County is experiencing an increase in mining, while it's agricultural base remains, for the most part, unchanged. The overall region is in the process of seeking industrial activity.[42]

Ohio, Daviess, and McLean counties all have county-wide land use planning, zoning ordinances, and subdivision regulations under the regional coordination of the Green River Area Development District. The District has policies favorable to industrial growth in these counties.[43] Muhlenberg County, a part of the Pennyrile Area, also practices zoning, subdivision regulation, and building and housing code enforcement and is favorable to industrial growth.[42]

Table 3.27. Population of counties and towns in the Equality, Kentucky, impact area, 1980

Ohio County	21,845
Equality	50
Hartford (and rural area)	3,752
Beaver Dam (and rural area)	6,867
Daviess County	85,702
Owensboro	53,834
McLean County	11,058
Livermore (and rural area)	3,424
Muhlenberg County	32,315
Central City (and rural area)	3,816
Greenville	5,215

Sources: Mohammed Taugi, Kentucky State Planning Office, personal communication, Nov. 25, 1980; U.S. Census Bureau, personal communication based on preliminary figures from the 1980 census of population, Nov. 25, 1980.

Table 3.28. Percentage of current land use in Equality, Kentucky, impact region

	County			
	Ohio	Daviess	McLean	Muhlenberg
Urban/built up		3.73		a
Agricultural	33.77	65.85	72.71	a
Forest	64.60	26.63	25.76	a
Other	1.63	3.79	1.33	a

[a]Not available because land use surveys have not been conducted in Muhlenberg County.

Source: R. Hiten, Green River Area Development District, personal communication, Nov. 26, 1980.

3.3.1.3 Geology and soils

Soils

Two major soil associations have developed on the Equality site: the Willston-Zanesville-Frondorf in the upland areas and the Newark-Upside-Melvin in the floodplain area. The Willston-Zanesville-Frondorf association is developed over siltstone and sandstone bedrock, ranges from clayey to sandy silt, is moderately to well-drained, and contains residual bedrock fragments. Hydrous oxides of iron and manganese may accumulate in the upper foot of soil. Loess caps some hilltops in the area. Surface horizons on hillsides are sandy to pebbly soils.

The Newark-Upside-Melvin association soils on the floodplain are generally medium-to-dark brown sandy silt loams in contrast to upland soils, which are reddish-to-yellowish brown with moderate clay content. Floodplain soils are characterized by 0.3 to 0.7 m (12 to 30 in.) of medium-to-dark brown, silty-to-sandy loam overlying light-to-medium brown, fine-to-medium sand of the alluvium. Iron and manganese nodules form in the lower portion of the surface soils. Floodplain soils are excellent agricultural soils and may qualify as prime farmland.

Geology

The alternative Equality site, located in the Western Kentucky coal field, is underlain by bedrock of the Pennsylvanian Lisman and Carbondale formations. Coal is mined on adjacent tracts, and mineable reserves of No. 14 coal may exist on the site. Some gas and oil are produced in the area; however, no known oil or gas reserves are on the site. Pennsylvanian strata beneath the site are interbedded sandstone, siltstone, shale, limestone, and coal. Soil development over bedrock is thin in the hilly portion of the site, but as much as 30 m (95 ft) of alluvium covers the bedrock surface near the Green River.

The site is located in seismic risk zone 2 near the zone 3 border. The Rough Creek Fault Zone, a major structural element of the region, is located about 16 km (10 miles) north of the site; a zone of smaller east-west trending faults is located 19 km (12 miles) to the south. It is not possible to assess subsidence or liquefaction potential of alluvium because of lack of information on physical character of the material.

3.3.1.4 Terrestrial ecology

The Equality alternative site consists of approximately equal areas of Green River floodplain and hills that rise more than 50 m above the floodplain. Riparian forest occupies about half of the floodplain. The three streams that enter the Green River on the site support hardwood swamp forest. Excellent habitat is provided for wood duck, raccoon, mink, and other species typical of wooded swamps. Vegetation in these areas is mature but has been disturbed by selective cutting. The remainder of the floodplain consists of prime farmland and is primarily devoted to the cultivation of corn.

Hedgerows dominated by black oak divide the small fields, making them particularly accessible to wildlife and providing corridors between wooded areas. Hills are mostly covered with oak-hickory forest. The presence of a few very large trees with typical open-field growth lends evidence that most of this area was once pasture. Succession on the recently abandoned farmland has progressed to the small tree stage.

The riparian forest on the site is potential habitat of the Indiana bat (Federally listed as an endangered species) (see Appendix K). Also, the bald eagle and arctic peregrine falcon may rarely pass through the area during migration, and gray and Indiana bats may use the site during the summer. The State of Kentucky recognizes but does not protect certain species that are rare within the State but not listed in the Federal Register.[44] Those species which may be found in the floodplain wetlands include the masked or common shrew, southeastern or Bachman's shrew, swamp rabbit, western lesser siren, three-toed salamander, and four-toed salamander. The entire site might be used by the rare bobcat, southeastern bat, and small-footed myotis.

3.3.2 Air

Northwestern Kentucky's climate is continental; the area is subject to wide extremes of temperatures and precipitation. Mean monthly temperatures range from 1°C (33°F) in January to 26°C (78°F) in July. Annual precipitation averages around 100 cm (40 in.); March is the wettest month, and October is the driest. Mean annual snowfall is around 30 cm (12 in.). Winds are moderate in the area, averaging around 3.5 m/s (8 mph), with a predominant direction of south through southwest. Northern Kentucky is subject to a variety of storms. Winter storms with high winds, low temperatures, and heavy snowfall occur infrequently. Ice storms or sleet can occur from October through April and present major hazards to utility wires and transportation.

The alternative Equality site is in the Evansville-Henderson-Owensboro Interstate Air Quality Control Region (AQCR 77). Although no air quality data are available for the vicinity of the site area, data are being collected in Ohio County about 29 km (18 miles) southeast of the site area. The Ohio County site is representative of conditions at the Equality site because of its rural nature, its location away from major pollution sources, and the general meteorological and topographic similarity of each site. All measured SO_2 concentrations in Ohio County are within Kentucky standards. Concentrations of total suspended particulates (TSP) exceeded the secondary annual standard of 60 $\mu g/m^3$; TSP levels were measured to be 63 $\mu g/m^3$ at two sites. One site exceeded the secondary 24-h standard of 150 $\mu g/m^3$ with a single measurement of 156 $\mu g/m^3$ (ref. 45). Fugitive generation of particles from agricultural activities, mining, or transportation are the most likely sources of TSP concentrations in the area.

The Paradise steam plant of the Tennessee Valley Authority, located near the Equality, Kentucky, site, has SO_2 monitors to the north of its plant which show SO_2 concentrations to be in compliance. Monitoring site No. 23 of the Paradise plant recorded an annual average of 23 $\mu g/m^3$, a second-highest 3-h reading of 950 $\mu g/m^3$, and a second-highest 24-h reading of 275 $\mu g/m^3$. Although these levels presently do not violate National Ambient Air Quality Standards, there are higher levels at the Equality site as compared with the proposed site at Newman, Kentucky.

3.3.3 Water

3.3.3.1 Surface water hydrology

The alternative Equality site, located at approximately Green River mile 756, is about 8 miles south of the confluence of the Rough and Green rivers. The floodplain at the site is about 1.5 miles wide, but it widens considerably a few miles downstream. One unnamed creek drains the bedrock hills and flows westward to the Green River through the center of the site. In addition, one very small lake is located within the site area boundaries, northwest of Smallhous Church.

The site is located between two U.S. Geological Survey stream gaging stations. One station at Green River mile 100, near Paradise, Kentucky, indicated an average river discharge of 260,572 liters/s (9201 cfs). The maximum discharge corresponding to a flood elevation of 120 m (394 ft) mean sea level (MSL) was indicated as 3,030,240 liters/s (107,000 cfs) on March 5, 1962. A discharge of 7080 liters/s (250 cfs) from October 23 to October 24, 1940, was the minimum flow recorded.[46] The 7-d, 10-year low flow was calculated as 9544 liters/s (337 cfs).[47]

In the event of a 100-year flood, the floodplain in the Equality site area would be completely covered. The expected river elevation of such a flood would be 120 m (394 ft) MSL,[48] which would cover the floodplain to the base of the bedrock hills east of the river (see Fig. 3.21 and Appendix D).

3.3.3.2 Groundwater

Water wells in the sand and gravel of the Green River alluvium near the site can yield more than 500 gpd. Although the silt and shale beds of the onsite bedrock hills will not yield water to wells in quantities large enough for domestic supplies, sandstone beds may yield large quantities of water, if the sandstones are not well cemented. The groundwater is usually hard and may contain objectionable quantities of iron. In addition, the saline/fresh water interface occurs within 61 m (200 ft) of the surface.

3.3.3.3 Surface water quality and aquatic ecology

High levels of suspended sediments from runoff and erosion, especially from surface-mined areas in Ohio, McLean, and Muhlenberg counties, and from barge traffic pose a serious water quality problem in the Green River. Other pollutants in the Green River include mine-acid drainage; municipal, industrial, and agricultural wastes; and oil-production effluents (Sect. 3.2.2.1). Table 3.29 presents data for the Green River downstream from the Equality site, regional water quality data, and water quality criteria for drinking water and for the protection of aquatic biota. These data indicate that total dissolved solids (TDS) in the region approach the drinking water standard. Surface waters in the region are generally moderately hard; reported values for the Green River range to extremely hard, and some trace elements (cadmium, copper, iron, lead, manganese, mercury, and zinc) reach concentrations in excess of criteria.

Although the Green River fishery is characterized by low productivity and a pollution-tolerant biota, the river supports a mixed warm water fishery including carp, largemouth bass, smallmouth bass, bluegill and other sunfish, crappie, muskellunge, white perch, buffalo, and white bass. Dominant plankton include diatoms, green and blue-green algae, rotifers, copepods, and cladocerans. Tubificids, chironomids, and oligochaetes dominate the benthic invertebrates. Few macrophytes are found in the channelized portion of the Green River.[49] Williams Creek, fed by a small stream at the eastern boundary of the site, contains river carpsucker, highfin carpsucker, and bluegill. Gizzard shad, freshwater drum, black crappie, and largemouth bass have been collected from the slough of the stream, which enters the site from the north and flows into the Green River midway between the northern and southern limits of the site (ER, Appendix P).

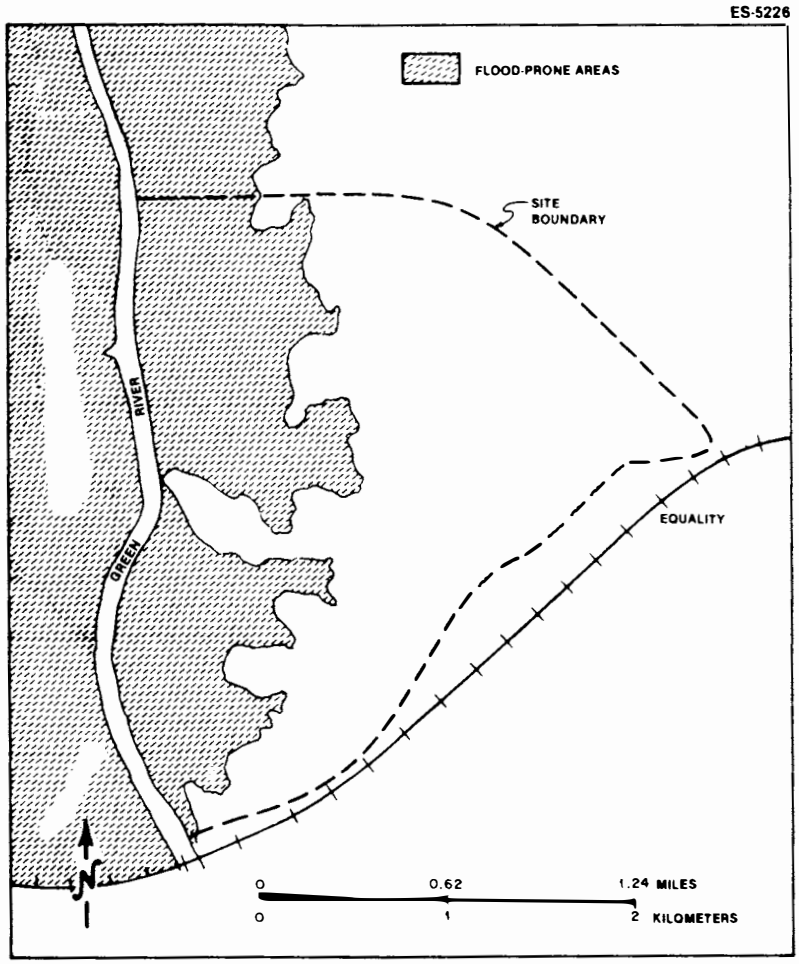


Fig. 3.21. 100-year floodplain areas of the Equality, Kentucky, site.

Impoundment and pollution of the Green River has resulted in the loss of a once-diverse assemblage of mussels.[50] Kentucky contains five mussels Federally designated as endangered.[51] Of these, only the pink mucket pearly mussel (*Lampsilis orbiculata orbiculata*) and the rough pigtow pearly mussel (*Pleurobema plenum*) are reported for the Green River. The pink mucket distribution in the Green River is reported only for the reach above Mammoth Cave. The rough pigtow pearly mussel may be in the Equality site vicinity.

The Kentucky list for threatened and endangered species is limited to those species on the Federal list. The mud darter (*Etheostoma asprigens*) and the longhead darter (*Percina macrocephala*), which are considered rare or threatened fish species in Kentucky but more abundant elsewhere, are also restricted to upper reaches of the Green River system in Kentucky.[44]

3.3.4 Economic, social, and cultural

3.3.4.1 Population

The Equality site and its immediate surrounding area is sparsely populated. The site itself contains ten residences, most of which are located in the hills. The average population density of Ohio County is only 37 persons per square mile. In 1970, only 14% of the county's total

Table 3.29. Water quality and flow rate in the vicinity of the Equality, Kentucky, site

All concentrations are in mg/liter unless otherwise shown

Parameter	Green River[a]	Regional[b]	Drinking water standard	Aquatic biota protection limit
Flow rate, m^3/s	46–1736			
7-d, 10-year low flow, m^3/s	9.5			
pH, units	6.6–8.3		6.5–8.5[c]	6.5–9.0[d]
Temperature, °C	1.5–30.1			
Total suspended solids	11–230	270–1900		
Total dissolved solids	104–319	120–350	500[c]	
Dissolved oxygen	6.4–15.0			5.0[d]
Hardness, as $CaCO_3$	95–220	60–120		
Sulfate	16–120		250[c]	
Chloride	3.2–14.0		250[c]	
Fluoride	0.0–0.4		1.4–2.4[e]	
Arsenic	0.000–<0.010		0.05[e]	0.3[f]
Barium	<0.200		1[e]	104[f]
Cadmium	0.000–0.004		0.010[e]	0.0012–0.0120[d]
Chromium	0.000–0.001		0.05[e]	0.100[d]
Cobalt	0.000–0.006			6.25[f]
Copper	0.006–0.014		1[c]	0.0009[g]
Iron	0.000–3.720		0.3[c]	1.0[d]
Lead	0.000–0.075		0.05[e]	0.003[g]
Manganese	0.020–0.470		0.05[c]	0.35[f]
Mercury	0.0001–0.0002		0.002[e]	0.00005[d]
Selenium	0.000–0.001		0.01[e]	0.02[g]
Silver	<0.030		0.05[e]	0.0001[g]
Zinc	0.000–0.060		5[c]	0.0004[g]

[a] Data for the Green River represent the range of values reported at Sebree in 1977 from the Ohio River Valley Water Sanitation Commission (1978), and at Beech Grove in Water Year 1975, from the U.S. Geological Survey (1977). Seven-day, 10-year low flow for U.S.G.S. Station at Paradise, Kentucky, the closest upstream station.

[b] From Geraghty et al. (1973).

[c] From U.S. Environmental Protection Agency (1977).

[d] From U.S. Environmental Protection Agency (1976).

[e] From U.S. Environmental Protection Agency (1975).

[f] Lowest concentration lethal to fish; source: Cushman et al. (1977).

[g] Application factor recommended in reference (c) multiplied by the lowest concentration reported by Cushman et al. (1977), as the concentration lethal to 50% of the test organisms in 96 h (the 96-h LC_{50}).

population was classified as urban; this compared with a statewide average of 52%. Table 3.30 indicates that Ohio County's population grew by 6% from 1960 to 1970. During that same period, McLean and Muhlenberg counties experienced slight declines in population, and the more urbanized Daviess County experienced a sizeable increase. The 1970 to 1980 period showed an overall growth rate of 14% for the entire impact region; during those same years, Ohio County grew 16%. The rapid urbanization of the Owensboro area that took place between 1960 and 1970 has leveled off substantially in the last 10 years, and the remaining impact area is predicted to remain essentially rural for the forseeable future.

3.3.4.2 Housing

Table 3.31 presents data on housing stock in the Equality impact area. Between 1970 and 1980, growth in the number of housing units varied from a low of around 10% in rural McLean and Ohio counties to a high of 32% in the more metropolitan Daviess County.

Table 3.30. Impact area population growth from 1960-1980

County	1960	1970	1980	Change from 1960-80 (%)
Ohio	17,840	18,790	21,845	+22
Daviess	70,708	79,486	85,702	+21
McLean	9,382	9,062	11,058	+18
Muhlenberg	27,791	27,537	32,315	+16

Sources: Mohammed Taugi, Kentucky State Planning Office, personal communication, Nov. 25, 1980; U.S. Census Bureau, personal communication based on preliminary figures from the 1980 census of population, Nov. 25, 1980.

Table 3.31. Housing stock in the Equality, Kentucky, impact area, 1970–1980

	Total housing		Percentage of change
	1970	1980	
Ohio County	6,103	6,753	10
Hartford	1,142	1,248	9
Beaver Dam	1,764	2,216	26
Daviess County	24,011	31,631	32
McLean County	3,055	3,316	9
Muhlenberg County	8,862	10,142	14

Sources: Mohammed Tougi, Kentucky State Planning Office, personal communication, Nov. 25, 1980; Cindy Martz, Green River Development District, personal communication, Nov. 25, 1980; U.S. Census Bureau, personal communication based on preliminary figures from the 1980 census of population, Nov. 25, 1980.

The Green River Area Development District and the Hartford city offices indicate that, with the exception of Daviess County, a housing shortage exists in the impact area as a whole. Available housing is relatively expensive, and the construction labor force is not adequate to handle existing demand (Katherine Maddox, personal communication, November 25, 1980, and Cindy Martz, Green River Area Development District, personal communication, November 25, 1980). Statistics from the 1970 Census that attest to the rural character of Ohio, McLean, and Muhlenberg counties include the high rate of overcrowding (10.4% of all housing units) and the large number of dwellings with inadequate plumbing facilities (21.9% for the entire area and 34.5% for Ohio County).[52]

3.3.4.3 Public services

Water and sewer

Table 3.32 lists water and sewer statistics for the four counties in the Equality impact area. Water supplies in Ohio County are close to being fully used by current customers. The same is true of the sewer system: average daily flow nearly meets the system's design capacity level. Muhlenberg and Daviess counties appear to have greater additional capacity for new customers for their water systems: Muhlenberg County's sewer system, however, is in need of additional capacity. McLean County is in the safest position in terms of available capacity for both

Table 3.32. Water and sewerage statistics for the Equality, Kentucky, impact region

10^3 gpd

	Water			Sewerage	
	Average daily consumption	Peak daily consumption	Plant capacity	Average daily flow	Design capacity
Ohio County					
Beaver Dam Municipal Water and Sewer System	450	550	*a*	400	For pop. of 6000
Hartford Municipal Water and Sewer System	325	375	500	275	300
Ohio County Water District	780	1,137	1,500		
Daviess County					
Owensboro Municipal Utility	10,000	13,524	20,000		
Owensboro Sewer Commission				8,500	12,000
McLean County					
Calhoun Water Works	250	*a*	430	130	200
Island Water Department	66	80	288	150	200
City of Livermore Utilities	200	250	500	Individual septic tanks	
Muhlenberg County					
Greenville Utilities Commission	339	397	750	300	500
Muhlenberg County Water District	750	*a*	*a*		
Plant No. 1	70	*a*	72		
Plant No. 3	233	*a*			
Central City Municipal Water and Sewer Commission	1,460	1,599	2,000	At capacity	600

[a]Not available.
Source: Kentucky Department of Commerce, 1979.

water and sewer service. As for future additions, 10 miles of pipeline have recently been added to the Central City water plant in Muhlenberg County to serve an additional 180 customers. McLean County has planned expansions at its Calhoun Water Works and at its sewer plant in the Island Water Department System.

Schools

The Equality impact area's school systems have experienced fairly stable enrollment over the past decade with the exception of a substantial decline in the Owensboro/Daviess County districts. Current unused capacity of all Daviess County school districts totals over 4500 seats. Turning to the other counties of the impact area, 225 spaces in Ohio County, 800 in McLean, and 950 in Muhlenberg are currently unused. Minor additions and general upgrading work are planned for several facilities (Earl Russell, Lloyd Tarter, Mildred Cole, and Earl Devine, personal communications, December 1, 1980).

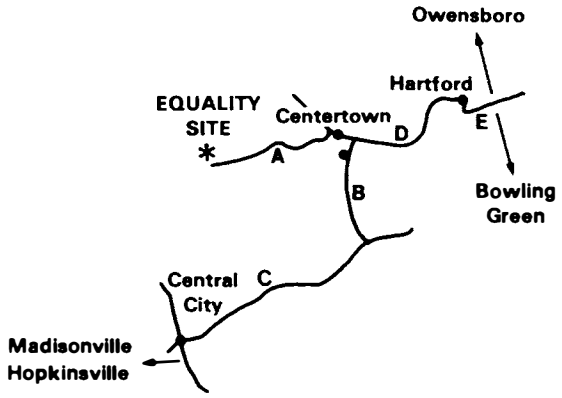
3.3.4.4 Transportation

One U.S highway (U.S. 231), two state routes (69 and 85), and a local access road (the Equality road) serve the immediate Equality site area. U.S. 231 is a two-lane paved road, varying in width from 6.2 m (20 ft) to 7.4 m (24 ft); it carries 10% truck traffic. State Route 69 has a 6.2-m (20-ft) bituminous surface and supported 2087 vehicles during an average 24-h period in 1979. State Route 85 has a 5.5-m (18-ft) bituminous surface and supported 1728 vehicles in a similar 24-h period in 1979. The Equality site access road also has a 5.5-m (18-ft) surface. All of these roads are without shoulders and run over rolling terrain with little area for

passing. Six percent of the traffic on the latter three roads is truck traffic (David Doctor, Green River Area Development District, personal communication, November 24, 1980).

Figure 3.22 gives the hourly capacities and peak hourly counts for selected road sections at the Equality site. It can be noted that road system does not currently experience heavy use.

ES-5637



SECTION	PEAK HOURLY COUNT	HOURLY CAPACITY
A	50	1070
B	210	1070
C	330	1600
D	250	1150
E	440	1600

Fig. 3.22. Current peak hourly traffic count and hourly capacity for major roads in the Equality, Kentucky, impact region.

A branch rail line runs between Hartford and Moorman, a hamlet just east of the Equality site. The section has 24 km (15 miles) of single track and is operated under track orders at a maximum speed of 25 mph. On a Federal Class scale of I (worst) to IV, the track is rated as Class II. Fewer than six trains per week run on the track, which carries about 1 million gross tons per year. The section has no weight or height limitations, and abandonment of the easternmost part of the section is being considered.[53]

The Green River is a navigable river and has locks at Calhoun and Spottsville to the north of the site. Tonnage carried on the river has declined from 16.9 million in 1970 to 10 million in 1978. The Green River system capacity is 60 million tons (Al Chandler, Cincinnati Corps of Engineers, personal communication, November 24, 1980).

3.3.4.5 Economic base

The economy of the overall impact area depends largely on agricultural and mining activities. Table 3.33 presents data on jobs by type of activity for the four counties. Ohio County's economic base is depending more heavily on high-sulfur coal in recent years, and agricultural activities remain strong. Figures from the Kentucky State Planning Office indicate that agricultural employment has declined from 16 to 4% in the past years, but the market value of agricultural products in Ohio County reached $15,388,000 in 1978 (Pam Riley, Kentucky Department of Commerce, personal communication, December 4, 1980).

The metropolitan area of Daviess County contains a broad industrial base, and the rest of the county maintains some agricultural activities. In McLean County, the economy remains primarily agricultural; mining activities provide the second largest employment, and there is a small amount of industrial activity. Muhlenberg County remains predominantly in the coal mining business but also has some agricultural activity and an expanding industrial sector.

Wholesale and retail total sales for 1977 are presented in Table 3.34. Statistics from the Bureau of the Census indicate that trade volumes have increased by 28% in retail trade and by 72% in wholesale trade in Ohio County in the past 5 years. Other counties in the impact area have experienced from 50 to more than 150% increases in trade.

Table 3.33. Number of jobs by type of employment in the Equality, Kentucky, impact area, 1979[a]

	Ohio	Daviess	McLean	Muhlenberg
Mining and quarrying	2,343[b]	812	Unavailable	3,175
Manufacturing	998	6,816	317	698
Wholesale/retail trade	753	7,315	385	1,655
Transportation and utilities	155	2,470	21	336
Finance, insurance, and real estate	141	1,172	54	208
Contract construction	136	2,151	52	391
Service/state and local government	1,185	8,485	446	1,742
Other	5	150	7	65
All industrial[a]	8,176	29,371	1,320[c]	8,270
Agricultural	537	1,332	473	388
Total	8,713	30,703	1,793	8,658

[a]Industrial figures are 1979 average annual number of jobs by place of employment; agricultural figures are 1979 employment by residence.

[b]This figure is for mining only and is therefore a low estimate for this sector.

[c]This total does not include undisclosed mining employment and is therefore lower than the actual total.

Source: P. Riley, Kentucky Department of Commerce, personal communication, Dec. 4, 1980.

Table 3.34. Wholesale and retail trade volumes for the Equality, Kentucky, impact area

10^6 $

	County			
Total 1977 sales	Ohio	Daviess	McLean	Muhlenberg
Wholesale trade	13.3	360.4	25.8	120.3
Retail trade	46.7	302.1	19.1	94.1

3.3.4.6 Labor and income

Table 3.35 lists selected statistics on labor and income for the impact region. Ohio County, where the SRC-I facility may be located, has the lowest median income of the four-county region and experienced a negligible 4% growth in employment over the past decade. Employment is expected to rise over the next decade, however, and the Kentucky Planning Office predicts a 24% growth rate. Daviess County has experienced the largest gain in employment in conjunction with its increased urbanization over the same period. McLean County showed a decrease in employment, but it is predicted to grow at a high rate similar to that predicted for Ohio County in the next ten years. Muhlenberg County has increased its employment primarily through an increase in mining activity.

3.3.4.7 Local government taxation

All property in Kentucky is assessed at 100% of fair cash value. The State and local tax rates for 1978 are provided in Table 3.36 for the Equality site area and immediate vicinity.

In addition to the general property tax, a 3% tax is levied by the county on utility bills. All areas may exempt new manufacturing from municipal property taxes for a period of 5 years.

Table 3.35. Labor and income statistics for the Equality impact area

County	Employment in 1980	Percentage of unemployed 1980	Per capita family income in 1980 ($)
Ohio	8,713	7.8	6,070
Daviess	30,703	7.2	7,647
McLean	1,793	8.5	5,510
Muhlenberg	8,658	9.6	6,648

Source: Pam Riley, Kentucky Department of Commerce, December 4, 1980.

Table 3.36. Combined State and local rates per $100 valuation

	Inside city of Beaver Dam	Inside city of Hartford	Outside city*
Land and buildings	$0.864	$0.944	$0.564
Manufactoring machinery, raw materials, goods in process, pollution control equipment	0.150	0.150	0.150
Finished goods, office equipment, vehicles, other tangibles	0.999	1.079	0.699
Intangibles (accounts, records, bonds, notes, etc.)	0.250	0.250	0.250
Leaseholds in I. R. bond financed plants	0.015	0.015	0.015

Source: *Industrial Resources, Ohio County*, Kentucky Department of Commerce, 1979.

3.3.4.8 Historical and archaeological resources

A group of private citizens in Ohio County maintains a local Survey of Historic Places that currently lists nine sites of local significance, all submitted by volunteers. To date, the state of Kentucky has conducted no comprehensive historic site survey in the area, and no Ohio County sites are currently on the National Register of Historic Places (Marsha Richmond, Kentucky Heritage Commission, personal communication, December 2, 1980).

Initial archaeological surveys of the bottomlands along the Green River indicate that further reconnaissance in the immediate site area could cover up to 25 or 30 sites of some archaeological significance. Portions of the Ohio County bottomlands are known to have been prehistorically occupied. Evidence of this has been found in a site north of the Equality area where surveys have produced large middens (shell mounds) dating back to between 2500 B.C. and 1500 A.D. Two sites east of Equality near Williams Creek are listed with the State as archaeologically significant. One or two of the midden sites warrant consideration for the National Register (Dr. Burley Clay, State Archaeologist, personal communication, December 2, 1980).

3.4 ALTERNATIVE SITE 2: RAVENSWOOD, JACKSON COUNTY, WEST VIRGINIA

Selection of the Ravenswood site (Fig. 3.23) for comparison with the Newman site for the proposed SRC-I project was based on the evaluation of reconnaissance-level (Fig. 2.7, Sect. 2.3.2.2). The siting methodology used is discussed in Appendix B. Also, information about this site is included in the floodplain-wetland assessment presented in Appendix D.

3.4.1 Land

3.4.1.1 Location

The alternative Ravenswood site is 641 ha (1585 acres) located adjacent to the Ohio River in Jackson County, West Virginia, on State Route 2. Meigs County, Ohio, is directly across the Ohio River to the west of the site, and the town of Ravenswood, West Virginia, is about 8 km (5 miles) to the northeast. Seventy-five km (47 miles) to the south on Interstate 77 lies Charleston, West Virginia; Parkersburg, West Virginia, is 65 km (41 miles) to the north, also on I-77 (Fig. 3.24). The area is described topographically in Fig. 3.25. The Ohio River forms the western boundary of the site, and the Kaiser Aluminum and Chemical Company's Ravenswood Works lies on an adjacent tract to the north. The site consists of gently sloping alluvial river terrace deposits with hills forming the eastern half of the area. A wooded small stream valley, which carries site runoff as well as runoff originating in the hills, crosses the site. A Chesapeake and Ohio rail line parallels the Ohio River along the western edge of the site.

3.4.1.2 Land use and development

The Ravenswood site, not currently zoned, includes four parcels: Kaiser Aluminum and Chemical, 405 ha (1000 acres); McCoy, 30 ha (74 acres); Pinned, 59 ha (146 acres); and Eastern Star, 147 ha (363 acres). The site consists of a narrow floodplain rising gently to a broad river terrace and then into hills at the eastern edge of the site. Ravines are present in the hilly eastern part of the site. Nearly half of the site is woodland; the remainder is used for agricultural purposes. Slightly more than half of the site is mapped as prime farmland (staff determination based on material provided to G. W. Suter, Oak Ridge National Laboratory, by W. F. Hatfield, U.S. Soil Conservation Service, Morgantown, West Virginia, Dec. 12, 1979). Most of the remainder of the site appears to be good quality farmland or pasture. Primary crops are corn and soybeans. The Keraland Recreation Area in the eastern portion of the site is a small facility operated by Kaiser Aluminum and used by the immediate population. The Kera Lakes area, located about 0.8 km (0.5 miles) northeast of the site, may also be used for recreational purposes. The small community of Ripley Landing, immediately south of the site, consists of several dozen residences.

In addition to the immediate site, a much broader area will receive land use and socioeconomic impacts resulting from construction and operation of the SRC-I facility. This larger area is generally referred to as the socioeconomic impact region and consists of those jurisdictions that will house the facility itself and the bulk of the workers required to build and operate it. Jackson, Mason, Kanawha, and Wood counties in West Virginia and Gallia and Meigs counties in Ohio will absorb most of the population growth engendered by the SRC-I project. Because of their large existing populations and the relatively small number of in-moving workers they are likely to house, project-related impacts in Kanawha County, where Charleston is located, and Wood County, which surrounds Parkersburg, are expected to be minor (Sect. 4.4.4.1). For this reason, the socioeconomic impact region will include only the rural counties of Jackson, Mason, Gallia, and Meigs.

As can be seen from Table 3.37, the four counties that will be most directly affected by the SRC-I plant are all predominantly rural, with relatively small amounts of urban land and large amounts of land devoted to forests and agriculture. Jackson County, one of the three fastest growing counties in West Virginia, is expected to increase its use of land for residential and commercial purposes in the decade ahead (Dick Kennedy, Jackson County — Chamber Development Authority, personal communication, Nov. 26, 1980). Mason County, West Virginia, is not growing as quickly but is also likely to expand its residential sector. In Gallia County, Ohio, residential development in the 1970s moved away from the urban center of Gallipolis into the outlying area, and this is likely to continue (John Clark, Ohio Valley Regional Development District, personal communication, Nov. 26, 1980). Finally, Meigs County also expects an expansion in its residential and industrial land use sectors and a corresponding drop in agricultural acreage.[54]

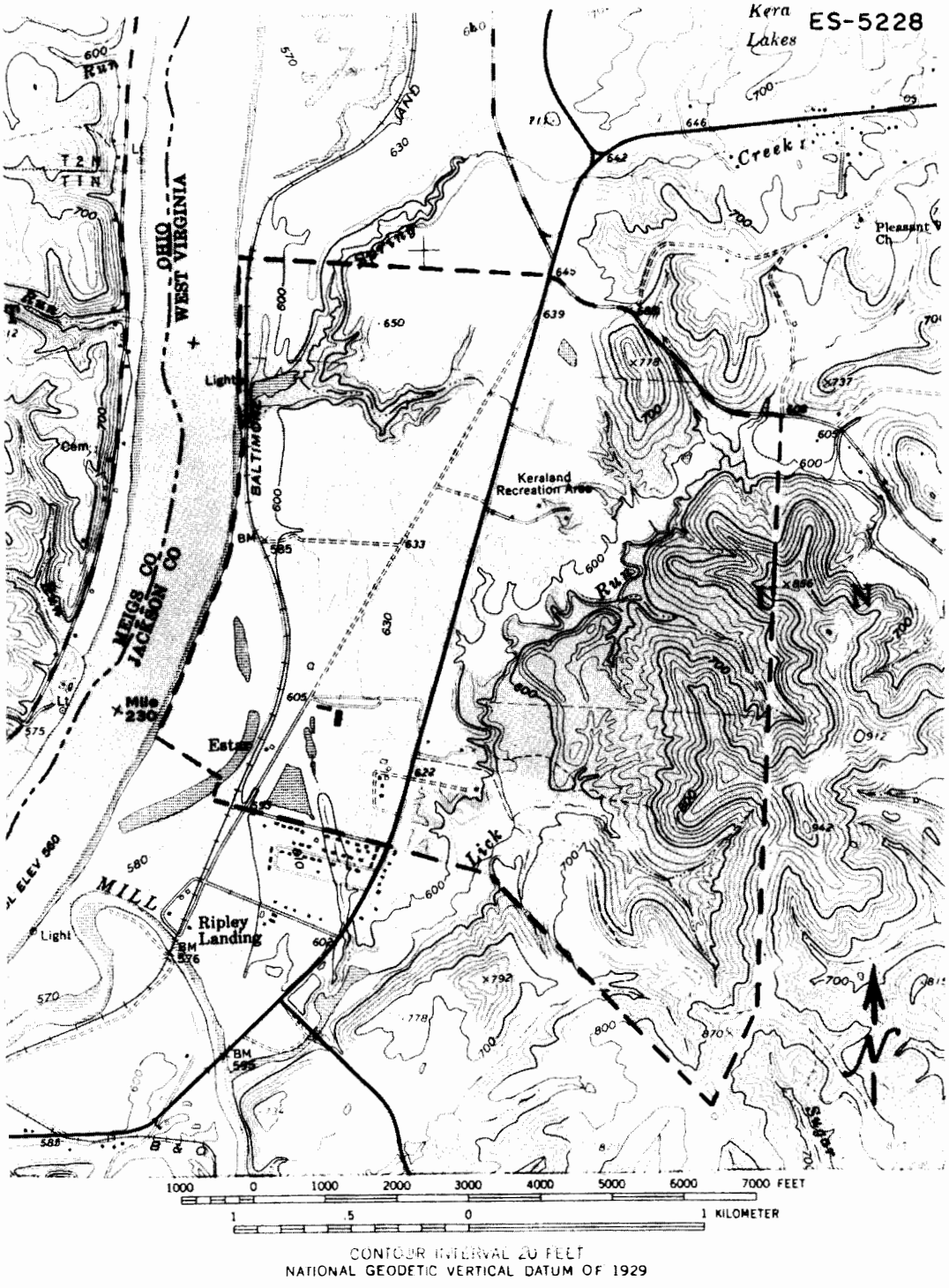


Fig. 3.23. The Ravenswood alternative SRC-I site in Jackson County, West Virginia.

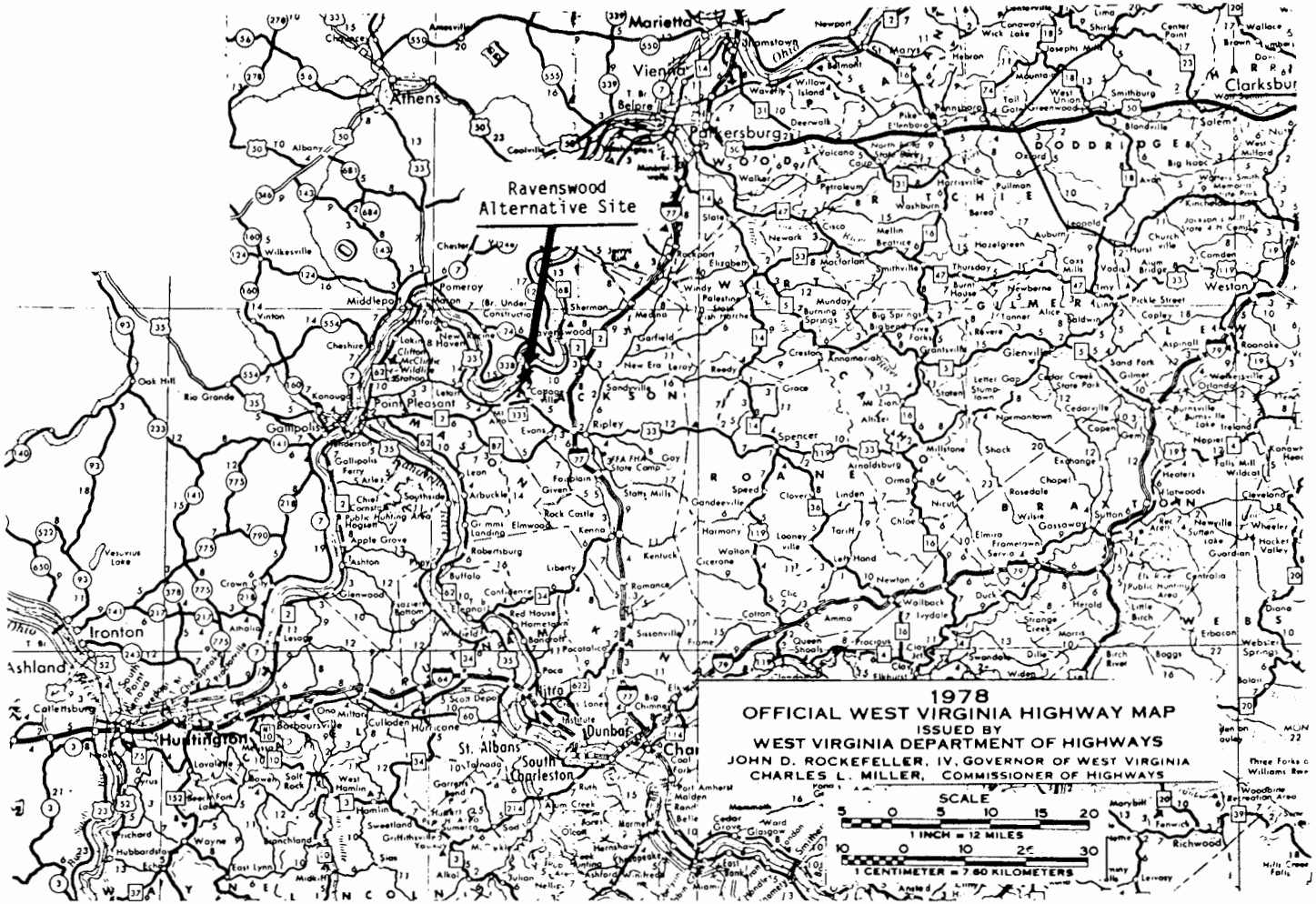


Fig. 3.24. Ravenswood alternative site, regional location.

ES-5228R



Fig. 3.25. Topography and general setting of the Ravenswood, West Virginia, alternate site.

Table 3.37. Current land use in socioeconomic impact region

	Jackson County, West Virginia[a]	Mason County, West Virginia[b]	Gallia County, Ohio[c]	Meigs County, Ohio[d]
Urban/built-up	1.8%	0.9%	3.9%	3.5%
Agricultural	26.0%	35.4%	40.1%	25.8%
Forest	71.0%	57.2%	53.4%	58.2%
Other	1.1%	6.0%	2.6%	12.7%

[a] Richard Kennedy, Jackson County Chamber Development Authority, personal communication, Nov. 26, 1980.

[b] Floyd Mays, Virginia Region 2 Planning and Development Council, personal communication, Nov. 26, 1980.

[c] John Clark, Ohio Valley Regional Development District, personal communication, Nov. 26, 1980.

[d] Gail Reinhardt, Ohio Department of Economic and Community Development, personal communication, Nov. 26, 1980.

Neither Jackson nor Mason counties in West Virginia have county-wide land use controls, but the town of Ravenswood in Jackson County does have zoning and subdivision regulations (Dick Kennedy, Jackson County – Chamber Development Authority, personal communication, Nov. 26, 1980) and Mason County's Point Pleasant has a local zoning ordinance (Floyd Mays, West Virginia Region 2 Planning and Development Council, personal communication, Nov. 25, 1980). In Ohio, both Gallia and Meigs counties have county-wide subdivision regulations, and the town of Gallipolis has a zoning ordinance (John Clark, Ohio Valley Regional Development District, personal communication, Nov. 26, 1980; Greg Keller, Buckeye Hills – Hocking Valley Regional Development District, personal communication, Nov. 25, 1980).

3.4.1.3 Geology and soils

The Ravenswood site is 641 ha (1585 acres) located adjacent to the Ohio River about 8 km (5 miles) southwest of the town of Ravenswood, West Virginia. The site consists of the gently sloping alluvial river terrace deposits with hills forming the eastern half of the area.

Soils

Site soils are classified in the Ashton-Wheeling-Laken association, and soils mapped on the site are predominantly of the Wheeling series. These soils are silty, sandy to gravelly loams and have formed on the Ohio River sand and gravel alluvium. They are good agricultural soils in level and gently sloping parts of the site. Slopes lacking vegetative support are subject to erosion.

Geology

The site is underlain by 18 to 21 m (60 to 70 ft) of alluvium that fills the incised Ohio River valley. Bedrock beneath the alluvium is interbedded sandstone, siltstone, and shale of the Permian Age Dunkard Group. Bedrock crops out in the hills east of the site. The site lies on the western limb of the north-trending Parkersburg syncline. No evidence exists of faulting in the immediate area. Seismic risk in the area is low; the site lies in seismic risk zone 1. Mineral resources of the site include sand and gravel deposits in the alluvium. The region has gas and oil reserves, but these are not developed on the site.

3.4.1.4 Terrestrial ecology

About one-third of the Ravenswood site is forested. Most of the forest land is mature bottomland mesophytic forest associated with Spring Creek. This 52-ha woodland is unusual in its maturity, lack of disturbance, and composition. Disturbance of the area should be avoided during construction and operation. However, without site plans, final determination of whether disturbance of the area can be avoided is not possible. The herbaceous flora of this woodland includes the false rue-anemone, which is rare in West Virginia and which has an unofficial State classification of "scientific interest." A backwater pond near the mouth of Spring Creek creates habitat for waterfowl, amphibians, and other semiaquatic animals. A narrow strip of riparian floodplain forest lies between the railroad tracks and the Ohio River. Most of the remainder of the site consists of cropland. Although no formal biological survey has been performed at this site, the unusual qualities of the Spring Creek forest have attracted the attention of members of local conservation organizations and universities. This interest has led to requests that Kaiser Aluminum preserve the forest and to listing of the forest by the West Virginia Heritage Trust Program (R. Radzyminski, private consultant to U.S. Soil Conservation Service in West Virginia, personal communication, Nov. 15, 1979; F. Pelurie, West Virginia Department of Natural Resources, personal communication, Dec. 4, 1979; and R. H. Fortney, West Virginia Department of Natural Resources, personal communication, Jan. 2, 1980).

The Ravenswood site does not constitute critical habitat for any species Federally listed as threatened or endangered, although the bald eagle and arctic peregrine falcon may make casual use of the site during migration, and the Indiana bat may use the site during the summer.

3.4.2 Air

West Virginia's climate is continental, with warm humid summers and cool winters. Average daily maximum temperatures range from near 6°C in January to near 30°C in July. Annual precipitation averages 101 cm, occuring 211 days per year. Snowfall averages 58 cm per year. Fog restricting visibility to less than 11 km (7 miles) averages 204 days per year; for 46 of those days, visibility is restricted to less than 400 m (0.25 mile). Thunderstorms can be expected 46 times annually; hail is rarely (twice per year) noted. Wind speeds are light, averaging less than 3 m/s (ref. 55). Wind direction is largely from the south, but local variations in terrain effectively channel the wind. The alternative Ravenswood site area, located in AQCR 179, has been judged by the state to be attaining all ambient air quality standards, but no monitors are sited in the area.[56] Emissions from the neighboring Kaiser Aluminum Company facility may be adversely affecting the air quality of the site; however, no emission data for this facility was available.

3.4.3 Water

3.4.3.1 Surface water hydrology

The site is located on alluvial terrace deposits adjacent to the Ohio River. Spring Creek carries surface runoff from the northern and central portions of the site and also drains a small watershed in the hills east of the site. A backwater embayment forms a pond and wetland area at the mouth of the creek. The southern and eastern parts of the site are drained by overland flow into Lick Run and directly to the Ohio River. During periods of high flow, flooding occurs in the Spring Creek and Lick Run areas. Flood elevations at Ohio River mile 230 were provided by the U.S. Army Corps of Engineers, Huntington, West Virginia District. Flood frequency and stage elevation at the site area:

	Stage elevations	
Flood frequency	m	(ft)
100 year	180.9	(588.0)
50 year	180.0	(585.1)
20 year	178.8	(581.2)
10 year	177.9	(578.0)
5 year	176.9	(575.0)
2 year	175.5	(570.4)
1 year	174.5	(567.0)

During a 100-year frequency flood, a large backwater would form in the Spring Creek and Lick Run valleys, and water table elevations in the alluvium would be expected to rise significantly. Flooding would affect tributary valleys and the western edge of the site adjacent to the river (see Fig. 3.26 and Appendix D).

3.4.3.2 Groundwater

Water is available from the Ohio River, from the alluvial aquifer, and from bedrock aquifers. Based on data from similar aquifers, groundwater yields of the alluvium range from 3×10^{-4} to 0.01 m^3/s (5 to 105 gpm), and yields from bedrock are 6.3×10^{-5} to 0.02 m^3/s (1 to 300 gpm). Specific data on groundwater quality and availability are not currently available.

3.4.3.3 Surface water quality and aquatic ecology

Table 3.38 presents a range of flow and water quality values reported from Ohio River stations upstream (mile point 204) and downstream (mile point 260) from the Ravenswood site. The table also presents water quality data for the region in which the Ravenswood site is located. For comparison, drinking water standards and criteria for the protection of aquatic biota are also listed. Surface waters in the region are generally moderately hard; the Ohio River in the Ravenswood area is moderately hard to very hard. Some trace element, concentrations in the Ohio River (cadmium, copper, iron, lead, manganese, mercury, and zinc) exceed drinking water and/or aquatic biota criteria. Additionally, sulfate in the Ohio River and regional TDS levels may approach drinking water standards.

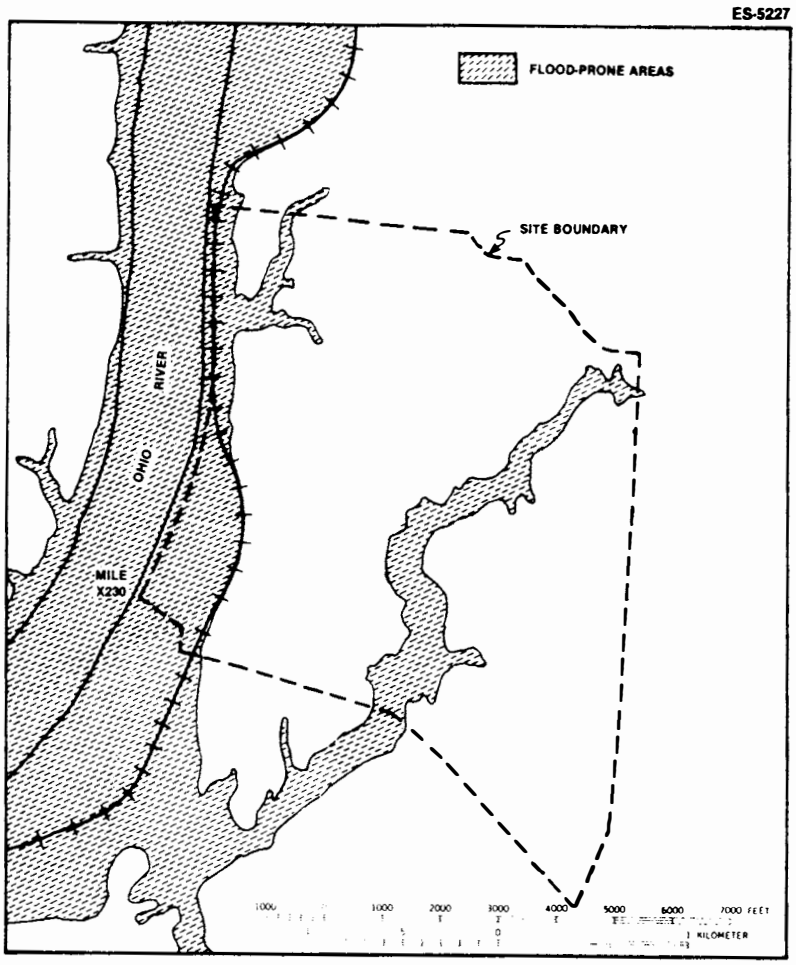


Fig. 3.26. 100-year floodplain areas of the Ravenswood, West Virginia, site.

Dominant fish (by weight or numerical abundance) in the Ohio River in the region of the Ravenswood site (mile point 200 through mile point 300) include emerald shiner, mimic shiner, channel catfish, carp, and gizzard shad. Sunfish, crappie, white bass, largemouth bass, and smallmouth bass, although not numerically abundant, are important sport fishes.[57] During a November 1979 site visit by ORNL staff, Spring Creek appeared to be moderately sedimented, a result of runoff from the cleared areas in the upper part of its watershed (offsite) and the low gradient drainage onsite, with isolated riffle areas. On the Ravenswood site, Spring Creek has a wooded riparian zone about 200 m wide.

Aquatic species Federally designated as endangered or threatened are not expected to occur at the Ravenswood site. The only Federally designated aquatic species reported in West Virginia,[51] the endangered pink mucket pearly mussel (*Lampsilis orbiculata orbiculata*) and tuberculed-pearly mussel (*Dysnomia torulose*), are found only in the Kanawha River.[58] The State does not maintain its own endangered species list but considers the Federal list applicable (James Rawson, Division of Wildlife Resources, personal communication, October 23, 1979).

Table 3.38. Water quality and flow rate in the vicinity of the Ravenswood site

(Concentrations are in mg/liter unless otherwise shown)

Parameter	Ohio River[a]	Regional[b]	Drinking-water standard	Aquatic biota protection limit
Flow, m^3/s	300 to 6646			
pH, units	6.5 to 8.3		6.5 to 8.5[c]	6.5–9.0[e]
Temperature, °C	0.0 to 28.7			
Total suspended solids	5 to 306	<270		
Dissolved oxygen	6.1 to 14.0		5.0[e]	
Hardness, as $CaCO_3$	86 to 230	60–120		
Alkalinity, as $CaCO_3$	27 to 72			>20[e]
Sulfate	48 to 213		250[c]	
Chloride	14 to 70		250[c]	
Total dissolved solids		120–350	500[c]	
Arsenic	<0.001 to <0.010		0.05[d]	0.3[f]
Barium	0.010 to 0.110		1[d]	104[f]
Cadmium	0.001 to 0.007		0.010[d]	0.0012–0.0120[e]
Chromium	<0.004 to 0.016		0.05[d]	0.100[e]
Copper	0.006 to 0.062		1[c]	0.0009[g]
Iron	0.100 to 9.000		0.3[c]	1.0[e]
Lead	0.010 to 0.050		0.05[d]	0.003[g]
Manganese	0.040 to 0.620		0.05[c]	0.35[f]
Mercury	<0.0005 to 0.0008		0.002[d]	0.00005[e]
Selenium	<0.001 to <0.005		0.01[d]	0.02[g]
Silver	<0.001		0.05[d]	0.00001[g]
Zinc	0.020 to 0.190		5[c]	0.0004[g]

[a] Data for Ohio River are the range of values reported for 1977 at Belleville (RM 203.9) and Kyger Creek (RM 260.0), from Ohio River Valley Water Sanitation Commission (1978).

[b] From Geraghty et al. (1973).

[c] From U.S. Environmental Protection Agency (1977).

[d] From U.S. Environmental Protection Agency (1975).

[e] From U.S. Environmental Protection Agency (1976).

[f] Lowest concentration lethal to fish, from Cushman et al. (1977).

[g] Application factor recommended in reference (c) multiplied by the lowest concentration reported by Cushman et al. (1977), as the concentration lethal to 50% of the test organisms in 96 h (the 96-h LC_{50}).

3.4.4 Economic, social, and cultural resources

As discussed in Sect. 3.4.1.2, the socioeconomic impact region consists of Jackson and Mason counties in West Virginia and Gallia and Meigs counties in Ohio. The bulk of project-induced impacts can be expected in these counties; for this reason, these counties will be the focus of the following discussion.

3.4.4.1 Population

The past and present populations of Jackson, Mason, Gallia, and Meigs counties and the major urban centers for each are presented in Table 3.39. Although all four counties have experienced some population growth since 1960, Jackson County's rate of increase has been both larger and more constant than that of the others, which all experienced some degree of decline before the onset of new growth in the 1970s. As mentioned earlier, Jackson County is one of three fastest growing counties in West Virginia.

Table 3.39. Population for counties and major municipalities in socioeconomic impact region, 1960-1980

County	Municipality	Population			Change 1960-1980 (%)
		1960	1970	1980	
Jackson, West Virginia		18,541	20,903	25,597	38.1
	Ripley	2,756	3,244	3,424	24.2
	Ravenswood	3,410	4,240	4,126	21.0
Mason, West Virginia		24,349	24,306	26,763	9.4
	Pt. Pleasant	5,785	6,122	5,662	-2.2
Gallia, Ohio		26,120	25,239	30,152	15.4
	Gallipolis	8,775	7,490	5,601	-36.2
Meigs, Ohio		22,159	19,799	23,641	6.6
	Pomeroy	3,345	2,672	2,718	-18.7
	Middleport	3,373	2,784	2,967	-12.0

Source: U.S. Department of Commerce, Bureau of the Census, *Census of Population*, 1960, 1970, 1980 (Preliminary).

3.4.4.2 Housing

Growth in the number of housing units in the four-county impact region during the last decade is shown in Table 3.40, as is the estimated magnitude of current vacancies. All four counties have increased their housing stock at a rapid rate in the last ten years.

Table 3.40. Housing stock and vacancies in socioeconomic impact region, 1970-1980

County	Total number of housing units[a]		Change 1970-1980 (%)	Vacancies in 1980 (%)
	1970	1980		
Jackson, West Virginia	6,898	9,342	35.4	3-5[b]
Mason, West Virginia	8,193	10,224	24.8	"above average"[c]
Gallia, Ohio	8,201	11,480	39.9	3-5[d,e]
Meigs, Ohio	7,278	9,290	27.6	<1 [f,g]

[a] U.S. Department of Commerce, Bureau of the Census, *Census of Housing*, 1970, 1980 (Preliminary).

[b] Richard Kennedy, Jackson County Chamber Development Authority, personal communication, Nov. 26, 1980.

[c] Charles Conrad, West Virginia Housing Development Authority, personal communication, Dec. 4, 1980.

[d] Ralph Klein, Ohio Valley Regional Planning District, personal communication, Dec. 4, 1980.

[e] Buckeye Hills—Hocking Valley Regional Development District, *Energy Impact Investment Strategy*, Draft, November 1980.

[f] Meigs County Regional Planning Commission, *Housing Plan*, June 1979.

[g] Based on figures from the municipalities of Pomeroy and Middleport.

In Jackson County, where the estimated vacancy rate is 3 to 5%, housing stock has increased by 35% in the last ten years. About 20% of all dwelling units are mobile homes, and 50% of the total housing stock is less than 20 years old. A current high level of residential construction indicates that growth in this area is likely to continue (Dick Kennedy, Jackson County-Chamber Development Authority, personal communication, November 26, 1980). In Mason County,

substantial numbers of vacancies exist in both the rental and the buyer markets. Although the number of multi-family units there has increased in recent years, the overwhelming majority of local residents live in single family homes. The mobile home market is currently very small, comprising roughly 3% of total housing stock (Tom Baldwin, West Virginia Region 2 Planning and Development Council, personal communication, December 4, 1980).

In Gallia County, Ohio, the vacancy rate for owner-occupied units is about 3% and the vacancy rate for rentals is about 5%, allowing some capacity for absorbing new growth. Residential construction has been substantial in recent years, and local housing authorities believe that the local market could respond to new growth in housing demand. In addition to traditional single family units, mobile homes also form a viable component of the housing stock, particularly in the more rural areas of the county (Ralph Klein, Ohio Valley Regional Planning District, December 4, 1980). Finally, in Meigs County, the growth in housing stock during the last ten years has barely kept pace with demand, resulting in an extremely tight local housing market. Traditional single family dwellings are still by far the most popular, but mobile home use has increased rapidly in the last two decades because of the lower cost and the ease of placement on dispersed rural sites along major roads.[59]

3.4.4.3 Public services

Water and sewer

Table 3.41 shows current use and system capacity for the major water and sewer districts in the four-county impact region. The numbers presented in the table indicate that each of the four counties is currently approaching or exceeding design capacity in at least one of their major service districts for water, sewer, or both. In Jackson County, the Ravenswood water treatment facility is currently operating above design capacity; in Ripley, the average daily flow at the sewage treatment plant is at the design capacity. Improvements are being planned for the Ravenswood plant and are under consideration in Ripley.

In Mason County, estimates of water use and capacity are not available, but the current water supply is assumed to be adequate. The major sewage treatment facility in the area, however, has an average daily flow that nearly equals capacity, indicating that peak flow will routinely exceed plant design limits. Improvements are now planned, but construction is not expected to begin until 1982 at the very earliest (Ernie Hissom, West Virginia Region 2 Planning and Development Council, personal communication, December 4, 1980).

In Gallia County, Ohio, the average demand for water in the city of Gallipolis is less than the design capacity of the water supply system, but peak demand is currently equal to that capacity. The peak flow at the sewage treatment facility, at 850,000 gpd, is less than 1 million gpd design capacity, but the quality of the effluent discharged from this primary treatment facility is extremely low, consistently violating EPA water quality standards. In addition, the facility has frequent pump station failures and is generally considered obsolete.[60]

In Meigs County, problems have been identified with both the water and sewer systems. In the municipality of Pomeroy, the existing sewage treatment facility is currently pushed beyond its design capacity during peak flow periods. The ability of existing water and sewer lines to accommodate new housing units is also severely strained. In Middleport, the village's excess water storage capacity has been eliminated by past growth, and one of the village's sewage treatment lagoons is beginning to show signs of deterioration.[59]

Schools

In Jackson County, local schools seem able to absorb new growth. Recent school construction has created the capacity to accommodate almost 1,000 additional students, and more improvements are planned. In Mason County, local officials believe that existing elementary schools could accommodate 300 more students and secondary schools could handle 400 more. In addition, planned improvements would increase this capability (Table 3.41).

In Gallia and Meigs Counties, however, the situation is much different. Gallia County schools are currently at capacity, but planned improvements could change this condition if a school bond is approved by local voters. In Gallipolis, there is some room left for growth in the

Table 3.41. Essential public services in socioeconomic impact region

County/Service District	Water[a]			Sewer[a]			Schools		
	Current average use	Current treatment capacity	Planned improvement	Current average use	Current capacity	Planned improvements	Current use	Current capacity	Planned improvements
Jackson Co. W.Va.									
Ravenswood	0.58 Mgd[b]	0.5 Mgd	Yes	0.38 Mgd	0.75 Mgd		5633	6660	Yes
Ripley	0.3 Mgd	0.72 Mgd	Under consideration	0.25 Mgd	0.25 Mgd	Under consideration			
Mason Co., W.Va.									
Pt. Pleasant	*c*	*c*		0.52 Mgd	0.55 Mgd	Yes, may start in 1982.	5569	6269	Yes
Gallia Co., Ohio									
Gallipolis	1.75 Mgd	2.5 Mgd	Yes	*c*	1.0 Mgd		3271	3271	Yes (If tax
Gallia Co. Water	0.4 Mgd	1.0 Mgd					2953	3250	is passed.)
Meigs County, Ohio									
Pomeroy	0.3 Mgd	*c*		0.2 Mgd	0.27 Mgd		4789	*c*	
Middleport	*c*	*c*		*c*	*c*				

[a] Figures are for major service districts in county.

[b] Mgd = million gallons per day.

[c] Information is not available.

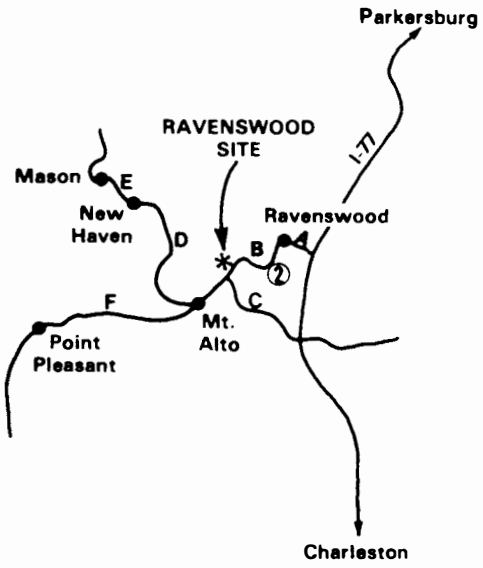
Sources: Dick Kennedy, Jackson County Chamber Development Authority, Nov. 26, 1980; Ernie Hisson, West Virginia Region 2 Planning and Development Council, Dec. 4, 1980; Ohio Valley Regional Development Commission, *Energy Impact Assistance Plan* and *Supplemental Community Facilities Study*, 1980; and Buckeye Hills – Hocking Valley Regional Development District, *Energy Impact Investment Strategy*, November 1980.

school system as a whole, but conditions vary from school to school. There are no spare classrooms (Jack Moskovitz, Gallipolis School District, personal communication, December 4, 1980). In Meigs County, capacity also varies from school to school. For the county as a whole, 5 of 19 schools are currently at or over design capacity (Greg Keller, Buckeye Hills — Hocking Valley Regional Development District, personal communication, November 25, 1980).

3.4.4.4 Transportation

The Ravenswood site is served by road, rail, and water facilities. As shown in Fig. 3.21, the site is located on State Route 2. Traveling west from the town of Ravenswood to the site and beyond to Point Pleasant, State Route 2 is a two-lane paved road, with 3.4-m (11-ft) lanes and 2.8-m (9-ft) shoulders. Heading east from Ravenswood to Interstate 77, State Route 2 widens to four lanes. The other major road in the immediate area (in addition to the Interstate) is U.S. Route 33, which intersects State Route 2 1.6 km (1 mile) south of the proposed site. U.S. 33 is also a two-lane paved road, with lane width varying from 3.7 m (12 ft) near the site to 3.2 m (10.5 ft) near the town of Mason at the Ohio state line (Doug Rice, West Virginia Department of Highways, personal communication, November 24, 1980). Figure 3.27 shows current peak hourly traffic counts and peak hourly capacity for the major sections of road surrounding the site.

ES-5638



12-80-PA3851-2

SECTION	PEAK HOURLY COUNT[a]	"E" HOURLY CAPACITY[b]
A		N/A
B	600	1800
C	700	1440
D	380	1800
E	380	1600
F	650	1340

[a] Level of Service "E" represents the peak number of vehicles traveling in both directions that can be accommodated by a given section of road. At this level of service, the smooth flow of traffic is subject to breakdown because vehicles are at minimum spacing. Because there is no room for error, this is *not* a desirable design load.

[b] 1979–1980 actual traffic counts. The peak hour for Section B is 3:00–4:00 PM; for all other sections it is 4:00–5:00 PM.

Fig. 3.27. Current peak hourly traffic and hourly capacity for major roads in socioeconomic impact region. Sources: West Virginia Department of Highways (personal communication between Doug Rice and Larry Griffith, Department of Highways, and Jeff Rexhausen, ORNL, November 24, 1980); and *Highway Capacity Manual, 1965*, National Academy of Sciences, National Research Council, Publication 1328, Washington, D.C., 1965.

In addition to the highways described above, the Ravenswood site can also be serviced by barges because of its location on the Ohio River. According to the U.S. Army Corps of Engineers, instituting barge service should be no problem because of the existence of a firm bank and the lack of sand bars in the area (Bill Eiger, U.S. Army Corps of Engineers, personal communication, November 25, 1980). Rail access is also available. Currently, the site is served by a single track with passing sidings, which would allow for the delivery of feedstocks and the export of processed materials (Jim Hale, Chessie Railroad System, personal communication, November 25, 1980).

3.4.4.5 Economic base

Current employment by major job category for each of the four counties in the socioeconomic impact region is presented in Table 3.42. Jackson County, West Virginia, with more than half its total jobs in manufacturing, has far more activity in this sector than any of the other counties; the Kaiser Aluminum and Chemical Company's Ravenswood Works provides the largest share of these industrial jobs. On the other end of the scale, only one out of every ten jobs in Meigs County is in manufacturing, but mining is much more important here than in the other counties of the impact region, accounting for more than one-third of total employment. In Mason County, West Virginia, construction, manufacturing, transportation, utilities, and government are all important to the local economy, accounting for roughly equal shares of local employment. In Gallia County, Ohio, nearly half of all employment is in the government and service sectors, but significant numbers of jobs are also found in the trade, transportation, utilities, and manufacturing sectors. Although the total number of people employed in agriculture is relatively small in all four counties, local activity in this area is substantial. The total value of agricultural products in 1978 was nearly $3 million in Jackson County, about $8 million in Mason and Meigs Counties, and over $10 million in Gallia County (Betsy Stevenson, West Virginia Department of Employment Security, personal communication, December 2, 1980; Gail Reinhardt, Ohio Department of Economic and Community Development, personal communication, December 1, 1980).

Table 3.42. Number of jobs by type of employment in the socioeconomic impact region, 1979

Jobs	Jackson County, West Virginia	Mason, West Virginia	Gallia, Ohio	Meigs, Ohio
Mining	80	50	300	1713
Construction	460	1980	696	298
Manufacturing	4210	1630	1207	402
Transportation and utilities	220	1550	1314	144
Wholesale/retail trade	1250	960	1793	825
Finance, insurance and real estate	170	160	234	133
Services	540	840	1906	287
Government	1020	1430	2364	802
Agriculture, forestry, and fishing	133	257	*a*	*a*
Total	8093	8857	9827	4608

[a] Data not available because there are fewer than 3 employees in this sector.

Sources: Jerry Reveal, West Virginia Employment Security Commission, personal communication, Dec. 8, 1980; and State of Ohio, Bureau of Employment Services, Division of Research and Statistics.

The total volumes of wholesale and retail trade for each county in the impact region are shown in Table 3.43. In both the wholesale and retail sectors, Gallia County has far more activity than any of the other impact counties.

Table 3.43. Wholesale and retail trade volumes for impact region, 1977

	Wholesale trade (in $ millions)	Retail trade (in $ millions)
Jackson County, West Virginia	17.6	62.4
Maron County, West Virginia	31.2	50.3
Gallia County, Ohio	54	85.3
Meigs County, Ohio	12	54.9

Source: U.S. Department of Commerce, *Census of Wholesale and Retail Trade.*

3.4.4.6 Labor and income

Table 3.44 shows the rate of unemployment and per capita income within the socioeconomic impact region. Jackson County, West Virginia, has the highest rate of unemployment (7.2%) and the highest per capita income ($6990) of all four impact counties. Gallia County, Ohio, has the lowest unemployment rate (5.2%), and Meigs County, Ohio, has the lowest per capita income ($5976). Both Ohio counties are well under Ohio's statewide per capita income of $7857, and the two West Virginia counties fall on either side of their state's average of $6629. Gallia and Mason counties enjoy lower unemployment rates than do their respective states as a whole, and Meigs and Jackson counties' unemployment figures fall on the high side of their state averages.

Table 3.44. Labor and income statistics for socioeconomic impact region

Location	1979 employment[a]	Unemployed 1979 (%)	1978 per capita income (%)
Jackson County, West Virginia	8093	7.2	6990
Mason County, West Virginia	8857	5.4	6242
State of West Virginia		5.6	6629
Gallia County, Ohio	9827	5.2	6195
Meigs County, Ohio	4608	6.3	5976
State of Ohio		5.9	7857

[a]Workers employed in county.

Sources: Jerry Reveal, W. Virginia Employment Security Commission, personal communication, Dec. 8, 1980; State of Ohio, Bureau of Employment Services, Division of Research and Statistics; and U.S. Department of Commerce, Bureau of Economic Analysis, *Surveys of Current Business*, April, 1980.

3.4.4.7 Local government taxation

Although the primary impacts from the SRC-I project will extend over a four-county region, any property tax paid by the facility during commercialization would go only to Jackson County as the jurisdiction in which the facility will actually be located. Neither the neighboring municipalities of Ravenswood and Ripley nor the other three impact counties would be empowered to tax the project. The following discussion, therefore, will focus solely on Jackson County. The reader should bear in mind, however, that no taxes will be levied on the facility by any jurisdiction until full ownership is transferred from the Federal government to the private sector at the end of the demonstration phase, should the decision be made to proceed with commercialization.

The 1980 total assessed value for all taxable property in Jackson County is $211 million. More than 75% of this property is located in the rural taxing districts of the county where the proposed facility is to be sited; the remainder is in the municipalities of Ravenswood and Ripley. The $211 million figure is arrived at by assessing all taxable property at 50% of "true value," yielding an assessed value equal to roughly one-third of market value. In non-municipal districts, personal property such as farm equipment and livestock (Class I) is taxed at a rate of $0.631 per $100 of assessed value, owner-occupied residential dwellings (Class II) are taxed at $1.268 per $100 assessed value, and commercial and industrial property (Class III) is taxed at $2.52 per $100 assessed value (W. A. Riggs, Jackson County Tax Assessor, personal communication, December 1980). The total property tax revenues collected in the non-municipal districts of Jackson County amounted to $2.68 million in 1979; roughly 60% came from personal property, and the remainder came from real estate (Mrs. Wilson, Jackson County Tax Department, personal communication, December 1980).

No tax is currently levied on construction work in progress (CWIP) in Jackson County, and there are no cooperative arrangements whereby taxes collected from property located in the rural districts is shared with the county's municipal governments. Tax reductions or exemptions are generally not offered to induce industrial facilities to locate in Jackson County, as is sometimes done by other local governments (W. A. Riggs, Jackson County Tax Assessor, personal communication, December 1980). However, new industry can receive favorable treatment from the State government, which offers a Business and Occupation Tax (B&O) credit and a seven-year tax exemption on demonstration facilities. In addition, new State-level tax incentives are being considered to attract new-energy-related industrial facilities to the State (Beth Hoyt, West Virginia Industrial Development Board, personal communication, December 1980).

3.4.4.8 Historical and archaeological resources

In the immediate vicinity of the Ravenswood site, five archaeological sites have been identified by the West Virginia Historic Preservation Office. In addition, Kaiser Corporation's Ravenswood Works is reported to be built over a later prehistoric village. Another archaeological site elsewhere in Jackson County is being considered for inclusion in the National Register of Historic Places. According to the State Historic Preservation Office, this entire area is rich in archaeological sites because of the widespread presence of prehistoric Indian settlements. Any additional disturbance in the site area may uncover additional archaeological information and, for this reason, a thorough archaeological survey of the site would be required before project construction could begin (Roger Wise, West Virginia State Archaeologist, personal communication, December 1980).

Turning to the subject of historic resources, four sites in Jackson County are listed in the National Register: one residence, one school, and two covered bridges. The State Historic Preservation Office has judged that other sites in the county are probably eligible for the National Register as well, but none of these are in the immediate vicinity of the proposed site. Additionally, the town of Ravenswood is thought to be eligible as a Historic District. Other significant sites may turn up as the result of a State historic survey, but such an effort has not yet been undertaken (Michael Pauley, West Virginia State Historic Preservation Office, personal communication, December 1980).

REFERENCES FOR SECTION 3

1. *Keystone News Bulletin* 37(1), 1979.

2. F. R. Cox, *Soil Survey of Daviess and Hancock Counties, Kentucky*, U.S. Dept. of Agriculture, Soil Conservation Service, November 1974.

3. Council on Environmental Quality, *Environmental Quality — 1978, The Ninth Annual Report of the Council on Environmental Quality*, U.S. Government Printing Office, December 1978.

4. ATEC Associates, *Preliminary Geotechnical Engineering Study, 2000 TPD Solvent Refined Coal Facility*, prepared for Wheelabrator Cleanfuel Corporation and Kentucky Center for Energy Research, 1977.

5. O. W. Nuttli and R. B. Hermann, *State-of-the-Art for Assessing Earthquake Hazards in the United States*, Miscellaneous Paper S-73-1, Report 12, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Miss., 1978.

6. E. L. Braun, *Deciduous Forests of Eastern North America*, Blakiston Press, Philadelphia, 1950.

7. A. W. Kuchler, *Potential Natural Vegetation of the Conterminuous United States*, American Geographical Society, New York, 1964.

8. R. W. Barbour and W. H. Davis, *Mammals of Kentucky*, University Press of Kentucky, Lexington, 1974.

9. R. W. Barbour, *Amphibians and Reptiles of Kentucky*, University Press of Kentucky, Lexington, 1971.

10. U.S. Department of the Interior, Fish and Wildlife Service, "Endangered and Threatened Wildlife and Plants," *Fed. Regist.* 44(12): 3637-3654 (1979).

11. C. H. Stephens and J. S. Durell, *Endangered and Rare Species in Kentucky*, Department of Natural Resources and Environmental Protection, Frankfort, Ky., March 1979.

12. R. Arbib, "The Blue List for 1980," *Am. Birds* 33: 830-835 (1979).

13. Department of Natural Resources and Environmental Protection, Division of Water Quality, *River Basin Water Quality Management Plan for Kentucky, vol. 3, Green River Basin*, Frankfort, Ky., 1975.

14. U.S. Geological Survey, *Water Resource Data for Kentucky*, annual reports for 1975-1979.

15. H. T. Hopkins, *Fresh-Saline Water Interface Map of Kentucky*, Kentucky Geological Survey, 1966.

16. Ohio River Valley Water Sanitation Commission, *Applications of Water Quality Index for ORSANCO*, prepared by the National Science Foundation for ORSANCO, Cincinnati, Ohio, February 1977.

17. U.S. Department of Agriculture, *Green River Basin Report on Water, Land, and Related Resources*, U.S. Dept. of Agriculture Field Advisory Committee, Lexington, Ky., 1975.

18. U.S. Army Corps of Engineers, Louisville District, *Continued Operation and Maintenance of the Navigation System, Green and Barren Rivers, Kentucky, Draft Environmental Impact Statement*, Louisville, Ky., June 1975.

19. U.S. Department of the Interior, U.S. Geological Survey, *Water Resources Data for Kentucky, Water Year 1978*, Water Report KY-78-1, Frankfort, Ky., 1978.

20. J. B. Andelman and M. J. Suess, "Polynuclear Aromatic Hydrocarbons in the Water Environment," *Bull. W.H.O.* 43: 498 (1970), Table 8.

21. W. R. Grace and Co. and the U.S. Department of Energy, *Environmental Report, Synthesis Gas Demonstration Plant, Baskett, Ky., vol. 2,* no date.

22. Academy of Natural Sciences of Philadelphia, *Green River Survey, 1965,* prepared for the Tennessee Valley Authority, April 1966.

23. Geomarine, Inc., *Selected Physical and Biological Properties in the Vicinity of Kentucky Utilities' Green River Electric Generating Station,* prepared for Kentucky Utilities Company, March 1976.

24. C. M. Palmer, "A Composite Rating of Algae Tolerating Organic Pollution," *J. Phycol.* 5: 78-82 (1969).

25. M. P. Taylor, *Behavior and Viability of Planktonic Organisms in Open Water Zone of the Green River, 1961, 1965, and 1970,* Tennessee Valley Authority, Muscle Shoals, Ala., February 1973.

26. J. R. Charles, "Effects of Oilfield Brines," reprinted from *Proceedings of the 18th Annual Conference, Southeastern Association of Game and Fish Commissioners,* Oct. 18-21, 1964.

27. J. L. Hesse and E. D. Evans, *Heavy Metals in Surface Waters, Sediment and Fish in Michigan,* report of the Michigan Water Resources Commission, Lansing, 1972.

28. D. S. White, F. C. Hill, and K. H. Haag, "The Fishes of Goose Creek, Jefferson County, Kentucky: A Stream Under the Influence of Urban Development," *Trans. K. Acad. Sci.* 38(1-2): 45-55 (1977).

29. B. G. Isom, "Mussels of the Green River, Kentucky," *Trans. K. Acad. Sci.* 35(1-2): 55-57 (1974).

30. J. C. Williams, *Mussel Fishery Investigation, Tennessee, Ohio, and Green Rivers, Final Report,* Kentucky Department of Fish and Wildlife Resources, Frankfort, Ky., 1969.

31. U.S. Department of Commerce, *Climates of the States — Kentucky,* Washington, D.C., August 1959.

32. U.S. Department of Commerce, *Climatological Data for Dress Regional Airport, Evansville, Indiana,* open file data, Washington, D.C., 1976.

33. Kentucky Division of Air Pollution Control, *Ambient Air Quality Summary Statistical Analysis, April 1978-March 1979,* Frankfort, Ky., 1979.

34. Owensboro Metropolitan Planning Commission, *Community Directions: A 1977 Comprehensive Plan for Owensboro, Whitesville, and Daviess County, Kentucky,* 1977; and Southwest Indiana and Kentucky Regional Council of Governments, *1974 Housing Condition Survey,* 1974.

35. J. Ballard, Evansville-Vanderburgh Area Planning Commission, personal communication, Dec. 3, 1980.

36. C. T. Koebel, *1979 Housing Report for Kentucky,* Urban Studies Center, University of Louisville, 1979, pp. 205 and 247.

37. *1977 Census of Governments, Compendium of Government Finances,* U.S. Department of Commerce.

38. *Evaluation of Factors Affecting the Acceptability of the Proposed Site for the Grace/Ebasco Synthesis Gas Demonstration Plant,* Preliminary Draft Report, Radian Corporation, Report FE-2314-10, DCN 200-151-10-01, April 1978.

39. Highway Research Board, *Highway Capacity Manual,* National Academy of Science, National Research Council; Special Report 87, 1965.

40. "Analysis of Transportation Impacts, Newman, Kentucky SRC-I Plant," Transportation and Economic Research Associates, Inc., Falls Church, Va., December 1980.

41. *Analysis of Traffic Impacts of the Synthesis Gas Demonstration Plant Program, Baskett, Kentucky*, Ebasco Services, Inc., by Tyzretts-Abbett-McCarthy-Stratton Engineers and Architects, Boston, Mass., March 1980.

42. Pennyrile Area Development District, *Land Use Policies Manual*, Hopkinsville, Ky., June 1977.

43. Kentucky Department of Commerce, *A Place to Grow*, Frankfort, Ky., 1973.

44. C. H. Stephens and J. S. Durell, *Endangered and Rare Species in Kentucky*, publication of the Department of Natural Resources and Environmental Protection, Frankfort, Ky., March 1979.

45. Department for Natural Resources and Environmental Protection, Division of Air Pollution Control, *Ambient Air Quality Summary Statistical Analysis — 1978.*

46. U.S. Department of the Interior, "Water Resources Data for Kentucky, Water Year 1978," *U.S. Geol. Surv. Water-Data Rep. KY-78-1*, June 1975.

47. Department of Natural Resources and Environmental Protection, Division of Water Quality, *River Basin Water Quality Management Plant for Kentucky, Vol. 3, Green River Basin*, Frankfort, Ky., 1975.

48. U.S. Army Corps of Engineers, *Continued Operation and Maintenance of the Navigation System, Green and Barren Rivers, Kentucky, Draft Environmental Impact Statement*, Louisville District, Louisville, Ky., June 1975.

49. W. R. Grace and Co. and the U.S. Department of Energy, *Environmental Report, Synthesis Gas Demonstration Plant, Baskett, Ky., Vol. 2*, no date.

50. U.S. Department of the Interior, *Procedures of a Symposium on Rare and Endangered Mollusks (Naiads) of the United States*, S. E. Jorgensen and R. W. Sharp, Eds., Twin Cities, Minn., 1971.

51. R. M. Cushman et al., *A Sourcebook of Basic Hydrologic and Ecological Features: Water Resource Regions of the Conterminous United States*, Ann Arbor Science Publishers, Inc., Michigan, 1980.

52. Green River Area Development District, 1970.

53. Kentucky Department of Transportation, *The Kentucky Rail Plan*, Frankfort, Ky., November 1979.

54. Meigs County, Ohio, Regional Planning Commission, *1970-1990 Meigs County Comprehensive Plan*, June 1972.

55. U.S. Department of Commerce, National Climate Center, *Comparative Climate Data Through 1976*, National Oceanic and Atmospheric Administration, Asheville, N.C.

56. West Virginia Air Pollution Control Commission, *Annual Report*, 1979.

57. U.S. Energy Research and Development Administration, *Final Environmental Statement, Portsmouth Gaseous Diffusion Plant Site*, Report ERDA-1555, Washington, D.C., 1977.

58. U.S. Fish and Wildlife Service, "Endangered Status for 159 Taxa of Animals," *Fed. Regist.* 41: 24061 (1976).

59. Buckeye Hills–Hocking Valley Regional Planning District, *Energy Impact Investment Strategy*, Draft, Marietta, Ohio, Nov. 15, 1980.

60. Ohio Valley Regional Development Commission, *Energy Impact Area Supplemental Community Facilities Study*, Portsmouth, Ohio, 1980.

4. ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

Section 4 presents an analysis of the predicted impacts from constructing and operating the proposed SRC-I demonstration plant at the proposed Newman, Kentucky, site (Sect. 4.2), and the alternative sites of Equality, Kentucky (Sect. 4.3), and Ravenswood, West Virginia (Sect. 4.4). These sections also discuss the issues that are likely to arise should the plant be commercialized at an expanded capacity, mothballed, or decommissioned. Section 4.2.5 discusses the cumulative impacts associated with the proposed Newman site. Section 4.1 discusses the occupational and public health effects of producing and using SRC products. Sections 4.5 and 4.6 present proposed monitoring and mitigation programs. Section 4.8 presents a summary of the floodplain/wetlands assessment.

4.1 OCCUPATIONAL AND PUBLIC HEALTH EFFECTS

4.1.1 Introduction

The public scoping process (see the Foreword) indicated that occupational and public health effects were principal concerns regarding the development of a synfuel industry. This section discusses the currently available data base for health effects of coal conversion facilities, the U.S. Department of Energy (DOE) assessment program, the materials of concern, the sources of exposure, and the control plans for the proposed SRC-I demonstration plant. Data collection, research, and assessment for the SRC-I demonstration plant is in progress and will continue to be necessary to better quantify impacts. The health and environmental research program for SRC-I is summarized in this section, and the detailed plan is given in Appendix Z. Sections 4.5 and 4.6 highlight monitoring and mitigation commitments.

Because of lack of studies for specific commercial-scale coal conversion facilities, health concerns arise primarily from studies on related processes and from measurements on process streams of bench-scale or pilot-scale facilities supporting coal conversion technology.[1-3] The most direct experience applicable to SRC-I comes from operation of the Fort Lewis and Wilsonville SRC pilot plants. Experience from petroleum refineries (see Appendix Z) and related petrochemical industries also aids in planning and implementing occupational and public health protection programs. The application of information gained from these processes as applied to SRC-I is discussed in the following sections and in Appendix Z. First, a general discussion of the historical basis of occupational and public health concerns that may be unique to coal conversion systems is given.

Scrotal cancer was associated with exposure to soot as early as the late eighteenth century.[4] Coal-carbonization workers exposed to complex mixtures of soots, tars, ashes, smokes, and pitch have experienced excess cancer as compared to general population rates. The U.S. Department of Health, Education and Welfare found that workers exposed to coal carbonization products experienced excesses of skin, lung, bladder, and kidney cancer.[5] In addition, Doll et al.[6] reported the mortality experience of gas workers in Great Britain over a 12-year period and found significant increases in lung, bladder, skin, and scrotal cancer among coal carbonizing workers. Concentrations of benzo(a)pyrene (BaP) and several other polynuclear aromatic hydrocarbons (PNAs) were elevated in worker atmospheres. Another study shows that workers with the highest exposures to these tarry fumes exhibited the greatest risk of dying from lung, liver, and scrotal cancer.[7] In human populations many exogenous and endogenous factors offset cancer of the bladder, but bladder cancers were associated with coal-tar occupations as early as 1931.[8] Induction of lung cancer has been known since 1936 when Kuroda and Kawahata[9] reported excesses of this disease among coal-gas workers in Japan. Kennaway and Kennaway[10] found a lung cancer mortality rate in coke oven-charger workers three times that of the average population.

These studies may be interpreted to indicate increased potential for a variety of cancers associated with coal gasification systems. Studies of coal liquefaction systems are discussed below. Although elevated exposures to carcinogenic PNAs (e.g., BaP) have been measured,[7] coal conversion processes in general contain complex mixtures of many hundreds of organic compounds as well as many inorganic materials (e.g., sulfur and nitrogen compounds, trace metals, and their compounds and radioactive materials — in short, anything in coal plus anything produced in the process). Also, the metabolic detoxification-toxification mechanisms convert many fugitive agents into carcinogens and/or carcinogenic potentiators.

Certain SRC process intermediates, products, by-products, and wastes will contain heavy metals and organometallic compounds and a broad range of complex organic materials, including PNAs, aromatic amines, and heterocyclic sulfur compounds that are known or suspected to be (1) mutagenic in microbial systems or (2) carcinogenic, teratogenic or toxic in laboratory animals.[11] In an SRC plant, these complex organic compounds result primarily from the hydrogenation reaction.

Although current and projected environmental quality standards and emission limitations require application of state-of-the-art pollution control techniques, standards and limitations do not yet exist for most of the classes of compounds that are of concern. For example, many agents may not be carcinogens but may act as strong potentiators of carcinogens through hyperplastic or cytotoxic activities that cause deviations in the normal homeostatic control mechanism.[12-14] These toxic but noncarcinogenic and/or nonmutagenic agents are not addressed by current health guidelines, but the EPA and NCI are both concerned with policy recommendations related to promoters. The Toxic Substances Control Act (TSCA) and its applicability to SRC materials are discussed in Appendix FF. Thus, compliance with existing environmental requirements alone will not ensure complete protection of the workers, the public, or the environment. For this reason, the design of the SRC-I demonstration plant focuses particular attention on (1) minimizing the release of such materials and (2) reducing the exposure of workers and the public. Section 4.1.3, "Sources of Exposure and Control Plans," discusses the steps proposed for accomplishing this.

Furthermore, pilot plant studies have shown that the qualitative and quantitative compositions of SRC products and wastes vary and are sensitive to changes in coal feedstock and process conditions such as temperature, hydrogen pressure, and residence time. This variability, combined with the fact that only a conceptual SRC plant design exists at this time, reduces the ability to predict the specific compounds and exact concentrations of such compounds that will be present in products, intermediate streams, wastes, and occupational environments. This, in turn, limits the ability to quantitatively predict occupational and public health consequences of altered plant operating conditions.

Chemical and biological screening analyses of available SRC pilot plant materials by Battelle Pacific Northwest Laboratory indicate that selected materials are active in certain toxicological tests.[11] However, an extensive industrial hygiene program has been in place since startup of the Fort Lewis SRC pilot plant (5 years) and there have been no increases of skin cancer traceable to chemicals found in the workers' environment. This is in distinct contrast to experiences in previous coal hydrogenation plants where equivalent industrial hygiene practices were not employed. In one particular case (Institute, West Virginia), an increased incidence of skin tumors (16 to 37 times) was found in the work force of 359 individuals after exposure times as short as 11 months to as long as 7 years.[15] However, followup studies on 50 workers have not yet revealed an increase in systemic cancers or in cancer mortalities in that work force.[16] Often this study is used to argue for the absence of systemic cancers. Rather, the age of the workers, the longer latency for systemic tumors, and the small number in the study population are not conducive to such detail. In principle, systemic cancers are expected and might be found in larger populations studied over longer periods of time. Laboratory studies in oncology also support the concern that systemic cancers should not be completely dismissed from future consideration. Because there has been no significant population of workers employed in direct coal liquefaction technologies, little is known at this time about health consequences of long-term work in such plants.

Given the implementation of worker education, clothing, medical, and monitoring programs at initiation of SRC-I operations, work-related illnesses would be expected to be substantially less than those observed in existing industries in which exposure to complex hydrocarbons might occur. The accumulated evidence does suggest that if exposures are reduced as measured by PNA content, coal tar pitch volatiles, or benzene-soluble particulates, then cancer incidence may be also reduced.[5] Of course, the evidence is predominantly from high exposure levels, where the

agent induces a significant amount of cancer potentiation through such processes as hyperplasia necrosis, inflammation, and cytotoxicity.[12-14] At very low exposure levels, potentiation may stem primarily from endogenous mechanisms, and the dose response may become flat, as illustrated by the typical "hockey-stick" response.[17,18] This behavior is most common for low doses given intermittently with sufficient separation in time. However, there is no scientific basis for choosing among possible dose-response relationships at the present time. It is clear, however, that the best worker (or general population) health protection is to give priority to efforts to minimize exposure to relevant toxic materials. A vigorous industrial hygiene program to prioritize, monitor, and assess potential occupational health problems is essential. Exposures in modern coal conversion facilities are expected to be, at worst, much lower than was the case for the coal utilization technologies discussed above. Because most coal conversion processing is carried out in closed systems, emissions would largely result from leaks, accidents, or emergency venting of tar, chars, soots, or other toxic substances. However, potential exposures vary widely from technology to technology, and continual monitoring will be essential. The general features of the approach to ensure adequate occupational and public health protection are discussed in Sect. 1, "Health Risks Assessment Methodology."

4.1.2 Materials of concern and research priorities

As judged to date by chemical and biological research on microorganisms, and cultured cells, and laboratory rodents, coal liquefaction produces various complex organic materials which have the potential for serious adverse health effects.[4-11,19,20] These materials include polynuclear aromatics, aromatic amines, heterocyclic compounds, highly substituted phenols, and other materials.[4-11,19,20] Many of these materials, particularly the polynuclear aromatics, are also produced by processes other than solvent refining of coal, such as pyrolysis or incomplete combustion of various organic materials, including coal, wood, and petroleum. Varying levels of carcinogenic potential, as measured in laboratory rodents, have been observed for other synthetic fuels (e.g., shale oil), heavy coal liquids (Bergius process), and crude petroleum. In general, the most pronounced effects are associated with the heavy, high-boiling point (above approximately 260°C) liquid and solid fractions of the process materials. Initial tests have suggested that the light hydrocarbon fractions are relatively free of mutagenic activity in cellular systems and free of carcinogenic activity in rodents, although the most realistic exposure routes were not always used and, furthermore, low dose effects would probably not be revealed without more understanding of the biological mechanisms. Weak genotoxicants could go undetected or become controversial as in the case of saccharine. Many of the polynuclear aromatic materials are solid or tar-like at ambient temperatures; all are high boiling and have very low vapor pressures at ambient temperatures. Thus concerns relate primarily to process streams at high temperatures and pressures where these materials may be in vapor state.

Results from acute toxicity tests, in which doses are given orally, show all SRC materials fall into the same category; moderate acute toxicity,[19] as determined from mutagenicity. All three fractions remain untested for dermal and inhalation carcinogenesis. This means that they are less toxic than many materials presently used in commerce today. Some SRC materials, at high doses, have been found to be teratogenic in rats (e.g., causing malformations in fetal tissue) when given orally to the dam at certain intervals during gestation. However, in most cases examined to date, there were signs of toxicity in the dam. Because there is wide species variability in teratogenic response, these results may not be totally applicable to man. Planned research relevant to teratologic effects of SRC-materials in a second, nonrodent animal species (rabbit) may aid in elucidating the teratogenic potential of SRC-materials.

Research should be prioritized because financial constraints may prevent all of the proposed research from being completed. The research emphasis should be placed as follows:

- Chemical characterization of SRC materials.
- Biological testing of SRC materials, with emphasis on whole animal testing and in vitro studies designed to elucidate genotoxic response mechanisms. Essential testing includes dermal and inhalation carcinogenesis, teratogenesis, and male reproductive effects.
- An extensive monitoring program for the demonstration program that will allow estimation of both inhalation and dermal exposures to "indicator" compounds for each family of hazardous compounds expected to occur (e.g., polycyclic aromatic hydrocarbons, aromatic amines, aza-imino-arenes, phenols).
- Definition of the extent of variation in chemical and biological activity of SRC materials as a function of feedstock, temperature, pressure, and likely process modifications.

4.1.3 Sources of exposure and control plans

The techniques for emission control summarized below are being incorporated into the engineering design of the plant, as well as the procedures under which the plant will be operated and the products distributed. Many of these techniques are used in other industries and are highly developed and commercially available. Others are based upon the industrial hygiene program at the Fort Lewis pilot plant. Some are also the result of using the best available technology to control emissions from those points in the process where the process material is suspected to have significant toxicological activity.

These techniques can be broadly classified as engineering controls incorporated into the design of the plant and operating procedures to mitigate the effects of worker and public exposures. Included in this category is a thorough industrial hygiene program. The engineering controls are intended to minimize emissions from the plant, which could impact the surrounding public, as well as reduce the exposure of plant workers to those materials suspected of toxicological activity.

4.1.3.1 Engineering control of process emissions during normal and upset conditions

Process operations could cause public exposure by three mechanisms: atmospheric dispersion, wastewater discharge and spills, and solid waste disposal. These are discussed below.

Atmospheric emissions

Atmospheric emissions of criteria pollutants such as SO_2, NO_x, suspended particulate matter, carbon monoxide, and hydrocarbons are regulated by the Clean Air Act. The unit processes, procedures, and equipment utilized in the design of the SRC demonstration plant are aimed at ensuring compliance with these regulations, as well as other Kentucky regulations governing H_2S and other pollutants. Engineering controls to achieve compliance with the Clean Air Act (discussed in Sect. 2.2.1 and in Appendix C) should minimize public health impacts due to this source.

Atmospheric emissions of process materials that are not criteria pollutants but that are suspected of having genotoxic or other biological activity will be minimized by the use of several advanced engineering controls. The most important of these is a controlled combustor and flare system to convert hydrocarbon emissions efficiently to carbon dioxide and water vapor. During normal operations and all process upsets, except the most severe emergencies, hydrocarbon emissions from process equipment will be completely contained and the emissions sent to this system. Emissions from the venting of most safety valves, fumes from product solidification, and all other relatively continuous or small point sources will be treated in this fashion. Fugitive emissions are discussed in Sect. 4.1.3.3.

This system will consist of several types of combustion equipment, together with flow control, cooling, condensation, and separation systems. The base case design being evaluated is presented in Appendix C.

The design approach taken in this controlled combustor/flare system is to remove the heavy hydrocarbon components of greatest concern from any gaseous emissions that are combusted in air open flame, to collect these compounds, and combust them at a later time (if recycle is not possible) in an enclosed thermal oxidizer under controlled combustion conditions. Combustion conditions in this enclosed thermal oxidizer will be maintained so as to ensure combustion residence time, turbulence, and temperature, which will destroy the hydrocarbon compounds of concern. Flue gases from this enclosed thermal oxidizer will be monitored to detect emissions and to adjust combustion conditions to maintain high efficiency control.

The remaining light hydrocarbon vapors will be combusted in equipment suitable for the high turndown ratios required, where combustion takes place in an open flame. Because flow rates to individual burner elements are controlled, essentially complete, smokeless destruction of these light hydrocarbons is expected. Major unanticipated emergency releases will be combusted in an elevated flare. Even in the event of such major releases, the heavy hydrocarbons will still be separated from the main vapor flow, collected and combusted separately.

Appendix C, Sects. C.2.2.6 and C.3.1.5 discuss the components and performance goals for the controlled combustor/flare system.

Another significant potential source of atmospheric emissions which may result in public exposure to these biologically active materials is the cooling tower. A preliminary analysis of heat rejection options is presented in Sect. 2.3.2.2 and in Appendix C. One of the most significant indirect mechanisms for public health impacts resulting from the heat rejection system is from leaks into the cooling system. If biologically active compounds leak into cooling water that is sent to a wet cooling tower, those compounds could be released to the atmosphere through codistillation, aerosol formation, or entrainment in drift. The proposed design has identified the processing equipment which typically contains the heavy hydrocarbon (boiling point greater than 260°C) materials of most concern from a health standpoint. This equipment includes the coal dissolver, hydrogen recovery, expanded-bed hydrocracker, and coker/calciner. These processing units will be equipped with aerial coolers or indirect cooling systems that should virtually eliminate the cooling system as a source of these hazardous compounds. Any leaks of process material which still occur can be detected with monitoring equipment and visual inspection. For reducing fugitive release of hydrocarbons, aerial coolers and indirect cooling are preferred over conventional wet, evaporative cooling towers and have been adopted in the proposed plant design for these streams projected to be of greatest concern. The remainder of the process areas will be served by wet, evaporative cooling towers. Other options being evaluated for these other process areas are discussed in Appendix C.

Wastewater and spills

Public health impacts resulting from wastewater disposal will be mitigated by the proposed plant design which incorporates a sophisticated tertiary wastewater treatment system that emphasizes the removal of toxic metals and organic compounds from the wastewater (Appendix C, Sect. C.2.1). This system will collect and treat all process wastewaters, process area runoff, runoff from product storage and shipping areas, leachates from the coal and solid SRC storage areas, as well as the slag disposal and hazardous waste-landfill areas, and blowdown from the cooling towers and boilers. Cooling tower blowdown will receive separate pretreatment before entering the main wastewater treatment system. The proposed wastewater treatment system will be designed to operate with total water recycle and zero wastewater discharge, but have the flexibility to treat and discharge all wastewater when process operating conditions do not allow recycle.

Major spills occurring at the main process area, in the product storage area, and shipping area will be contained to prevent them from reaching the water through surface runoff. Residues and process liquids from cleanup operations from such spills will be contained at the plant site in all cases. If possible, process materials will be separated and recycled. When this is not possible, incineration in a controlled combuster will be used for disposal.

Because treated wastewater will be discharged to the Green River under some conditions, a monitoring program will be instituted to assess the impacts (see Sect. 4.5). This program will emphasize both emissions monitoring in the wastewater stream itself and monitoring within the river for bioaccumulation of process specific chemical entities with potential for adverse health impacts as determined through ongoing research and established criteria.

Solid waste disposal

Potential public health impacts resulting from solid waste disposal are expected to be small. Solid wastes from the demonstration plant will be disposed of on site, in compliance with the provisions of the Resource Conservation and Recovery Act (RCRA). Materials of concern (e.g., RCRA-designated hazardous materials) relating to potential public health impact will be contained on site in a landfill designed to store hazardous materials and minimize transport into the environment, including groundwater. This landfill, described in Appendix C, Sects. C.2.3 and C.3.2, will be lined with low-permeability clay underlaid with a plastic liner, with leachate collection systems above and below the double liner to collect any leachate that should occur. This leachate (if any occurs) will be recycled to the wastewater treatment plant. The landfill will be built on a portion of the site above the 500-year flood elevation, and the bottom of the liner will be above the historical high-ground water table elevation. Other RCRA requirements for fencing and record keeping will be practiced.

The major solid waste stream, in terms of volume generated, will be the slag/fly dust produced by the gasifier. Preliminary experimental work on this fly dust and slag from the SRC-I process (Appendixes P and C) indicates that both would be classified as nonhazardous under the RCRA. Further tests (Appendix C) on gasifier slag from the SRC-II process indicate that benzene-soluble compounds were present in low concentrations. If biologically active organic compounds were present in the slag, they would be expected to appear in this benzene-soluble fraction. However, in ongoing research, other solvent systems will be tested for their effectiveness in leaching of organic components from slag. Similar tests are being performed on SRC-I slag and fly dust. Because these gasifier wastes are generically similar, it is expected that the results will be the same for SRC-I materials. Based on available data, it is believed that public health impacts resulting from leaching of biologically active organic compounds from the gasifier wastes will be minimal (Appendixes C and P and Sect. 4.2.2.2). Should testing indicate the presence of significant amounts of biologically active compounds in leachate from SRC-I gasifier fly dust and slag, the fly dust and slag will be treated as hazardous and disposed of accordingly. Airborne particulates from slag disposal, a potential source of inhalation exposure to occupational and environmental populations, will be analyzed for biological effect in appropriate assay systems.

The gasifier slag disposal plans are indefinite, and alternatives are discussed in Appendix C. The proposed design will include clay and synthetic liners, leachate detection and removal systems, and flood proofing. The DOE and ICRC are awaiting guidance from EPA and KDNREP regarding the design requirements for obtaining a RCRA disposal permit for the gasifier wastes. The design will comply with the conditions and specifications of the permit.

One alternative being evaluated is solidification of the gasifier wastes by a process that converts them, before land disposal, to a hard, impermeable, solid mass similar to cement or rock. These processes have the potential to be used in place of or in conjunction with the hazardous materials landfill previously discussed. They are presently being evaluated for technical feasibility, and are discussed in Appendix C.

All other solid wastes except raw water treatment sludge are assumed hazardous for design purposes and will be stored in hazardous landfills that conform to RCRA standards for such landfills, with double liners, leachate detection and collection, and dikes to prevent flood inundation. Appendixes M and R indicate that groundwater flows toward the Green River beneath the hazardous landfill (away from local aquifer users), and the rate of migration in the event of a liner failure is very slow. A mitigation plan for handling liner failures is given in Appendix HH.

4.1.3.2 Major emergency upsets

Emissions during emergency conditions could be of two types: (1) an upset or other condition that requires venting of process materials at a rate too great to provide complete controlled combustion in an enclosed thermal oxidizer and requiring some flaring; or (2) an uncontrolled ground-level release of process materials resulting from vessel rupture. Emergency conditions of the first type arise from the need to relieve pressures within process equipment to prevent vessel rupture and catastrophic failure (explosion or failure of containment resulting in fire). Such incidents will result in the removal of a hot, high-pressure hydrocarbon stream from the equipment being protected. Most such releases will be small and would be routed to one of the combustion devices in the controlled combustor system. Currently, it is expected that only a few major releases of the worst-case type would be too large and released over too short a time period to be treated in this manner.

To provide a significant measure of protection to the environment and public health, it is planned currently that all such releases would be sent to a quench and liquid knockout system where most of the heavy organic compounds would be removed. The remaining light gaseous compounds would then be sent to either a ground flare field or an elevated smokeless flare system that should destroy most compounds having acute toxicity or reduce their concentration to levels that are not acute health hazards when transported to points of population exposure. The flare system in combination with the liquid knockout system should also provide at least partial control of those materials having potential long-term effects (i.e., biologically active complex hydrocarbons). The flare would be designed to protect personnel and equipment from the high levels of thermal radiation (heat) emitted by flaring these large process upsets.

Both the controlled combustor system and the flare system will be designed to prevent grounding of the plume in the process area. Thus, emergency releases of the first type (an upset or other

condition that requires venting of process materials to the flare system) are not considered to be a significant exposure mechanism for the work force. Small emergency releases will be directed to the controlled combustor. Large-scale emergency releases through the flare may result in only partial combustion of some of the biologically active compounds. However, the concentrations to which the public is exposed are expected to be small. As discussed in Appendix C under "Air emissions during emergencies," the duration of such an event should be less than 2 h. Furthermore, such major incidents will be very infrequent, not continuous. (The controlled combustor and flaring systems are discussed in Appendix C, Sects. C.2.2.6 and C.3.1.5.)

Emergencies in other process areas where streams are not toxicologically active (e.g., gasifier area and gas treating area) would also be vented to the flare system. Large releases would be combusted in either a ground flare field or an elevated flare.

The second type of emergency condition (an uncontrolled ground-level release of process materials) would be caused by vessel rupture. This could release a large quantity of hot, high-pressure hydrocarbons in an uncontrolled fashion. (Note that one purpose of the flaring system is to relieve pressures in order to prevent this type of incident.) Accidents involving the uncontrolled releases of process materials resulting from equipment failure would probably involve fire or explosion. Emissions of process materials resulting from such an event cannot be predicted at this time. The safety analysis report (Appendix AA) will address the likelihood of these events, the impacts that would result from them should they occur, and appropriate design and operating measures to protect employees and the public.

An uncontrolled release of high-temperature process materials could, in some cases, present fire, thermal, and acute toxicity hazards considered to be more significant than the long-term health hazards. These acute hazards will determine the design of safeguards to minimize the probability of occurrence and will determine the actions to be taken if uncontrolled ground-level releases should occur. The plant design will use the best engineering practices of modern petroleum-refining and petrochemical facilities to minimize the likelihood of such releases. Personnel and equipment hazards caused by fires and/or explosions will be minimized to the extent possible by careful equipment layout, isolation of equipment with valving, fire control and emergency response planning, and other such techniques practiced in modern petrochemical facilities.

4.1.3.3 Engineering controls of fugitive emissions

Fugitive particulate emissions contribute to the total suspended particulate emissions of the plant. These include dusting from coal piles, SRC solid product storage piles, and solid-handling operations. Such emissions fall under provision of the Clean Air Act. Control measures designed to comply with this act (discussed in Appendix C, Sects. C.1.2.1, C.2.2.3, C.3.1.2) should minimize public health impacts caused by this source. Furthermore, transport of most fugitive particulates will probably be over short distances only, which will restrict environmental impacts to areas near the facility (Sect. 4.2.3.1). Nevertheless, measurements will be made to determine the physical and chemical characteristics of these materials (Sect. 4.5).

Additional concerns from an occupational and public health viewpoint are fugitive hydrocarbon emissions from process equipment that may be adsorbed on particulates or occur as vapors. Pump and compressor seals, valve packings, and drains are major sources of leaks and fugitive emissions. The proposed plant design will include double mechanical seals with fluid barriers or an equivalent system for centrifugal pumps and compressors that handle gaseous, light-liquid, or two-phase organic liquids. The distance pieces on reciprocatory pumps and compressors will be purged with nitrogen, and the purged materials will be directed to the controlled combustor. Sampling points utilized to characterize process streams will be equipped with caps, blind flanges, or double valving to eliminate small fugitive emissions caused by sampling-valve failure. Operating procedures for sampling will be designed to minimize evaporation or aerosol formation during sampling and to eliminate losses to the environment caused by discard of the initial sampling flow. Selected flanges will be equipped with O-ring compression gaskets to reduce the probability of leaks past metal-metal interfaces.

It is planned that additional controls of fugitive emissions will include a program of equipment inspection, leak detection, and area monitoring for early identification and elimination of emission sources. Because such leaks (especially from high-pressure sources) can pose a fire hazard as well as a health hazard, they will receive immediate attention after detection. Some

of the major process sytem components containing materials of concern that are anticipated to require frequent maintenance will be installed in parallel redundancy to allow for repair immediately after detection of emissions without overall system shutdown.

Fugitive emissions to the atmosphere are not expected to be the major source of occupational exposure for those plant workers involved in maintenance operations. For these worker categories, dermal exposure is expected to be the most significant exposure mechanism. Measures to mitigate these exposures are discussed in Sect. 4.1.3.6. Fugitive emissions to the atmosphere are expected to be the major exposure source to other categories of workers at the plant site because process temperatures used will often far exceed the boiling points of even the higher-molecular-weight polycyclic aromatic hydrocarbons and amines. The high pressures used in these processes ensure some leakage of these materials as aerosols. Their presence in airborne emissions is supported by monitoring at Donor Solvent pilot facilities. Engineering controls discussed above will be designed with the intent of limiting concentrations of fugitive hydrocarbon emission to within the OSHA-specified Threshold Limit Value (TLV) for coal-tar pitch volatiles in all process areas. The proposed New Source Performance Standards for the Synthetic Organic Chemical Manufacturing Industry (SOCMI) has also been used as a basis for the design of controls for fugitive volatile organic compounds.

Although there has not been a long-term epidemiological study of internal organ cancers with coal liquefaction workers, there have been epidemiological studies of workers in industries which produce related compounds from coal.[4-12] These and other animal studies have resulted in standards for exposure to volatile carcinogenic coal-derived materials in the coke-oven industry.

The epidemiological study of coke-oven workers[5] that related coal-tar pitch volatiles (CTPV) exposure groups to death rates concluded, "The established threshold limit value (TLV) of 0.2 mg/m^3 is considered to be adequate, as this level of exposure for an average period of 30 years does not increase the risk of dying from lung cancer." As an upper limit, engineering controls will be designed to keep exposures within the limits specified by OSHA[5] for CTPVs while further monitoring, chemical characterization, biological testing, and occupational and public health assessments can be carried out in conjunction with operation of the SRC-I facility to develop directly applicable protection procedures.

To reduce worker exposure in enclosed environments such as control rooms and office areas, consideration is being given to control measures such as filtering recycled ventilation and air conditioning air to prevent buildup of high concentrations of fugitive hydrocarbon aerosols.

Because of dispersion, it is felt that exposure to fugitive hydrocarbons transported away from the plant site will not have a significant health impact because concentrations in the immediate plant area will be held to low levels. Monitoring to be done in the surrounding area to ensure that such concentrations are negligible is discussed in Sect. 4.1.3.5.

4.1.3.4 Maintenance

While maintenance operations provide an opportunity for unplanned releases to the environment, the major risk will be occupational exposure via skin contact and inhalation. Experience at the Fort Lewis SRC pilot plant and at plants manufacturing hazardous chemicals indicates that this risk can be significantly ameliorated by providing industrial hygiene training and protective equipment for the work force and by developing safe, proper maintenance procedures to minimize environmental release and personnel exposure.

For the demonstration plant, specific highly detailed maintenance procedures will be developed after detailed design of the process equipment is completed. These procedures will be based on experience developed in other industries that handle materials that are hazardous through personal contamination, especially skin contact. These procedures will specifically address (but are not limited to) the following areas: (1) the potential health hazard, (2) frequency of maintenance, (3) required maintenance identified by emissions monitoring, (4) procedures for minimizing fugitive emissions during maintenance, (5) decontamination procedures before working on equipment or shipping offsite, and (6) containment of decontamination fluids and wash waters.

4.1.3.5 Monitoring

Parts of the mitigation process to prevent health impacts will be a thorough monitoring program. This will consist of three types of monitoring: (1) emissions monitoring from point and fugitive

sources, (2) ambient monitoring (both at the site and in the surrounding environment), and (3) area/personnel monitoring to determine worker exposures. The latter is an integral part of the industrial hygiene program and is discussed in Sects. 4.1.3.6, 4.5, 4.6, and Appendix Z.

Monitoring of point emission sources will make it possible to ensure that emission control processes and equipment are functioning properly and that emissions are within regulated limits. The monitoring systems will include stack sampling for air emissions to monitor all criteria pollutants as well as materials believed to be potential health hazards (e.g., polycyclic aromatic compounds, both as vapors and in suspended particulate matter). All airborne sampling equipment will contain cold traps or similar measures for minimizing loss of volatile organics during sampling procedures. Some of the volatile organics may contain compounds of significant genotoxicity (e.g., benezene and lower molecular weight aromatic amines). Monitoring methods for other compounds shown to be toxic through ongoing research will be developed and deployed. Wastewater discharge will be monitored for regulated pollutants (e.g., toxic metals, BOD, total suspended solids) and also for materials which are potentially toxicologically active (e.g., polycyclic aromatic and other materials of concern, as identified through ongoing research). In addition to ensuring compliance with regulatory limits, this monitoring will help identify sources of potential problems and appropriate areas for process modification.

Ambient monitoring of air, surface water, and groundwater quality will be carried out by the project sponsors in the vicinity of the plant to determine the impact of emissions. This program will be designed to monitor the impact of emissions both at the point of maximum concentrations (to the extent that this is possible) and at significant receptors even though pollutants are dispersed before reaching these receptors. This will be used to ensure compliance with ambient air quality standards for criteria pollutants, to assess the impact on attainment regions for PSD determinations, and to provide a baseline for comparison when planning for possible commercialization. It will also be used to ensure that there is no significant impact on pollutant concentrations for groundwater or surface water caused by emissions from the demonstration plant. If significant impacts are detected, mitigation measures will be implemented by the project sponsors.

Because complex hydrocarbons are a potential public health problem of concern, they will be monitored at the points where air dispersion modeling predicts greatest exposure for the surrounding public (to the extent possible). This monitoring will serve to indicate significant exposures as they occur. In conjunction with source monitoring, this ambient monitoring will allow source mitigation techniques to be analyzed and instituted at the plant whenever required to protect public health.

Similar monitoring for toxic materials will be carried out by sampling aquatic life that might be exposed to trace concentrations caused by wastewater effluents. This will be especially directed toward identifying bioaccumulation of these materials by organisms. Emphasis will be on accumulation in organisms (e.g., fish, crayfish) which could cause direct dosage to man, or which are in the food chain of these organisms.[21]

4.1.3.6 Occupational health protection

A thorough industrial hygiene program will be instituted to ensure the adequacy of engineering controls designed to minimize worker exposure to potentially toxic materials and to institute additional controls if necessary. This program is based on experience gained at the Fort Lewis and Wilsonville SRC pilot plants and on state-of-the-art practices in coal liquefaction and related industries.

Engineering controls are expected to minimize exposures to materials having acute chemical toxicity and to reduce concentrations of all regulated substances to within limits specified by OSHA except during emergency conditions (fires, explosions). Additionally, the industrial hygiene program will be designed to minimize the exposure to potentially toxic materials that are presently unregulated.

To provide the greatest amount of protection, it will be assumed that all process streams having the potential to contain toxic materials (carcinogenic or otherwise) are toxic. Until or unless toxicological and process stream characterization studies have identified a process stream as being noncontributory to carcinogenesis processes of "initiation" and "promotion," it will be treated as a potential hazard to workers, and all applicable elements of the occupational health program will be followed in dealing with it.

The primary mechanisms for worker exposure to these biologically active materials will be through dermal contact and inhalation. The industrial hygiene program will be designed primarily to control both these mechanisms of exposure. Worker education and training is the first element of the program. The core of any successful occupational health program is worker acceptance and participation, and this is a stated goal of the program. The means of attaining this goal are threefold: initial training of new employees, annual retraining, and periodic health and safety meetings. The latter will allow airing of individual concerns and permit review of emergency procedures. The workers will be familiar with the potentially hazardous nature of process materials, with mechanisms of exposure, and with the worker protection procedures implemented to minimize exposure.

The proper use and maintenance of protective equipment and clothing helps to minimize any adverse health effects of worker exposure to coal liquefaction materials that may pose health hazards. For normal operations, employees in areas where contact can occur will be issued and required to use overalls, underwear, socks, and leather boots with oil-resistant soles. In the event of a spill of toxic materials or work assignment that might lead to personal contamination, the employee will wear special protective equipment such as synthetic rubber boots, special gloves, an impervious rain suit, face shield, goggles, and/or respirator. Hearing protection will be provided in areas with high noise levels. Visitors entering the plant will be provided with protective clothing to prevent contamination of their street clothing.

To protect the worker and to prevent transport of coal liquefaction contaminants off the plant site, special procedures and facilities have been developed for employees working in areas where contamination may occur. The key elements in the design and use of the change facility are the segregated "clean" and "dirty" areas and a mandatory daily shower and shampoo for workers. All employees and visitors must pass through a change facility when entering or leaving the plant areas where contamination can occur. Monitoring of personal hygiene effectiveness (e.g., skin contamination) will be assessed as a technique for improving worker hygiene. If this is concluded to be a safe and effective practice, it will be made available to workers as they pass through the change facility. One possibility depends upon optical fiber methods for quantitating dermal exposure to polycyclic aromatic materials which are currently being developed at Oak Ridge National Laboratory. These methods are being refined to minimize the ultraviolet (UV) light intensity used in the technique. This is necessary because besides possessing genotoxic dangers by itself, UV light may activate some polycyclic aromatics absorbed in the skin to their active mutagenic and carcinogenic forms. This monitoring need not be done daily, but only periodically and after known high-dose exposure incidents involving workers. This method may not detect the aromatic amines that can easily pass through the skin into the lymph and blood. However, because these compounds will represent only a small proportion by weight of the total fluorescent material present, an accurate estimate of total dermal polycyclic aromatic exposure can be obtained.

The second element of the worker protection program is a carefully designed set of specific work practices. The demonstration plant will follow comprehensive and specifically defined work practices in the following areas: personal decontamination, washing practices following accidental contamination, eating, drinking, smoking, material transferals, material storage, material disposal, maintenance procedures, and emergency plans and procedures. These work practices will be in accord with accepted principles of industrial hygiene followed in other industries which have handled hazardous materials in the past.

Medical monitoring is an important third element in the program. A medical monitoring program will be made available to all employees who may be occupationally exposed to coal liquefaction products, and participation in the monitoring program will be encouraged. Examinations designed to detect potential coal-liquefaction-related symptoms will be made before employment and annually thereafter unless a different frequency is indicated on the basis of professional medical judgment. This medical monitoring will help detect medical problems early (should any occur), when prognosis for successful treatment is generally very high.

It is of utmost importance to retain employee records for a sufficient period of time. Because of the occupational health uncertainties inherent in a new industry and the long latency period of potential cancers, employee records will be kept for a period of time consistent with or longer than those stipulated in Federal regulations. These records shall include demographic information as well as comprehensive work histories, exposure monitoring data, and medical surveillance results.

The fourth element of the program is a thorough system of industrial hygiene monitoring which will assess worker exposures to potentially harmful substances and help formulate work practices and engineering controls to prevent exposure. Potential indicator compounds will be evaluated by methods equivalent to or more current than those discussed by the National Institute for Occupational Safety and Health (NIOSH).[3] Frequency of monitoring will be dependent upon an assessment of the potency of toxicants and the initial concentrations measured. Protocols will be developed by an industrial hygienist. Initial area and personnel monitoring will be conducted for, but not limited to, the following agents: coal dust, coal-tar pitch volatiles (CTPVs), polynuclear aromatic hydrocarbons, aromatic amines, phenols, cresols, benzene, toluene, xylene, indicator compound(s) for aza-/imino-arenes, carbon monoxide, nickel carbonyl, carbonyl sulfide, hydrogen sulfide, sulfur dioxide, hydrogen cyanide, welding fumes, silica, trace metals, noise, lighting, and radiation. Materials will be identified (indicator compounds) that may be monitored routinely and continuously to ensure health protection.

4.1.3.7 Transportation accidents

Although accidental releases on the plant site are not expected to result in public exposure, it is likely that transportation of the products will at some time result in accidental releases which result in direct and indirect exposure of the public to process materials. Direct exposure may result from contact with the material because of involvement in the accident, response and cleanup operations, or from inhalation of materials aerosolized as a result of fire. (Appendix DD has a detailed transportation spills analysis.) Indirect exposure could occur through contamination of municipal or domestic surface water or groundwater supplies or through the aquatic food chain.

The proposed coal liquefaction demonstration plant in Newman, Kentucky, will have a capacity of 5400 metric tons of coal per day (6000 tpsd) and will produce energy products which consist of heavy fuels oils, light fuel oils, and solid SRC-I fuel.

The SRC-I solid product was not considered in the transportation spill analysis because preliminary laboratory tests show that leachates from that product do not appear to present a significant hazard to water quality or the environment as a whole (see Appendixes C and P). The purpose of this section is to investigate only the worst-case spill for the route selected below, which is considered to be the loss of SRC-I liquids during shipment. A brief analysis of the potential consequences of a worst-case spill is also included.

Transportation routes

Light oil products. For purposes of this analysis it was assumed that the SRC-I light liquid products will be transported to Lake Charles, Louisiana (Table 4.1). One possible route, selected by computerized routing analysis, is discussed below. This routing was used for the purpose of impact analysis. The light oil SRC-I shipments would be originated by the Louisville and Nashville (L&N) railroad at the plant's siding in Newman, and the shipments would interline with the Southern Pacific Railroad (SP) at the Avondale Switching Yard in New Orleans for final delivery to Lake Charles.

Table 4.1. Summary statistics for projected SRC-I liquids movements

Heavy products	
Volume shipped per month, tons[a]	4,050
Number of shipments per month	1
Ton-miles per month	2,126,250
Car-miles per month	31,500
Light products	
Volume shipped per month, tons	42,900
Number of shipments per month	8.7
Ton-miles per month	42,900,000
Car-miles per month	630,630

[a]Month = 30 days.

After originating in Newman, the shipment would proceed through Henderson, Kentucky, and south through Hopkinsville, Kentucky, into Tennessee. The route for SRC-I shipments in Tennessee would pass through the city of Nashville before entering Alabama. The shipment would continue south through the major industrial cities of Birmingham, Montgomery, and Mobile. The route along the Gulf of Mexico would pass through the cities of Biloxi and Gulfport, then enter Louisiana and cross Lake Pontchartrain into New Orleans. The final delivery would be to the Cities Service Refinery at Lake Charles. The SP Railroad serves this refinery on a regular basis, and the siding and switching infrastructure are in good operating condition. The rail route over which this shipment would be hauled is in good condition and does not present a capacity problem if only two additional trains operate per week. This route is designated as "A" mainline by the Federal Railroad Administration (FRA), which is FRA's highest designation for a rail line.

The rail shipment from Newman to Lake Charles would pass through more than one hundred towns, cities, and communities which have a combined population of over 2.5 million people. An accident resulting in an explosion or a spill into the water supply could have adverse effects on the local population.

The largest cities through which the light oil shipment would be transported are New Orleans (555,000), Nashville (461,000), Mobile (368,300), Birmingham (278,000), and Montgomery (189,600). A list of all towns and cities of over 1000 inhabitants through which the route passes is presented in Table DD.1, Appendix DD.

The described rail route to Lake Charles crosses numerous rivers, creeks, and wetlands. The total number of water bodies crossed probably exceeds one hundred. The major river crossings are listed in Table DD.2, Appendix DD. In Kentucky, rail shipments would cross the Green River at two locations. In Tennessee the major crossing would be over the Cumberland River at Nashville. In Alabama the rail route would cross the Tennessee River at Decatur, the Alabama River near Montgomery, and the Mobile River at Mobile. The route would cross the Mississippi River before entering New Orleans and interlining with the SP Railroad. Along the Gulf of Mexico coast from Mobile to Lake Charles, the rail shipment would pass through bayou terrain. This terrain contains wetlands and sensitive plant and animal species which could be adversely affected by a spill of SRC-I liquid products.

Spilled SRC-I liquid could contaminate municipal water supplies along the route, in both the case of systems supplied by surface water and groundwater. Spills on land could percolate into and contaminate groundwater. However, the soil tends to retard movement and attenuates many chemical species. The role of the soil in attenuating spilled chemicals is discussed in a later section (see Sect. 6.2.2 Appendix DD). There is no such buffer against contamination of surface waters in the event of a spill directly into open water. Many of the streams listed in Table DD.2 are used for public water supply. For example, the Cumberland River is the source of water for metropolitan Nashville, Tennessee.

Heavy oil products. For the purposes of this analysis it was assumed that the SRC-I heavy liquid products will be transported to Pittsburgh, Pennsylvania. One possible route, selected by computerized routing analysis, is discussed below. This routing was used for impact analysis. The route for the heavy oils from the Newman demonstration plant to Pittsburgh would be over L&N rail lines and the Chessie Rail Lines, both of which are subsidaries of the CSX rail corporation. The use of a single carrier from plant to destination and infrequent shipments minimize the probability of an accident or incident in transit.

The shipment will originate on existing L&N rail lines in Newman and would be hauled northeast through Louisville, Kentucky, to Covington, Kentucky. At Covington, the shipment would switch to Baltimore & Ohio (B&O) rail lines, part of the Chessie system.

The major cities through which the heavy oil shipment of SRC-I products would pass include: Owensboro (50,700), Louisville (310,000), Covington (43,900), Cincinnati (383,000), Columbus (529,000), Wheeling (42,700) and Pittsburgh (421,000).[22] A listing of all towns and cities with population over 1000 through which the route passes is presented in Table DD.3, Appendix DD.

The route from Newman to Pittsburgh would cross the Ohio River twice, at Covington, Kentucky, and Wheeling, West Virginia. Additional river and creek crossings in Ohio are listed in Table DD.4, Appendix DD. Along this route there are relatively few river and stream crossings, as compared to the southern route previously described for light liquids.

Spill probability

Because the SRC-I liquid fuel is a new energy product, very few shipments have occurred and no accident data have been reported. To provide a measure of the probability of an accident involving future SRC-I shipments, an analysis of shipments of similar commodities and reported rail incidents involving hazardous materials is presented in Sect. 4.0, Appendix DD.

The following production/transportation assumptions were made:

1. Heavy liquid fuel oils, produced at a rate of 122 metric tons per day, would be shipped once a month to Pittsburgh, Pennsylvania (approximately 840 km). This movement is expected to require one train of approximately 60 tank cars.

2. Light liquid fuels, produced at a rate of 1300 metric tons per day (705 metric tons per day of naptha and 595 metric tons per day of fuel oil) would be shipped twice weekly from the plant site to Lake Charles, Louisiana. Each train will consist of approximately 75 tank cars. Summary statistics are presented in Table 4.1.

Since the DEIS was published, the product slate has changed such that slightly greater quantities of heavy distillate and lesser quantities of naphtha will be produced (see Sect. 2.2.1.1). Therefore, the following table overstates the probability of the worst-case spill occurring.

Shipments of SRC-I liquid will probably be classified as hazardous material because the SRC-I liquid contains naphtha, polynuclear aromatics (PNA), tar, and other chemical compounds previously determined to be hazardous. Three commodity classes from the Standard Transportation Classification Code (STCC) were chosen for analysis: Industrial Inorganic Chemicals, Miscellaneous Chemical Products, and Products of Petroleum Refining. Based on the accident record for these three commodity classes, probabilities of spills from SRC-I shipments were determined (see Table 4.2).

Table 4.2. Predicted spill frequencies during rail shipment for the SRC-I demonstration plant liquid product

Reportable spill incidents to water bodies in terms of:	Frequency[a]
No. of shipments	
Heavy products	26,000
Light products	3,000
Volume shipped	
Heavy products	470
Light products	44
Ton-miles	
Heavy products	400
Light products	20
Car-miles	
Heavy products	530
Light products	30

[a]Frequency is defined in terms of months elapsed between spill incidents. For example, for volume shipped, the figure "470" is derived by dividing the tons shipped per month by the spill incident frequency expressed as incidents per tons shipped (see Appendix DD).

The four methods used for determining accident probability show highly variable results, with the estimate based on number of shipments predicting the fewest accidents for SRC-I shipments and the estimate based on ton-miles predicting the most frequent accidents. The estimate based on number of shipments probably underpredicts the actual accident rate because both of the routes to be used for shipment of SRC-I products are lengthy. The results of the other three methods are similar to each other.

Impacts of spills

In terms of water quality and aquatic ecology, spills of SRC-I liquid product have the potential to cause substantial impact. Three sites were selected to illustrate worst-case impacts (see Appendix DD). A spill of the contents of one tank car (75,800 liters) is assumed to enter the Green River at Spotsville, Kentucky, (Case I), the Cumberland River at Nashville, Tennessee, via Loves Creek and Cheek Lake (Case II), and a Louisiana bayou adjacent to the rail line (Case III). Spills into the rivers, if not contained, could cause water supply emergencies for Evansville, Indiana, Henderson, Kentucky, Nashville, Tennessee, and Nashville's northeastern suburbs. Soluble phenolic compounds in spilled SRC-I light product could dissolve into waterbodies, creating short-term contamination. Water withdrawn from the Ohio River and the Cumberland River would be unfit for drinking water because of taste and odor problems and the risk of exposure to undesirable organic compounds. Phenolic compounds and other soluble components of the spilled SRC-I fuel could cause massive mortality to aquatic organisms in a zone near the spill site. Long-term adverse impacts to water quality and aquatic ecology could result from insoluble hydrocarbon trapped in sand and gravel substrate and dispersed by adsorption to fine sediments (Appendix DD, Sect. 5.1).

Effects of a spill of SRC-I liquids on groundwater quality would depend on the spill volume, location, nature of the substrate at the spill site, and cleanup timing. Because phenolic compounds are water-soluble, they have the greatest potential for groundwater contamination. Effects of the spill of SRC-II liquid at the Fort Lewis pilot plant on nearby aquifers exemplify this potential (see footnote 6, Appendix DD). Polynuclear aromatic hydrocarbons (PNAs) have very low solubilities in water and tend to form microdrops that adhere to soil or sediment particles when dispersed to the environment. PNAs would thus be retained in the soil near the spill site.

Proposed transportation routes for shipment of SRC-I liquids pass over numerous aquifers which could be contaminated by a spill. One area of particular concern is the well field for the City of Owensboro, Kentucky. Groundwater pumped from an alluvial aquifer between the L&N railroad and the Ohio River could be contaminated by a spill near the well field. A more complete discussion of spill effects on groundwater and soils is found in Sect. 5.2 of Appendix DD.

Spills on land or water, either at the storage sites or while in transit in unit trains or barges, would immediately release high concentrations of nonmethane hydrocarbons into the atmosphere. Those light, insoluble distillates that would remain above the water surface would evaporate. Some of the vapors released are known toxic gases such as the vapors from naphthalene and phenol portions of the SRC-I product, and proper protective respiratory equipment should be worn when near such spills. Effects to air quality are likely to be temporary because the liquid would be rapidly absorbed into the soils, and the remainder would be cleaned up as quickly as possible. Spills on water would also temporarily affect air quality because they will be contained, recovered, and cleaned as soon as possible. Another temporary effect could result if the vapors of a spill were to ignite. Additional substances such as carbon monoxide (CO) and sooty particulates would result from incomplete combustion of organics.

The impacts from the worst-case spills that could occur during transportation of SRC-I product consider scenarios which are very unlikely. The frequency of the worst-case spill is considerably smaller than the frequency of spills presented in Table 4.2 (see Appendix DD and Sect. 4.1).

Mitigation of transportation spills

To reduce the possible impact of public exposure due to releases resulting from transportation accidents, a program will be instituted to provide fast response for containment, treatment, and cleanup of materials from such spills. The program presently being evaluated will include at least the following elements:

- A telephone response system operated by the industrial partners, located at the plant site and capable of providing information regarding the properties, hazards, recommended containment, and cleanup procedures for SRC products;
- Participation in the CHEMTREC program sponsored by the Manufacturing Chemists Association. This will provide an alternate source of the same information and assistance as the response system indicates above;
- Direct assistance to the local emergency response personnel when requested;

- Maintenance of a rapid-response assistance capability including trained personnel, transportation, and funding necessary to provide this immediate advice and assistance in the event of a spill; and

- Training and information on emergency procedures for personnel involved in the transportation of SRC products by unit trains or highway trailers which are wholly utilized for SRC product transport.

In addition, the criteria used to select transportation modes will include minimization of public health impact should spills occur, provided that this is consistent with the requirements of adequate transportation to end users. Products could be shipped by multiple car trains, barge, or unit train over specified chosen routes. Personnel associated with shipping or handling operations could be given special training in handling procedures and in using the telephone response system outlined above. In addition, the distribution of products from the initial operation of the demonstration plant will be limited to a selected group of users, which will minimize the possibility of spills.

4.1.3.8 Control of other industrial health hazards

There are a wide variety of potential health hazards associated with the SRC that do not involve genotoxic materials and that are typical of other chemical process industries. Engineering controls and other mitigation measures have been developed by these industries as they have gained design and operating experience. These control methods are not considered extraordinary or developmental. Such control measures will be utilized in the design and operation of the demonstration plant to control such potential hazards to the extent that risks will be equal to or less than those in equivalent commercial industries.

These hazards can be broadly classified as physical or chemical. Potential health hazards from physical agents fall into four categories: (1) noise, (2) radiation, (3) thermal, and (4) general industrial hazards. Where it is feasible, excess noise will be reduced by engineering controls; however, not all sources will be controllable because of their size or specific dynamic characteristics. Areas around these sources will be identified with warning signs, and hearing protection will be provided. In addition, all plant personnel will receive audiograms annually to detect hearing losses.

In the proposed plant design, radiation sources will be used at some locations as fluid-level indicating devices. Areas near these radiation sources will be monitored periodically to ensure against contamination by leakage from the source.

Thermal hazards will primarily be in the form of burns resulting from the high temperatures inherent in the liquefaction processes. Detailed specific work practices will be written and followed for working with equipment handling high-temperature materials. Thermal protective equipment will be specified as required for handling certain hot equipment.

Other general industrial hazards (injuries resulting from falls, operating machinery, etc.) will be minimized by a worker safety program as is standard practice in equivalent chemical industries.

Potential health hazards caused by chemical agents can be broadly grouped as those having acute toxic effects with rapid onset of symptoms and those having long-term chronic effects. Materials of long-term concern because of their potential for causing mutagenic, carcinogenic, or teratogenic effects have been discussed in Sect. 4.1.2.

In the demonstration plant, potential health hazards from gases are primarily from acute toxicity causing rapid onset of symptoms. Those of concern include carbon monoxide, hydrogen sulfide, hydrogen cyanide, carbonyl sulfide, and sulfur dioxide. Exposure to these gases will be minimized through the prudent use of engineering controls which are standard design practice in equivalent chemical industries. For example, flaring of gaseous streams containing such materials will be done through elevated flares designed to prevent grounding of plumes containing quantities of hazardous materials in excess of the Occupational Safety and Health Administration (OSHA) standards. A monitoring program, as discussed in Sect. 4.1.3.5, will be instituted to monitor worker exposures, and the above controls will be modified, where necessary, to minimize worker exposures to acceptable levels.

In addition to liquids suspected of long-term genotoxic effects previously discussed, some liquids have other long- or short-term toxic effects. Such liquids are primarily hydrocarbon

components of the process streams. Hexane, benzene, phenols, creosols, toluene, and xylene have specific organ or tissue toxicity and will be carefully monitored. Specific work practices that are similar to work practices for handling these materials in other chemical industries will be developed.

Potential health hazards from solids are posed by coal dust, which in sufficient amounts can cause coal workers' pneumoconiosis (black lung disease). It is believed that dust from handling of solid SRC product may pose the same hazard. This hazard may be the same for gasifier slag. Coal, solid product, and solid-waste-handling facilities will minimize dust exposure by using engineering controls developed by the coal-powered utility industry and more recently constructed coal liquefaction pilot plants.

4.1.3.9 Summary of health and environmental research program

Ongoing studies are discussed in Appendix Z, and include environmental research which will (1) aid in the development of an environmentally acceptable SRC-I process, and (2) provide data for environmental assessment of the process. The detailed environmental plan for SRC-I provides a management plan that involves the cognizant offices of the DOE (Assistant Secretary for Environmental Protection, Safety, and Emergency Preparedness and Assistant Secretary for Fossil Energy, Oak Ridge Operations Office), the developers of the SRC-I process, and environmental research groups. Criteria for selection of samples to undergo environmental analyses are given, and approximate timelines are presented for obtaining pertinent samples.

In addition to an industrial hygiene study of the Wilsonville plant, NIOSH has also performed industrial hygiene surveys at the SRC-II pilot plant and the Cresap pilot plant (see ref. 1). Plans are under way to survey the H-Coal and Exxon Donor plants, too. In addition, control technology assessments and the industrial hygiene study are made concurrently at each of these plants.

At this time, the SRC-I processes are at the pilot-plant stage of development, and a demonstration facility is scheduled to begin operation in 1984. Because design criteria may change, the environmental research described in the environmental plan document is organized in four phases which correlate with and will provide information early in process development.

Phase I research (screening) evaluates samples from existing SRC-I facilities [pilot, process demonstration unit (PDU), and bench] which may bracket potential demonstration/commercial practice in terms of physical and chemical criteria. The samples are being subjected to a battery of short-term biomedical and ecological assays. Chemical fractionation and analysis are being performed to determine compounds and compound classes of potential concern. In some cases, chemical fractionation/manipulation is required to provide materials amenable to biological and ecological testing. Phase I research provides a first estimate of potential environmental properties of SRC-I materials. As such, Phase I aids in:

- setting research priorities for the second phase of work which involves longer-term, more extensive biomedical and ecological assays and chemical analyses;
- providing initial data on materials and chemical entities that may require ameliorative action during process development; and
- providing first, qualitative analyses for assessing environmental risk to be expected from deployment of the SRC-I processes.

Phase II (baseline) research will evaluate SRC-I materials which are considered most representative of potential demonstration/commercial practice. These materials will be subjected to longer-term, more-extensive biological and ecological analyses relative to effects and environmental fate. Chemical fractionation and analyses will again be used to (1) provide materials amenable to bioassay and (2) determine compounds and compound classes of concern.

Summaries are provided in Appendix Z of ongoing efforts and results to date on research in Phases I, II, and III. The current program is defined most specifically in Phase I, with decreasing levels of specific description in Phase II, and little specificity in Phases III and IV. Phases III and IV are contingent on process development and results of Phases I and II. Therefore, the plan will be routinely updated to more specifically define later-phase research efforts. Studies suggested in the plan are consonant with the environmental concerns and requirements stated in the latest Environmental Development Plan for Coal Liquefaction.

4.1.3.10 Exposure from product end-use applications

Exposure from product end use may involve occupational and public exposure. Occupational exposure may result primarily through skin contact, while public exposure may result from combustion emissions (assuming that combustion is the only end use for demonstration-plant products). The discussion in Sect. 4.1.3.4 of dermal exposure for maintenance workers applies to occupational exposures for end users.

The SRC-I process produces both solid and liquid fuel products. Emissions from combustion of the solid products have been studied during a full-scale demonstration burn test at Georgia Power Company's Plant Mitchell.[23] Equivalent full-scale burn tests have not been carried out for the SRC-I liquid products. However, full-scale tests have been carried out using liquid products from the SRC-II process. In addition, many smaller tests of both liquid and solid products have been performed. Appendix C discusses these tests in more detail.

A full-scale test burn of the solid SRC-I product was carried out at Plant Mitchell of Georgia Power Company in 1977. The purpose of this test was to demonstrate that the solid SRC-I product could be utilized effectively in an existing utility boiler. An extensive program was carried out prior to the burn test to develop equipment modifications to such equipment as pulverizers and burners. The test burn was sponsored by EPRI, under the direction of Southern Company Services, utilizing approximately 3000 tons of solid SRC supplied by DOE. The fuel was produced at the Fort Lewis, Washington, pilot plant and shipped to Albany, Georgia, for the tests.

The test boiler was a 22-MW converted B&W maritime boiler, with side-wall firing. The burn test consisted of three phases: (1) burning coal using the original burners to establish a baseline for comparison, (2) burning coal using the modified burners, and (3) burning SRC-I solids using the modified burners. The SRC-I phase lasted 18 d, during which combustion conditions were adjusted to obtain optimal combustion and emission monitoring was carried out. York Research Corporation was contracted to conduct a major portion of the emissions testing work related to the SRC burn test. During each phase of the program, emissions measurements were performed with the boiler operating at full load (22 MW), medium load (14 MW), and low load (7.5 MW). The following measurements were made:

- Continuous monitoring of opacity, O_2, CO_2, CO, NO_x, and SO_2 in the precipitator-outlet flue gas,
- Manual SO_2 and NO_x tests using EPA methods 6 and 7, respectively, at selected full-load conditions,
- Particulate loadings at both the inlet and outlet to the primary precipitator by EPA Method 5 and ASME Power Test Code PTC27,
- Particle size distributions of the fly ash at the inlet and outlet of the precipitator,
- Percent combustibles in the precipitator inlet fly ash, and
- Resistivity of the inlet fly ash (performed by Southern Research Institute).

Combustion of solid SRC

A number of conclusions regarding the combustion and emissions characteristics of SRC-I solid fuel products may be drawn based on the results of the Plant Mitchell burn test. Although these conclusions are based on a specific test of pilot-plant products in a specific boiler, it is felt that the comparisons and data trends will be generally similar when SRC is utilized in other boilers.

Emissions of SO_2 and NO_x were clearly within the Environmental Protection Agency (EPA) "Standards of Performance for New Utility Sources" during these tests. Emissions of SO_2 were lower than those for coal, because of the lower sulfur content of SRC. Emissions of NO_x were lower for SRC than for coal in spite of the higher fuel-nitrogen typically present in SRC solids. This may presumably be attributed to the design of the dual register burner, which had been optimized for SRC and which employs staged combustion to reduce formation of NO_x.

Particulate emissions were considerably lower using SRC than coal because of the low ash content of SRC solids. The fly ash formed was extremely high in carbon content, however, which led to a

very low resistivity. The older design primary precipitator could not collect this SRC fly ash adequately, presumably because of the low ash resistivity. The secondary precipitator, which is of modern design, was able to reduce solid emissions to within the EPA new source standards. It is felt that a properly designed precipitator will be able to meet these standards in any future applications. It should be noted that fly ash from coal-fired power plants has been the subject of rigorous chemical and biological analyses. Results to date suggest that coal fly ash may cause biological effects through inorganic and organic chemicals associated with it. Comparative data for SRC-I ash are not yet available but are expected within the year. There is not a prior reason to assume that SRC-I fly ash will be higher or lower in biological effect than coal fly ash.

Combustion of SRC liquids

Large-scale burn tests have not been carried out using the liquid by-products from the SRC-I process. However, a large-scale test has been conducted by Consolidated Edison of the combustion characteristics of SRC-II liquids. These liquids are similar in chemical character to liquids from the SRC-I process. Although the physical properties, such as density and viscosity, are expected to vary, this is not felt to be important to utilization of SRC liquids, provided that appropriate minor modifications are made to the fuel storage and delivery system. The primary important difference is expected to be the nitrogen content of these liquids. Because the nitrogen content of SRC-I liquids is lower than that of SRC-II, the results of the Consolidated Edison burn test will be conservative if used to represent SRC-I liquids.

The demonstration program was carried out by KVB, Inc., at the 74th St. Generating Station of Consolidated Edison. Approximately 4500 bbl of SRC liquids from the Fort Lewis pilot plant were fired in a test boiler with a nominal full-load capacity of 450,000 lb/h of steam. The SRC liquids burned contained 0.22% sulfur and 1% nitrogen.

Nitrogen oxide emissions were nominally 70% greater than those obtained for the No. 6 fuel oil under both baseline and low NO_x conditions (Appendix C). Assuming equivalent thermal NO_x formation, this implies a 20% conversion of the differential fuel nitrogen to NO_x for baseline conditions. Reductions in NO_x levels through staged combustion were on the order of 35% for both SRC and No. 6 fuel oils. A boiler now capable of satisfying the EPA New Source Performance Standards (NSPS) for NO_x emissions of 0.3 lb/10^6 Btu would be expected to be capable of satisfying the 0.5 lb/10^6 Btu NSPS for coal-derived liquids using SRC-II fuel oil equivalent to that burned in this test program.

Particulate mass emissions were nominally lower for SRC-II fuel oil than for the No. 6 fuel oil and were below the EPA NSPS of 0.03 lb/10^6 Btu under all test conditions; however, the content of genotoxic aromatic compounds may be higher because of the expected higher initial aromatic content of the SRC-II fuel oil. The emissions at full load exhibited a biomodal size distribution comprised of a large number of carbon particles with diameters on the order of 0.05 mm or less and a smaller number of agglomerated particles with sizes greater than 0.1 mm. The No. 6 fuel oil emissions did not exhibit this agglomerated behavior although the actual particle concentrations were higher than for the SRC-II fuel oil. Comparative biological effects data on No. 6 fuel oil ash vs SRC liquid ash are not available at this time but are expected within FY 1981.

4.1.3.11 Hydrotreatment of SRC liquids

In the proposed SRC-I demonstration plant, various grades of liquid products are produced in the main SRC area, in the coker/calciner area, and in the expanded-bed hydrocracker. Some of these liquids present potential health concerns.

In the proposed expanded-bed hydrocracker area, approximately one-third of the solid SRC product will be hydrotreated to produce light, medium, and heavy oils. Preliminary research studies have indicated that hydrotreating SRC liquid products in the boiling range 185-360°C (365-716°F) may significantly reduce the mutagenic activity of transported products, as determined by the Ames *Salmonella typhimurium* assay.[19,20] Although other important biological endpoints were not measured, chemical analyses showed marked reductions in the amount of genotoxic chemical classes such as PNAs, heterocyclic PNAs, and primary aromatic amines.[20] However, the samples characterized were blends of middle and heavy distillate fractions of SRC-II liquid produced from Pittsburgh seam (West Virginia) coal at the Fort Lewis pilot plant and were only generically

representative of projected demonstration plant materials. They also contained significantly less heavy end material than some of the demonstration plant heavy fuel oils that are of primary processing interest and that have been shown to be more biologically active. It should be noted that only 135 tons/d of heavy distillate liquids will be produced and distributed (less than 9% of the coal liquid products) from the SRC-I demonstration plant. Of this quantity, half will be produced by hydrocracking solid SRC products. This hydrotreating may in itself reduce the mutagenic activity of the heavy distillate liquid product.

While the studies to date on the biological effects of hydrotreating have been strictly exploratory, they have demonstrated the need for better characterizing the potential health impacts of possible fuel oil-upgrading processes. A comprehensive plan for evaluating the influence of upgrading operations and changes in plant operations on the biological effects of SRC liquids is therefore now in preparation. The results of this program will provide valuable input to the health and environmental management options for heavy SRC-I liquid products.

Although hydrotreating might reduce the potential impacts of the transportation and use of SRC-I medium and heavy liquid products, including the impacts of accidental releases, it would have a negligible effect on the emission of complex organics from the demonstration plant. Expansion of the proposed hydrotreating section to provide sufficient capacity to treat all liquid products from the demonstration plant would result in a small increase in the emission of criteria pollutants. Based on the information currently available, it is the judgment of DOE that inclusion in the demonstration plant of an expanded hydrotreating facility capable of treating all liquid products solely to reduce biological activity would appear to warrant consideration only if further studies indicate that exposure to SRC liquid products cannot be adequately controlled to comply with applicable regulations. If, however, further studies indicate that the materials responsible for a significant portion of the biological activity may be concentrated in a small fraction of the product, which may be separated by distillation or other means, hydrotreating of this fraction may warrant consideration. Studies relevant to this point on SRC-II heavy liquid products are in progress and results may be available in early 1981. It should be noted that, at this time, the extent of hydrogenation that might change mutagenic properties of SRC materials is not known; thus, the economic impacts of hydrotreating for environmental/control purposes are difficult to predict. Further, it has not been demonstrated that results derived from microbial assays of hydrotreated SRC materials correlate with results from animal assays of dermal or pulmonary carcinogenicity. These assays are considered more appropriate in assessing risk to man than are the microbial tests.

Hydrotreating entails catalytic hydrogenation of light SRC liquid products to light distillate of naphtha fuels suitable for use as transportation fuels and as medium and heavy oil fractions. The addition of a complete hydrotreating capability to the SRC-I demonstration plant would require an assessment of the impact of the hydrotreating process on the plant environment, plant economics, and product distribution. In DOE's view, because the environmental concerns could be mitigated with the use of other control plans, inclusion of a complete hydrotreating facility for the sole purpose of mitigating the environmental concern may not be justified.

4.2 PROPOSED SITE — NEWMAN, KENTUCKY

4.2.1 Land

This section discusses the construction and operational impacts predicted for the proposed site in the areas of land use, geology and soils, and terrestrial ecology. Section 4.5 discusses recommended construction and operational monitoring, and Sect. 4.6 discusses recommended mitigation measures.

4.2.1.1 Land use

The proposed site is currently zoned A-R (rural agriculture) and no development can take place on the site until it is rezoned I-2 (heavy industrial). An application for rezoning will be submitted after issuance of a record of decision.

There will be a loss of prime farmland soils on the developed portions of the site by alteration of land use, a reduction of soil productivity for future agricultural use due to soil grading and compaction, some soil loss by erosion, and the displacement of about 24 families (60 people) from their homes. No additional land-use impacts are anticipated during operation, unless the

proposed facility is expanded to commercial size. Then, the percentage of the site actually developed will increase from about 50 to 75%. If decommissioning of the facility should ever occur, the impact on soils caused by construction and operation may preclude returning some areas of the site to agricultural use or may adversely affect the agricultural value of the soils for a period of 100 years after decommissioning (see Sect. 4.2.1.2).

An important consideration in evaluating the impact of the change in land use resulting from SRC-I facility construction is the growing local and nationwide concern for the preservation of prime farmland. Based upon an examination of U.S. Soil Conservation Service soil maps, it is estimated that about 91% of the proposed site is covered by prime soils (Appendix X).

In 1978, the amount of harvested cropland in Daviess County was estimated to be 67,309 ha (this number includes an allowance for an 8% incomplete census) (Bureau of the Census, *U.S. Census of Agriculture*, Washington, D.C., 1978). At present, Daviess County is estimated to have 71,064 ha of prime farmland and 6232 ha of additional farmlands of statewide importance (phone conversation, R. L. Kroodsma, ORNL, with Glenn E. Kelley, U.S. Soil Conservation Service, Lexington, Kentucky, June 8, 1981). Not all of these farmlands are actually in agricultural production (e.g., some could be forested or in pasture), which accounts for some of the difference between acreages of harvested croplands and prime farmlands. Yet, the prime and additional farmlands make up most of the total harvested cropland in the county. The 511 ha of cropland on the site represent 0.76% of all harvested croplands in Daviess County, and the prime farmland on the site represents 0.65% of the county's prime farmland.

It is assumed that the distribution of site acreage among various agricultural classifications as recorded in July 1979 (Table 4.3) is an approximation of the kind of distribution that would occur if the SRC-I facility were not constructed. The 1979 distribution is assumed to represent long-term trends, although year-to-year variations can be expected because of crop rotation. Thus the annual value of agricultural production that would be forfeited is estimated to be about $250,000 (1978 dollars) (Table 4.4).

Table 4.3. Approximate percentage of site area (by land use classification) to be removed by SRC-I facility

Land use classification	Total site area		Area removed by facility		Percentage
	Ha	Acres	Ha	Acres	
Agricultural cropland	511	1263	257	635	50
Agricultural pastureland	26	64	10	25	38
Fencerow and railroad rights-of-way	7	17	1	2	14
Woodlots	10	25	0	0	0
Riparian hardwoods	15	37	10[a]	25	67
Bottomland hardwoods	15	37	0	0	0
Water	<1	<2	<1	<2	<90
Other (farmsteads, pipelines, and unclassified)	15	37	6	15	40
Total	600	1482	285	704	48

[a]A May 7, 1980 Dames and Moore report, *Draft Environmental Assessment of a Barge Dock Facility for International Coal Refining Company*, indicates that only 3.4 ha will be cleared for barge facilities. Other riparian forest, probably less than 3 ha, will be cleared for the intake and outfall facilities. Thus, total clearing of riparian forest will probably be considerably less than 10 ha.

Source: ER, Table 4.1 and staff calculations based on aerial photograph.

Concern is growing in the region regarding the industrialization of the Ohio River Valley. Much of the valley's bottomland has been developed in recent years. Though the site is not adjacent to the Ohio River, it represents yet another major industry that will utilize valley resources. In addition, it is possible that this project, along with others already planned for the region,

Table 4.4. Estimated annual value of agricultural production at the SRC-I facility site

Crop	In production, October 1977[a]		Daviess County yield per hectare (acre) 1977[b]	Estimated total production	Estimated value per unit (dollars)	Approximate total value (dollars)
	Ha	Acres				
Soybeans	505	1248	66.7 (27.0) bu	33,700 bu	6.20	209,000
Tobacco[c]	6	15	5,560.0 (2,250.0) lb	33,400 lb	1.22	40,700
Estimated total annual value of crop production (1978 dollars)						249,700

[a]Based on distribution of land use patterns shown in Fig. 3.2. Although yearly variations due to cropland rotations are to be expected, the relative agricultural production probably remains fairly constant.
[b]Source: Kentucky Crop and Livestock Reporting Service, 1978; figures represent Daviess County acreages.
[c]Assumes burley tobacco.

will encourage additional complementary industrial and/or commercial facilities, further altering land-use patterns in Daviess and Henderson counties as well as in the entire region.

Indirect impacts on prime farmland will be associated with upgrading of roads and housing, commercial, and other development that may occur as a result of the SRC-I project. It is not feasible to accurately estimate the amount of agricultural land that will be impacted by these developments. Demands for housing and mitigation of traffic problems by improving roads and other options are considered in Sect. 4.2.4, although the amount of land needed has not been estimated. Another indirect impact that may occur is farm subdivision and conversion to nonagricultural uses, which may occur as human populations increase in the area and land values rise. Cumulative and indirect impacts are also discussed in Sects. 1.4.3 and 4.2.5.

Management of land use under the power lines (Sect. 2.2.1.2) will be the responsibility of the Big Rivers Electric Corporation. However, it is expected that agricultural uses of this land will be allowed to continue as prior to construction of the lines. Only the land required for the tower bases would be removed from production.

4.2.1.2 Geology and soils

Construction impacts

Construction impacts related to site geology and soils include

- foundation settlements caused by the presence of loose sand in the subsurface and
- loss of some prime farmland soils by alteration of land use, reduction of soil productivity for future agricultural use caused by soil grading and compaction, and some soil loss by erosion.

Subsurface conditions on the site are described in Sect. 3.2.1.2 and Appendix L. The loose sand present beneath the southern part of the site could cause problems of differential foundation settlement if not properly treated. Possible compaction methods and approximate costs per unit volume of soil treated have been studied.[24] To minimize foundation settlement and to design and construct a foundation capable of sustaining earthquake loads of 0.15 to 0.20 g acceleration, with risks of only minimal damage, a foundation testing program will be executed. Methods of consolidating the loose sand horizon will be studied. As foundation preparation progresses during construction, the geotechnical engineer will supervise a continued subsurface testing program to ensure that design specifications are achieved. Compaction of the loose sand to an average penetration resistance value of 15 blows per foot, as recommended by ATEC Associates,[25] should effectively minimize the potential for foundation settlements.

Soil-grading and construction activities for the demonstration project will affect approximately 303 ha (749 acres) of prime farmland soils. These figures include some areas that will be temporarily affected (stockpiles and construction areas) but are not included in Table 4.3. Figure 3.7 shows the distribution of prime farmland soils on the site area (see also Appendix X). Impacts on soils will range from little to no impact in areas not affected by construction to

compaction of soils and/or complete removal or burial of surficial soils, depending on the extent of grading required in particular areas. Construction of the barge slip will involve soil excavation and stockpiling and landfilling of dredged materials on the site (Appendix Y). Site soils are susceptible to erosion on slopes steeper than about 6%. Some impact on soil productivity resulting from grading and compaction is unavoidable if the site is developed for industrial use. Areas expected to be affected most are those where substantial foundation preparation is required (footing excavation, construction of pile foundations, areas where surface soils may be completely removed or compacted extremely to treat underlying materials). Soil profiles will be completely destroyed in some areas. Quantification of areas likely to receive minor versus major impacts from construction will be possible only when the final plot plan, site preparation, and grading specifications are complete. Impacts on soils (other than erosion) that occur during the construction phase would not be apparent unless the facility were removed and the land reverted to agricultural use, at which time soil tilth and productivity would likely be less than under currently existing conditions.

To limit soil loss by erosion, sediment retention structures will be placed in drainageways around active construction areas. Seeding and mulching will be used to stabilize soils as construction progresses. Particular attention will be given to revegetating slopes at the edges of filled areas and on dikes.

Operational impacts

Under normal operating conditions, there should be no adverse impacts related to geology or soils on the site beyond the disturbance that occurs during construction. Potential impacts are related to foundation settlement and infiltration of contaminants in the event of liner failure in waste-handling or coal storage areas.

Foundation instability is most likely to be caused by consolidation of weak alluvial materials or by seismically induced soil liquefaction. The probability of a seismically induced foundation failure at the site is determined by the probability of recurrence of an earthquake of sufficient intensity to cause failure. The recurrence interval of earthquakes producing ground acceleration of about 0.15 g at the site is estimated to be from 200 to 500 years. Occurrence of an earthquake when groundwater levels are high (i.e., flood conditions) would increase the possibility that liquefaction may occur. The probability of simultaneous seismicity and flooding is lower than the flooding or earthquake probabilities taken individually. Based on the present understanding of seismicity of the area, the probability of a damaging event occurring during the expected operational lifetime of the facility is low. The foundation preparation program, which will be an integral part of construction, will include subsurface testing to ensure preconsolidation of loose materials beneath structures and areas where settlement could cause structural failure of facility components.

Attenuating capacity of existing site soils with respect to infiltrating leachates containing dissolved trace metals is good. Mobility of potential contaminants in the site soils is discussed in Appendix R. Plant areas that have the potential for generating leachates or spilled liquids include coal storage areas, metal-sludge landfills, ash ponds, product storage areas, solvent storage areas, and wastewater holding areas. Section 4.2.2.2 discusses the groundwater quality impacts of these plant areas. Leachate derived from the Western Kentucky No. 9 coal (described in Appendix P) is very acid (pH = 2.1) and contains amounts of Fe, SO_4, As, Se, Cd, and Cr in excess of drinking water and RCRA standards. Active and long-term reserve coal piles will be equipped with a low permeability compacted clay liner, and leachate will be diverted, collected, and routed to wastewater treatment facilities. Failure of the leachate containment system beneath the coal storage area, should it occur, could result in saturation of underlying soils with contaminants that could endanger groundwater quality or limit future soil uses. The metal-sludge landfill is being designed in accordance with RCRA hazardous waste disposal guidelines and will be monitored for infiltration of leachates.

Slag and flydust from gasified ash concentrate will be disposed of in ponds. Although the detailed design is not yet available, the ponds will have features similar to landfills suitable for hazardous waste disposal (i.e., double liners, leachate detection and collection systems, and dikes to avoid flood inundation). Preliminary testing of gasified residues from the SRC process indicates that leachates produced do not contain excessive amounts of potentially hazardous heavy metals. Extraction by the EPA extraction procedure indicates that the waste does not qualify as a hazardous waste under RCRA criteria.

Leachability of the solid SRC product has been tested at ORNL, and test results are included in Appendix P. Based on testing and analyses completed to date, leachate from the product is not expected to affect soils adversely. Pore plugging due to the infiltration of runoff containing

fine particulates is the most probable impact that would result from product leaching. The SRC product will be stored on a compacted clay liner, and leachate and runoff will be diverted, collected, and routed to the wastewater treatment facility.

Prior to treatment, process wastewater and area runoff will be impounded in various retention areas. Untreated wastewater is expected to contain biodegradable organics, hydrogen sulfide, phenol, ammonia, cyanides, metals, and trace organics not subject to biodegradation but amenable to activated carbon adsorption. Wastewater retention areas will be lined to prevent infiltration of contaminants into the soil/groundwater system (see Sect. 2.3.2 and Appendix C). Runoff from the tankage area will be routed to the wastewater treatment system.

Impacts of decommissioning and mothballing

If the facility is mothballed, no impact, beyond that of construction and operation should occur, assuming that contaminated runoff and leachates from the process area, coal storage areas, and solid waste disposal areas are collected and treated.

Impacts on geology and soils, if the facility is decommissioned and dismantled, will depend on anticipated future land use and the extent of facility removal. Alteration of structures for other industrial uses is a possibility. Impacts on soils resulting from construction and operation may preclude reverting some areas of the site back to agricultural use or may adversely affect the agricultural value of the soils for a number of years. Solid waste disposal areas would be closed and covered in a manner that would isolate wastes from leaching or erosion, spreading contaminants. Future land uses in these areas may have to be restricted to maintain integrity of the landfills. Surficial soils in areas under buildings will be compacted to a depth of several feet, and pile or caisson foundations may be used in some areas. Deeply compacted soils will take several years to return to their former agricultural productivity. Effects may be more severe in areas where the soil profile is extensively altered. Piles and caissons may preclude future cultivation on some parts of the site unless they are cut off well below the plow zone.

Impacts of expansion to and operation of a commercial facility

Expansion to a commercial-scale facility at this site will impact additional prime farmland acreage over the lifetime of the facility in process areas. Solid waste storage areas will occupy parts of the site indefinitely. Impacts on soils which result from mining coal to operate the plant at commercial scale are expected to be greater than direct site impacts (see Forward).

At commercial-scale operation most of the approximately 600 ha (1484 acres) of the site would be developed for process and support areas. During a 14-year period of commercial operation, 224 ha (560 acres) will be required for ash storage in addition to 16 ha (40 acres) used during the demonstration phase, only 72 ha (180 acres) of which will be onsite. Additional ash disposal areas and/or commercial uses for part of the ash will be required for ash produced during commercial operation beyond this 14-year period.

4.2.1.3 Terrestrial ecology

Introduction and summary

The primary impact to terrestrial biota at the site will be the loss of habitat and consequent reduction in wildlife populations due to construction and the long-term presence of the industrial facility. Because most of the site is presently cleared for agriculture and represents poor wildlife habitat, most wildlife species would not be significantly affected. The Federally endangered Indiana bat occurs on the site. No other endangered species occurs on the site, and none would therefore be affected. Several uncommon or rare bird species will be affected. Impacts expected to be more minor at the site include disturbance of wildlife by vehicular traffic and noise, slightly elevated levels of vegetation stress due to air pollutant emissions, and impacts of possible spills of toxic materials.

Threatened or endangered species

Surveys for bats in July and August 1980 discovered the Federally endangered Indiana bat in the Martin Creek forest, but not in the Green River forest (Sect. 3.2.1.3; see Appendix K for

biological assessment). The Martin Creek forest will not be affected by construction, which should minimize impacts on the species. Noise and construction activities may have some impact on the bats. Direct and indirect impacts of construction and operation of the SRC-I demonstration facility should not jeopardize the continued existence of the species, because no designated critical habitat (caves) will be affected. Indiana bats are widely dispersed in summer, and SRC-I is apparently outside the main population centers. The U.S. Fish and Wildlife Service (USFWS) concurred that the SRC-I project should not jeopardize the existence of the species (Appendix I). Additional surveys for the bats will be conducted on the site in the early summer of 1981. No other species listed as endangered by the USFWS or Kentucky is expected to occur regularly on the site (Sect. 3.2.1.3), and none should be affected. Information received in November 1980 indicates that a 161-kV power line to serve the SRC-I facility would be constructed by the Big Rivers Electric Corp. (Sect. 2.2.1.2). DOE is working with Big Rivers Electric Corporation to ensure that the proposed route will avoid Indiana Bat habitat.

Impacts of construction

Acreages of the various habitats to be cleared during construction are given in Table 4.3. Agricultural land represents by far the largest acreage to be affected [257 ha (635 acres)], and riparian hardwood forest represents the second largest [10 ha (25 acres)]; see footnote a, Table 4.3. This riparian hardwood forest along the Green River and the bottomland hardwood forest along Martin Creek represent the most ecologically important communities on the site, as they support a high diversity of both vegetation and wildlife. The forest along Martin Creek will not be affected by construction.

The riparian forest will be cleared for the intake, outfall, and barge loading/unloading facilities. This clearing will contribute slightly to the significant national problem of loss of floodplain forests. As much as 90% of the nation's original riparian or floodplain forests may have already been lost, and current losses approximate 6% of the remaining area per year.[26] Floodplain forests are highly important in several ways, including the support of a large number of wildlife species (threatened and endangered species, e.g., the Indiana bat), storage and slow release of floodwaters, water quality maintenance (e.g., sediment entrapment), groundwater recharge, and very high biological productivity.[26]

The agricultural land to be lost is poor habitat for wildlife (Sect. 3.2.1.3). However, it is highly productive land and in the absence of agriculture and industrial use could be high-quality wildlife habitat. Loss of prime farmland may result in added pressures on remaining farmland and in the clearing of more floodplain and riparian forests to compensate for farmland losses.

Construction will alter drainage on the site including flow of water into Bryant Ditch, which drains into Richland Slough. However, overall flow of water into Richland Slough would be altered very slightly (Sect. 4.2.2.1), and no significant impacts on the water balance of the slough should occur.

Impacts resulting from the SRC-I project will be significant in contributing to the continuing loss of wildlife habitat in the United States. Wildlife populations in construction areas will be eliminated. Populations of permanent and summer resident wildlife species will be reduced at least in proportion to the amount of habitat lost.

Most of the wildlife species that are residents or summer breeders at the site are common and widespread. Because the extensive agricultural land on the site represents poor wildlife habitat, loss of the site would not have significant impacts on these species. However, two rare or uncommon species have been regularly observed at the site in all seasons of the year. One is the red-headed woodpecker, which is common to abundant in the bottomland and riparian hardwood forests on the site. This species has declined significantly and has become a very uncommon species in most of its range and is included on the Audubon Society's Blue List of declining species.[27] Second is the loggerhead shrike (also on the Blue List), which has become rare over much of its range in the eastern United States and which inhabits open country. Two other more common Blue Listed species, the yellow warbler and the American kestrel, breed on the site in riparian edge and open country habitats, respectively. Prediction of impacts on many other breeding bird species is somewhat limited by the fact that field surveys at the site were not done during the main breeding season. Migrant or winter resident species should not be significantly affected, because there should be other habitats available for their use. Some floodplain forest habitat for the increasingly rare swamp rabbit (Sect. 3.2.1.3) will be lost along the Green River, but the more suitable forest habitat along Martin Creek will not be cleared for the proposed project. Construction at the site will eliminate five small ponds on

the site, destroying habitat for several amphibian and reptilian species. All ten species of herpetofauna observed at the site are common and widespread and should therefore not be significantly affected.

Because of the importance of riparian or floodplain habitats to wildlife and because of the losses such forests have already experienced, as little of this forest as possible will be cleared at the site. Only as much forest land as is needed for the wastewater discharge, water intake, and barge facility will be cleared. The proposed barge slip will require clearing of about 1.6 ha of the riparian forest along the Green River (see Appendix Y). As further construction and design plans evolve, plans will be developed to minimize forest clearing.

Wildlife use of two important habitats near the site should not be significantly affected. These include the 265-ha (655-acre) Richland Slough, 1 to 2 km (0.6 to 1.2 miles) west of the site, and the Sloughs Wildlife Management Area, 2 km south-southwest of the site (Sect. 3.2.1.3). Both of these areas are used by several waterfowl species.

Operational impacts

Ecological and land-use impacts could result from particulate and gaseous emissions, vehicular traffic, noise, human presence, and disposal of waste products. Death of migrating birds could result from collision with facility structures at night or during foggy conditions, but mortality would be minor compared to that from tall TV and radio towers. Indirect impacts on wildlife resulting from the SRC-I project are mortality from collision with vehicles, disturbance caused by barge traffic, and further losses of habitat because of road construction, housing and commercial developments, and mining of coal. The amount of habitat to be lost can not be accurately estimated, but could be substantial. Indirect and cumulative impacts are also discussed in Sects. 1.4.3 and 4.2.5. The effects of potential vehicular traffic, barge traffic, noise, waste disposal, and human presence would be relatively minor. Emissions to the atmosphere during operation are potentially more significant, because of possible impacts on agricultural crops and native biota. The following analysis focuses on impacts to vegetation, as air pollutants in general have not been shown to have significant direct effects on wildlife populations, except in extremely high concentrations (see Appendix K for more detail).[28]

The maximum expected increases in offsite ground-level concentrations of the major air pollutants (SO_2, NO_x, and particulates) resulting from point source emissions during normal operation of the proposed plant are less than 17% of the existing concentrations at the site (Table 4.18). The existing concentrations could already adversely affect very sensitive plant species. At the point of maximum impact, the small increment from normal plant operation would slightly increase any existing levels of impacts on vegetation. Any such increases would be very difficult to detect by monitoring and could probably not be distinguished from effects on vegetation caused by existing air pollution. Applicable EPA air quality standards should not be violated during normal plant operation (Sect. 4.2.3.1). During abnormal operating conditions or start-up, emissions to the atmosphere could be much higher than during normal conditions but are not expected to exceed National Ambient Air Quality Standards due to their short duration. More detailed analyses and background information are given in Appendix K.

At the specific localities where pollutant concentrations will be maximal as determined by wind direction and dispersion modeling, the normal operation of the plant is expected to increase ambient ground-level concentrations of SO_2 by 9.5 $\mu g/m^3$ for the 3-h maximum, 2.4 $\mu g/m^3$ for the 24-h maximum, and 0.2 $\mu g/m^3$ for the annual average. These concentrations compare with current ambient SO_2 levels of 824, 190, and 20 $\mu g/m^3$, respectively (Table 4.18). For sensitive plants it has been projected that 4-h SO_2 concentrations required to produce threshold injury are from 262 to 2620 $\mu g/m^3$ (ref. 29). Therefore, existing ambient levels could be affecting very sensitive species. Soybean cropping is the predominant land use in the area; tobacco and pasture are minor uses. Soybeans, tobacco, and most pasture grasses are considered sensitive species. They might experience a very slight reduction in productivity because of demonstration plant operations. Section 4.5 discusses monitoring of crop productivity to measure the effects of plant operation, if any, and to develop mitigating measures if needed.

Plants are several times less sensitive to NO_x than to SO_2.[30] Normal plant operation is expected to increase the ambient annual average NO_x concentration of 16 $\mu g/m^3$ by only a maximum of 2.7 $\mu g/m^3$ (Table 4.18). Therefore, there should be no significant effects on plants from NO_x emissions.

Predicted increases in the maximum concentration of carbon monoxide are less than 10% of the air quality standards (10,000 and 40,000 $\mu g/m^3$ for 8-h and 1-h periods respectively). The maximum 1-h concentration of nonmethane hydrocarbons is conservatively predicted to be 236 $\mu g/m^3$ (Sect. 4.2.3.1). Particulates from coal handling and storage will settle primarily close to the facility (Sect. 4.2.3) and should therefore have no significant effects on vegetation surrounding the site. Normal plant operation is expected to increase the ambient annual average particulate concentration of 42 $\mu g/m^3$ by 1.0 $\mu g/m^3$ (Table 4.18). This increase in concentration represents 2% of the secondary air quality standard (60 $\mu g/m^3$).

The formation of secondary pollutants such as ozone and peroxyacetyl nitrate and the occurrence of acid rain are regional, rather than site-specific, problems. Operation of the proposed plant will add a small increment to these problems.

Operation of the cooling towers will result in deposition on vegetation and soils of small amounts of biocides, inhibitors, and various salts. Cooling tower installations at industries throughout the United States have not caused significant ecological problems. Therefore, operation of the small cooling tower at the proposed site should have no significant impacts on vegetation.

Spills of toxic materials on the site would be unlikely to get into Bryant Ditch and Richland Slough, because of control measures including the proposed site drainage and runoff control plans. Control of spills is addressed in Sect. 2.2.1. Waterfowl use of waste ponds could cause some mortality but should not significantly affect waterfowl populations; use of the ponds will be observed to determine whether any corrective actions should be taken (Sect. 4.5.3).

Commercialization. Commercialization at an expanded capacity will result in the same types of impacts as those due to the demonstration facility. An additional 1.6 ha of riparian forest would be cleared for the barge slip (see Appendix Y), and other habitat losses will also occur. Commercial facilities will be located closer to Martin Creek forest than demonstration facilities but none of the forest will be cleared. If unexpected impacts (e.g., severe vegetation stress due to air pollutant emissions) occur during demonstration, these will have to be assessed when deciding whether to commercialize.

Decommissioning and mothballing. These actions would not be expected to have any significant adverse impact on terrestrial biota. Some minor short-term impacts might occur during decommissioning due to the increased levels of construction-type activities during this phase.

4.2.2 Water

This section discusses the construction and operational impacts predicted for the proposed site in the areas of surface water hydrology, groundwater quality and hydrology, surface water quality, and aquatic ecology. Section 4.5 discusses recommended construction and operational monitoring, and Sect. 4.6 discusses recommended mitigation measures.

4.2.2.1 Surface water hydrology

Floodplain encroachment

Portions of the site area to be developed lie within the 100- and 500-year floodplains of the Green River. Modeling of impacts on flood flows resulting from the proposed site development indicate that the effects will be minor (Appendix E); however, development of much of the site constitutes encroachment onto the Green River floodplain (Appendix D).

Construction impacts

Construction activities will alter a portion of the Green River floodplain and will have a minor impact on flood discharges in the immediate site vicinity. Site grading will raise the grade elevation of the process areas to 117.3 m (388 ft), which is the elevation estimated by the Army Corps of Engineers (Appendix G) for a 500-year flood. Figures 3.8 and 3.9, Sect. 3.2.2.1, show areas that, under existing conditions, are above the 100- and 500-year flood elevations; flood-prone areas to be developed for the demonstration project are to be filled or diked for flood protection.

The effect that filling of this portion of the floodplain will have on flooding of adjacent areas has been estimated by computer modeling of the downstream reach of the Green River and the Ohio River confluence. The model used was HEC-2, and results of the model simulation of impacts on flood level indicate a probable increase in water elevation of the 100-year flood of about 1 cm (0.02 ft) in the immediate site area, an increase that should be undetectably small. A description of the methodology and model calibration is included in Appendix E. Flood level increases resulting from site development should not adversely affect adjacent areas.

As a result of grading and earthwork activities during construction, the present drainage patterns of the site will be altered. Bryant Ditch, which presently drains about 60% of the site (Fig. 3.9), will be disturbed by construction activities. Portions of Bryant Ditch passing through the site will be segregated from the remainder of the ditch and used as a conduit for collecting runoff from areas of the site and transporting it to sediment control basins. Under present conditions, eroded sediment from the Bryant Ditch watershed is deposited in Richland Slough. Sedimentation basins are planned to minimize sedimentation of the slough as a result of construction runoff. The remaining portions of the site that will be disturbed drain directly into the Green River.

Soil erosion from the site during construction will be controlled through implementation of a construction drainage plan, although some siltation will result. Sediment release from the site will be controlled by retention dams (sediment traps) and other erosion-control facilities. The exact location, height, maintenance, etc., of these dams and other facilities have not been finalized. Seeding and mulching the completed areas as construction progresses will also help to reduce and control erosion.

The compaction of soil and construction of impervious areas will reduce infiltration and therefore cause an increase in surface runoff. This increase will be temporary, however, because runoff from much of the plant area will be collected and treated during the operational phase of the project.

Impacts resulting from alteration of the onsite drainage should not be extensive, and increased runoff should be easily handled by Bryant Ditch and the Green River. Silt retention basins and other facilities will be maintained by removal and disposal of excessive sediment into fill areas on the construction site. Because the land is already heavily farmed (implying frequent soil disturbance), erosion and sedimentation during construction should not have a significant impact on ambient water quality.

Dredging

Excavation will be required to construct the barge slip and water intake and discharge structures at the shore of the Green River (see Appendix Y for barge information and Appendix C for crosssectional diagrams of the intake and discharge structures). During the construction there will be some equipment (barges, pile drivers, etc.) at the shore of the river. This equipment will tend to obstruct part of the navigable channel, and suitable markings will be provided in order to provide warning to passing traffic. There may be some excavation near the shoreline and in the bed of the stream, but final plans have not been made regarding the extent of excavation. Dredge material will be stored onsite as shown in Fig. 2.3. Boxes 51 and 53 of this figure are the locations of this storage. The construction will cause temporary local increases in suspended solids, nutrient levels, and chemical and biochemical oxygen demand. The impact of these activities is expected to be a local increase in suspended sediment loading in the Green River. Section 4.2.2.3 discusses the impact of these materials on water quality. Hydrologic impacts are not expected to be significant.

Operational impacts

During operation of the demonstration facility, impacts on surface water hydrology will be minor. The slight increase in estimated water levels of the 100- and 500-year floods (should one occur), which results from filling areas on the lower terrace and on the river banks, will remain.

Surface runoff from some areas of the plant will be directed to wastewater treatment and discharged directly to the Green River instead of flowing into Richland Slough as they presently do. Runoff from approximately 36 ha (90 acres) will be diverted to wastewater treatment. Inasmuch as the total Richland Slough watershed contains over 4000 ha (9000 acres), impacts on the water balance of the slough will be minor.

Operation of the proposed SRC-I facility with zero wastewater discharge is projected to consume an average of about 159 liters/s (2520 gpm) of water from the Green River. When discharge occurs, water withdrawal will be 217 liters/s (3445 gpm) and flow back to the river will be at least 59 liters/s (931 gpm). Therefore, the net loss to the Green River will be about the same as for the zero wastewater discharge case. This represents 1.4% of the 7-d, 10-year low flow of 11,156 liters/s (176,855 gpm) at the site. This loss of water will have little effect on the quantity of water available to downstream users.

Impacts of decommissioning and mothballing

Impacts of mothballing should not exceed the impacts of construction and operation. Impacts associated with decommissioning of the facility depend on the fate of the site after shutdown — an alternative industrial use or reversion to agricultural use. Development of an alternative industry could affect flows in the Green River, depending on shore line development and consumptive water-use requirements. Decommissioning followed by removal of the facility and all stored feedstock, product, and waste and regrading to approximate original contour would leave the site essentially unaffected as far as surface water hydrology is concerned. If topographic alterations such as the raised railroad spur, the filled process area, and ash pond dikes are left after decommissioning, the effect on flood flows will be the same as that resulting from construction. Consumptive water use would cease at the time of shutdown.

Impacts of expansion to a commercial facility

Current plans indicate a fivefold expansion of the demonstration-scale facility (6000 tpsd) to commercial scale (30,000 tpsd). The major surface water hydrologic impact accompanying such an expansion is increased water consumption. Impacts on flood flows due to decreased floodplain storage capacity are not expected to be significant. Present plans do not indicate that a further encroachment on or narrowing of the floodway will result from commercial expansion. Expansion of the barge slip will slightly alter flows of the Green River; however, with continued channel maintenance, no effect on channel navigability is anticipated (see Appendix Y).

The volume of water used by the commercial facility depends on whether the facility is operating with or without a treated wastewater discharge (Sect. 4.2.2.3). With a discharge, 1040 liters/s (16,500 gpm) will be withdrawn from the river. The wastewater discharge is estimated to be 295 liters/s resulting in net water consumption of 745 liters/s or 6.7% of the 7-d, 10-year low flow of the Green River. In the zero wastewater discharge mode, the water withdrawal is reduced to 745 liters/s and all water withdrawn is consumed. In either case there would be a 6.7% reduction in the 7-d, 10-year low flow. This water use will affect surface water availability to other potential users downstream on the Green River (Sect. 4.2.5). Potential water quality impacts are discussed in Sect. 4.2.2.3.

Expansion will require processing runoff from a larger total area through the wastewater treatment facilities. Bryant Ditch and Martin Creek are the drainages that would be affected. Impacts on the discharge of Bryant Ditch will be a significant reduction in flow as additional area is used for ash disposal and thus removed from the ditch's natural watershed. Since Bryant Ditch makes up only 1% of the Richland Slough watershed, reduction in its flow should not cause significant effects on the water balance of the slough. The effect on flows in Martin Creek is expected to be insignificant.

4.2.2.2 Groundwater quality and hydrology

Construction impacts

Potential impacts on the groundwater regime of the site caused by construction are expected to be minor. Soil compaction and covering with impermeable materials, pavement, buildings, pond liners, etc., will reduce the amount of recharge to the groundwater system. Approximately 205 ha (500 acres) of the site will be covered with impervious surfaces, resulting in potential recharge loss of 10^6 liters/d (250,000 to 400,000 gpd). This impact is minor because the dominant influence in recharge of the alluvial aquifer is infiltration of water from the beds of the Green and Ohio rivers. Construction of the barge slip is expected to have no measurable effect on groundwater levels. Hydraulic interaction occurs between the alluvial aquifer and the Green River with 600 m of the proposed barge slip location.

The most probable source of impact on groundwater quality is contamination by infiltration of liquid spills on the site. During construction, petrochemicals, solvents, and other undesignated chemicals will be in use. Of these potential contaminants the largest volume will be diesel fuel oil, which will be stored in a 3785-liter (1000-gal) tank. Minor spills are likely to be attenuated by surficial soils. Major spills or frequently repeated minor spills in the same area could locally endanger water quality of the alluvial aquifer. Mitigation of such an impact would require well drilling and water testing to delineate the contaminated area and local aquifer pumping and water treatment to remove the plume of contaminated water. At the present time, specific natural groundwater movement beneath the site is not known. Equipment fueling and lubrication will be handled in a central, controlled area with facilities to properly handle spills to minimize risk of groundwater contamination.

Operational impacts

Potential impacts on the alluvial aquifer during operation are drawdown of the aquifer from pumping of potable water on site and deterioration of the aquifer by infiltration of contaminants from the plant area. The consequence of groundwater contamination is potential contamination of domestic water supplies and general deterioration of the water resource. As discussed in Sect. 3.2.2.2, groundwater beneath the central and southern portions of the site drains to the south, apparently entering the Green River near the southeast corner of the site. Along the western site boundary, groundwater may flow to the southwest toward Richland Slough. Current data do not positively indicate the hydraulic gradient in that area.

Preliminary modeling of groundwater contamination by Dames & Moore (Appendix R) indicates that combined attenuation effects and slow natural groundwater flow will confine arsenic, cadmium, and selenium to within 800 ft of the hazardous waste disposal for 100 years. Additional modeling is expected to be performed before plant construction.

In the event that contaminants from ash disposal areas or the tankage area reach the alluvial aquifer, it is possible that the domestic water supplies for the residences west of the site on Sauer Lane could be contaminated. However, groundwater monitoring wells located at the perimeter of the ash disposal landfills will be sampled regularly to detect the presence of contaminants in groundwater near the western site boundary before reaching residential supplies. The mitigatory strategy will be supplemented with information obtained during the operational monitoring period.

Aquifer drawdown. Aquifer drawdown was modeled to assess the impact of consumptive groundwater use on water levels in the alluvium. A description of the modeling and parameters used is included in Appendix O. At the anticipated maximum rate of groundwater use, 360 liters/min (100 gpm), there should be no measurable effect on domestic wells further than 1.6 km (1 mile) from the site. Estimated drawdown of a well 305 m (1000 ft) from the site well after ten years of continuous pumping is 0.18 m (0.59 ft), assuming (as a worst case) that there is no hydraulic connection of the aquifer with the Green River in the immediate site area. Impacts on groundwater availability are therefore expected to be minor.

Wastewater handling. Liquids stored onsite, process wastewater stored in equalization basins, and leachates derived from the coal, SRC solid product, and solid waste storage areas have the potential for contaminating the alluvial aquifer if they infiltrate the subsurface in significant quantities. Prior to treatment, process wastewater is expected to contain biodegradable organics, hydrogen sulfide, phenol, ammonia, cyanides, metals, and trace organics resistant to biological degradation. All wastewater handling areas, including retention and equalization basins, will be lined to minimize direct infiltration of the wastewater. A liner selection study and the alternative liner materials are discussed in Appendix C, Sect. C.2.3.2. Under normal operating conditions there should be no hazard of groundwater contamination. Undetected leaks in the wastewater handling system (cracks in sluiceways, deteriorated expansion joints in retention areas, etc.) could allow untreated wastewater to infiltrate soils and reach the groundwater. Groundwater monitoring will be conducted beneath potential areas of contamination, and implementation of remedial treatment, if required, is part of the operational plan to protect the alluvial aquifer.

Coal pile. Coal pile leachate quality is discussed in Appendix P and in Sect. 4.2.1.2. Active and long-term reserve coal storage areas as currently proposed will have 15-cm (6-in.) compacted clay liners. Coal leachate accumulation at the liner surface will be collected at the perimeter of the coal storage area by contouring the base and routed to wastewater treatment (see Appendix C). Liner failure resulting from uneven soil compaction beneath the storage area, frost action,

or other damage could result in infiltration of acidic, metal-rich leachate. Under the anaerobic groundwater conditions of the site, heavy metals could remain in a mobile condition and could migrate within the aquifer. Extremely close supervision of foundation preparation measures will be carried out to ensure that the proposed liner will be adequate.

Solid SRC storage. Leachability of the solid SRC product has been tested at ORNL. A discussion of the preliminary test results is included in Appendix P. Leachate concentrations are below all the primary drinking water standards. The leachate exceeds the proposed secondary drinking water standard for manganese and is more acid than the pH range recommended in the secondary standard. Organic constituents of the leachate are under study, and the study will be available at a later date. Leachate from SRC solid product does not appear to present a hazard to water quality based on testing and analyses performed to date. Upon completion of the leaching tests, which involved agitation of the sample, the leachate remained black and opaque. The coloration was caused by fine particulates which remained in suspension but were retained on 0.45 micron filter membranes. Runoff from the SRC storage area will be collected and routed through the wastewater treatment facility. Because of the brittle nature of the product, shipping and handling activities may generate dust causing local surface water quality impacts. This requires that the product be properly stored and handled, including measures for dust suppression and leachate collection.

Metal sludge landfill. Metal sludges from the wastewater treatment area will be disposed of in a secure landfill that is designed to meet RCRA hazardous waste landfill requirements. The design of this facility is included in Sect. 2.2.1, and crosssectional diagrams are presented in Appendix C. As currently proposed the liner consists of a 20-mil synthetic material overlain by 0.9 m (3 ft) of compacted clay. (A liner selection study and the alternative liner materials are discussed in Appendix C, Sect. C.2.3.2.) Leachate collection systems exist above the clay, and a leachate detection system exists below the synthetic membrane. Leachate intercepted by the upper collection system is recycled to wastewater treatment. Groundwater monitoring wells will be located at the landfill perimeter and will be monitored on a quarterly basis. Any liquids detected in the leachate detection system beneath the landfill liner will be analyzed to determine if a leak has occurred. Careful construction and operation of the secure landfill will be required to protect groundwater quality.

Gasifier solid waste disposal. The impact of landfilling gasifier slag and flyash on the proposed site is expected to be minimal. Even if the leachate enters the groundwater, the leachate composition (see Appendix P) suggests that it is nonhazardous according to RCRA criteria and would not significantly degrade the groundwater quality. Appendix HH describes a mitigation plan that will be put into effect in the event that leachate is detected below the landfill liner. Onsite groundwater and soil studies have not definitively shown the direction of groundwater flow beneath the slag/flyash disposal sites, but additional testing is planned (Sect. 4.5). The design of the slag/flyash ponds described in Appendix C, Sect. C.2 includes a compacted clay liner above a synthetic liner, a leachate removal system, a leachate detection system below the lower liner, and diked walls to prevent inundation during a 500-year flood. (A liner selection study and the alternative liner materials are discussed in Appendix C, Sect. C.2.3.2.) The base elevation of the proposed landfill will be 8 ft below the groundwater table that would result from a 100-year flood. This elevation is believed to be the highest elevation that the groundwater table would reach during a flood of this magnitude. If the groundwater table reached such a level if would produce an uplifting force on the base of the landfill liner and would have the potential of causing vertical shifts or breaks in the liners and leachate-collection system. The proposed mitigation plan is to increase the level of water in the pond, adding additional load to the base of the landfill and providing a counteracting force. This mitigation plan should be effective in protecting the integrity of the liners and leachate-collection system.

Solid waste volumes. The rates of production of solid-wastes during the demonstration projects are summarized in Table 4.5. Daily production volumes are multiplied by 330 operating days per year. The actual number of days of operation per year will be less than this because of shutdowns. Under optimum operating conditions the facility could operate for 328 days each year.

Gasifier slag and fly dust will be disposed of in slag ponds. Three ponds are planned for use during demonstration phase plant operation. Gasifier slag storage capacity is close to the worst-case production volume for five years of operation, assuming the plant operates 90% of the time. Inasmuch as the plant is expected to operate at less than the total design capacity during the early years of operation, actual slag production will be less than that estimated above.

Table 4.5. Solid waste production rates

Type of waste	Dry weight (tons/d)	Wet volume (m^3/d)	Annual volume (m^3/year)
Gasifier slag and flyash	635	865	285,200
Metal-bearing sludge	7	27	8,950
Biological treatment sludge	2	9	2,980
Raw water treatment sludge	7	27	8,950
Water soluble solids	32	77	25,730
Slop oil	5.5	6	1,990
Spent activated carbon	3	8	2,680

Source: ICRC, personal communication, Dec. 12, 1980.

Annual production of metal-bearing sludges, biological treatment sludges, and water-soluble treatment sludge is estimated to be 37,064 m^3. These wastes will be stored in the hazardous waste landfill.

Impacts related to high groundwater levels

Process areas will be raised to above the 100-year flood elevation by site grading and filling. The bases of the slag disposal and liquid tankage areas will be below the 100-year flood level and will be protected from flooding by normal diking procedures and other filled areas. During the wet season (late winter and spring) when groundwater levels naturally rise, high water table conditions accompanying flood events could cause flooding within the tankage area and exert uplifting forces. This flooding and uplifting could breach liners in the slag disposal landfills providing a route for potentially hazardous substances to enter the groundwater. However, the likelihood of such impacts will be minimized by liner stabilization measures including a hold-down system to prevent failure under high groundwater conditions.

Flotation

For structures that are recessed below the ground surface and are not provided with positive drainage systems that will always maintain the groundwater level below the base of the structure, flotation must be considered. Uplift pressures can be resisted by either sufficiently increasing the weight and/or contents of the structure to balance the hydrostatic forces or using tension piles.

The most economical way to protect against uplift is to weight the structure. If functional restrictions permit, weight can be added to the structure by allowing water to enter the structure when the pressure on the outside of the facility exceeds the inside fluid pressure.

The base of the hazardous landfill [at an elevation of 119 m (390 ft)] is above the historic high water table, and no liner flotation provisions will be necessary.

The ash ponds [base at an elevation of 114 m (373 ft)] can be weighted against uplift pressures as discussed above by adding additional water to the ponds. Groundwater levels will be tracked through wells drilled around the waste disposal facilities. Regular tracking of groundwater levels will provide sufficient warning of a high water-table condition. The likelihood of the water table reaching the ash pond lining system is remote.

Mitigation measure — breach of hazardous waste landfill liner

In the event of a leak from a hazardous waste management facility, the leak detection system will identify the existence of the leak as well as the area of the facility from which the leak is emanating. Parallel hazardous waste facilities will permit the immediate redirection and continued proper management of the wastes, while excavation and repair of the leaking facility is accomplished.

Preliminary hazardous waste landfill modeling results (Appendix R) indicate that, even in the event of complete liner failure, transport of chemical species to the water table will take a

number of years. Because rupture or other failure of a liner will be quickly detected by the leachate detection system, reparation of such a breach can be accomplished well before any degradation of groundwater quality can occur.

Impacts related to decommissioning and mothballing

Potential groundwater impacts after shutdown of the facility depend on future use of the site and handling of wastes stored onsite. The possibility of selling the slag for other commercial use is presently under consideration. If that method of slag disposal is used, waste disposal requirements would be reduced.

If waste storage areas are to be left intact and covered, wastes will have to be dewatered, leachates treated, and the landfills covered in a manner approved by State or Federal regulatory agencies. Some level of continued monitoring and maintenance may be required by RCRA to ensure isolation of wastes. Any leachable materials (including coal) left onsite after shutdown will constitute a potential water contaminant if they are accessible to percolating waters that reach the alluvial aquifer. If leachable materials remain on site, continued leachate collection and wastewater treatment and discharge may be required.

Total removal of the waste after demonstration plant shutdown would result in less long-term risk of groundwater contamination on this site but presents the risk of accidentally breaching a liner and losing some contaminants. An alternate offsite disposal area for waste would also have to be located and approved. Wastes would have to be dewatered prior to removal and carefully excavated. Approximately 762,000 t (840,000 tons) of ash will be generated during the demonstration as well as additional solid wastes which may be considerably more hazardous than the ash from the standpoint of RCRA designations. The solid waste disposal section of Sect. 2.2.1.2 discusses the types, quantities, and degree of hazard of these solid wastes. Removal of this ash would be a lengthy process, during which the clay pond liner could be ruptured, allowing any remaining fluids to infiltrate the soil.

If the facility is mothballed, process area runoff could continue to wash contaminants from process equipment, paved areas, and process sewers. This may necessitate continued runoff collection, wastewater treatment, and discharge.

Impacts related to commercial expansion

Impacts related to expansion are (1) reducing infiltration recharge to the aquifer over a larger area, (2) increasing consumptive groundwater use, and (3) onsite storage of more process chemicals, product, and waste, increasing the possibility of accidental contamination.

Reduction of surface infiltration recharge to the alluvium is expected to have a minor impact on the aquifer because most recharge to the alluvium comes from infiltration in the channels of the Green and Ohio rivers. Though groundwater consumption will increase somewhat, the well will not be enlarged and withdrawals are not expected to exceed 360 liters/min (100 gpm). Modeling of aquifer drawdown indicates that slightly increased groundwater use should not adversely affect water availability in areas adjacent to the site. (See Appendix O.)

Coal storage, product storage, waste storage, and process facilities would be expanded for the commercial-scale operation. Larger quantities of leachate will be generated from coal, waste, and product storage. Leachate quality is discussed in Appendix P. Long-term leachability of the ash has not been determined; however, leachate quality will be monitored during the demonstration phase. With larger amounts of potential contaminants onsite for a long operational life, the probability of liner failure and infiltration of leachate increases.

Part of the demonstration operational phase is monitoring potential impacts on soils and groundwater. Information on the environmental effects of the demonstration facility will be used in design of the expanded facility to minimize additional adverse impacts associated with its operation. A well-planned and well-executed monitoring program during the demonstration effort is required to clarify the uncertainties of potential impacts.

4.2.2.3 Surface water quality

Construction impacts

Construction activities may affect surface water quality by erosion and sedimentation resulting from site preparation and riverside construction operations. In general, these impacts will be temporary and localized. The implementation of a construction drainage plan will limit sediment discharge from site disturbance, and, because of the generally flat terrain, no significant impacts are anticipated. Similarly, riverside construction activities are expected to cause only minor impacts to the water quality of the Green River. The preliminary erosion control plan is presented in Appendix GG.

Site preparation activities (clearing, grading, and general earth-moving operations) will disturb an estimated 223 ha (550 acres) of land (Table 4.3). The watercourses that will be affected by these activities include Bryant Ditch, the Green River, and the six onsite ponds, five of which will be eliminated. It is not anticipated that site preparation activities will affect Martin Creek. Although erosion will be accelerated during site preparation, the potential for greatly increasing erosion is lessened somewhat by existing site conditions. Essentially the entire area proposed for construction has been previously cleared for agricultural purposes, and the topography of the site is flat, ranging in elevation from 113 to 119 m (370 to 390 MSL). Some erosion, nonetheless, may unavoidably occur. The levels of suspended solids and certain dissolved and adsorbed chemicals such as nutrients may be higher than ambient levels in localized reaches of the watercourses, especially Bryant Ditch, which drains 60% of the site. This potential impact is expected to be similar to water quality perturbations resulting from local agricultural practices. Retention basins to prevent suspended solids from reaching watercourses will be constructed early in the construction phase.

The construction of a water intake structure, an effluent diffuser, and a barge slip will affect water quality in the Green River. Estimates of the area that will be disturbed (Appendix H, Table H.5) indicate that barge slip construction will disturb the largest area, 0.33 ha (0.8 acre) (see Appendix Y). Hydraulic dredges will be used to cut the channel between the river channel and the land excavation. The volume of dredged material to be removed may be as great as 18,000 m^3. Construction will cause temporary local increases in suspended solids, nutrient levels, and chemical and biological oxygen demands, but these impacts are not expected to be significant based on the limited extent and short duration of disturbance.

Sanitary wastewater produced during construction will be disposed of in an environmentally acceptable manner. Two alternatives are available: (1) hauling the waste to a permitted waste disposal facility off-site, or (2) disposal of the waste onsite in a package treatment system. If the onsite alternative is used an NPDES permit will be required prior to discharge. Neither alternative will cause significant impacts to the environment.

The only potential contaminant to be stored on the site in large quantities [storage tank capacity of 3785 liters (1000 gal)] is fuel oil. It is unlikely that this material would reach the Green River in quantities sufficiently large to result in significant contamination.

Operational impacts

Impacts to the surface water quality of the onsite or near-site bodies of water during SRC-I plant operation may result from the disposal and discharge of wastes. In the proposed plant design, the most significant impact will occur when treated wastewater is discharged to the Green River. When the zero wastewater discharge system (described in Sect. 2.2.1.2 and Appendix C) is used, no impacts to surface water from wastewater discharge will occur.

Wastewater generated at the SRC-I facility will consist of various types of liquid wastes, which will be segregated to receive the appropriate treatment (Fig. 2.5). The principal waste streams entering the equalization basin are projected to be stripped sour water, cooling tower blowdown, and process and oil wastes. Runoff from the coal and product storage areas and from the process area will also be treated. In addition, intermittent or less voluminous waste streams will also enter the proposed plant's treatment system.

Discharge of wastewater could occur under three circumstances: (1) when equipment for wastewater recycling is nonfunctional; (2) before the plant reaches the normal on-stream time, or when the plant is completely or partially shut down and water consumption is less than wastewater generation; and (3) when precipitation exceeds the 10-year 24-h storm or a prolonged wet period occurs. Wastewater recycle will be accomplished by using treated effluent as cooling-tower

make-up and operating an evaporator to treat cooling tower blowdown. The goal of the wastewater treatment system is to operate primarily in the zero-discharge mode. Treated wastewater discharge will be necessary when the recycling equipment is inoperative. A complete or partial process shutdown would also necessitate wastewater discharge because waste heat may be unavailable to evaporate a sufficient quantity of treated wastewater from the cooling tower. However, under shutdown conditions only a fraction of the normal volume of wastewater would be produced. The runoff resulting from a rainstorm greater than the 10-year, 24-h storm would exceed the capacity of the runoff retention basin, and this excess runoff would have to be discharged. Discharge of excess runoff is not expected to degrade river water quality. Runoff typically has its highest concentrations of contaminants during the "first flush" in the first hours after rainfall begins. This runoff would be contained and treated, and only the lightly contaminated portion would be discharged. In addition, excess runoff would be discharged at times when river flow and dilution capacity are high.

The most significant discharge, occurring with inoperability of the recycling system, would result in discharge of fully treated wastewater to the Green River (Figs. C.8 and C.10).

After final treatment, an effluent, normally flowing at 59 liters/s (931 gpm) [maximum rate of 126 liters/s (2000 gpm)], will enter the Green River at approximately mile point 19 via a diffuser discharge structure (see diagram in Appendix C, Fig. C.7). Tables C.16 and C.17 in Appendix C present the projected wastewater effluent to be discharged to the Green River. The projected chemical loading to the Green River under average conditions is presented in Table 4.6 as percentages of the Green River's load. Rather than being firm predictions based on a detailed plant design and an NPDES permit, these are best engineering estimates that are believed to be

Table 4.6. Chemical loading of SRC-I Plant effluent to Green River under average conditions[a]

Chemical constituent	Effluent load (kg/d)	Green River load (kg/d)	Percentage of final Green River load contributed by SRC-I effluent[b]
Ammonia (as N)	28.5	4,260	0.66
Arsenic	0.570	<50.6	<1.11
Barium	5.70	1,410	0.40
Biochemical oxygen demand	114	53,300	0.21
Cadmium	0.855	<40.0	<2.09
Chemical oxygen demand	855	594,000	0.05
Chromium, total	5.70	128	4.27
Copper	5.70	<586[c]	<0.96
Cyanide	2.57	<53.3	<4.59
Iron, total	11.4	86,600[c]	0.01
Lead	1.43	<85.2	<1.65
Manganese	11.4	6,150	0.18
Mercury	0.006	<28.2	<0.02
Nickel	0.285	<2,480[c]	<0.01
Phenol	0.570	<200	<0.28
Phosphorus	28.5	2,400	1.18
Selenium	2.00	<48.3	<3.98
Silver	0.570	20.8	2.67
Total suspended solids	114	1,280,000	0.01
Zinc	5.70	1,070[c]	0.53

[a] Average conditions mean: (1) average concentrations of effluent chemical constituents (ER, Table 2.6); (2) average effluent discharge rate (66 liters/s); (3) average concentrations of Green River chemical constituents as determined during baseline monitoring (ER, Appendix E, Part I, Table E.6-E.8); and (4) average Green River discharge rate [308 m^3/s (10,890 cfs)]. When data appeared as approximate values (e.g., < a certain number), actual numbers were averaged and expressed as < the arithmetic mean.

[b] Calculated by the following formula: effluent load/(effluent load + Green River load) x 100.

[c] Values taken from ORSANCO data, see ER, Appendix E, Part I, Table E-4.

Source: Data for calculations from ER, Sect. 2.4.7, Table 2.6 and Appendix E, Part I.

conservative. Under these assumptions, five chemicals from the projected effluent – cadmium, chromium, cyanide, selenium, and silver – constitute between 2 and 5% of the river's load.

During preliminary consultation in preparation of a National Pollutant Discharge Elimination System (NPDES) permit application, the EPA and the State of Kentucky will jointly develop effluent limitations for the plant. The effluent limitation may be based on instream water quality standards, best available treatment technology economically achievable for control, or New Source Performance Standards for a related industry. These effluent limitations will become the design basis for the treatment system and may be different from the projected effluents used in this EIS.

To examine the impact of SRC-I effluent discharge on the water quality of the Green River, a simple model was used to determine the concentrations of substances discharged after complete mixing of the effluent with the river water (Table 4.7). The following worst-case conditions were used in the model:

Table 4.7. Compliance of chemical constituents in projected plant effluent with water quality standards or criteria (after mixing using $Q_{7\text{-}10}$), as mg/liter

Chemical constituent	Water quality standard (or criterion)[a]	Maximum effluent concentration	Maximum ambient concentration	Total mixed concentration[b]	Compliance with standard (or criterion)
Ammonia	0.05 as un-ionized NH_3 (0.02)	20	0.59	0.69	Uncertain; pH and temperature dependent
Arsenic	0.05	0.25	0.004	0.006	Yes
Barium	1.0	2	0.09	0.10	Yes
Beryllium	1.1 in hard water	0.01	Assume 0	0.00006	Yes
Biochemical oxygen demand		30	4.0	4.1	
Cadmium	0.012 (0.00003)	0.3	0.003	0.005	Yes (EPA criterion not met)
Chemical oxygen demand		300	39	40.4	
Chlorine, residual	0.01	1	Assume 0	0.006	Yes
Chromium, total	0.05	2	0.01	0.02	Yes
Copper	1.0 (0.006)	2	0.07	0.08	Yes (EPA criterion not met)
Cyanide, free	0.005	0.9	0.002	0.007	No
Fluoride	1.0	T8D[c]	0.22		
Iron	1.0	4	3.28	3.28	No
Lead	0.05	0.4	0.007	0.009	Yes
Manganese	0.05	4	0.48	0.50	No
Methylindane		2.1	Assume 0	0.012	
Mercury	0.002 (0.00057 μg/liter)	0.002	0.003	0.003	No
Nickel	(0.12)	1.6	0.10[d]	0.11	EPA criterion met
Nitrate, as N	10	T8D	0.38		
Oil and grease		20	Assume 0	0.12	
Phosphorus		10	0.16	0.22	
PAH compounds, individual[e]		0.003–0.28	0	0.003	
Phenol	0.005 (0.001)	0.6	0.01[d]	0.013	No
Selenium	0.01 (0.04)	0.7	0.006	0.010	Borderline
Silver	0.05	0.2	0.003	0.004	Yes
Solids, total suspended		35	108	108.0	
Sulfide	0.002 as undissociated H_2S	0.09	0.1[d]	0.1	Uncertain; pH dependent
Zinc	5.0 (0.05)	2	0.26	0.27	Yes (EPA criterion not met)

[a] Concentrations listed (from Table H.1) are not to be exceeded. Values in parentheses are water quality criteria. Hardness-dependent criteria are calculated assuming 131 mg/liter hardness.

[b] Mixed concentration calculated by the following formula:

$$C_m = [C_e(Q_e) + C_o(Q_o)]/(Q_e + Q_o) ,$$

where

C_m is the total mixed concentration when combined with maximum ambient levels,
C_e is the maximum concentration of the undiluted effluent,
C_o is the maximum ambient concentration,
Q_e is the average effluent volume,
Q_o is the 7-d, ten-year river low flow.

[c] T8D = to be determined.

[d] Maximum ambient concentration not an exact number (e.g., expressed as < a certain number). For purposes of calculation, assumed to be equal to that number.

[e] PAH, polycyclic aromatic hydrocarbon.

Source: Modified from ER, Appendix E, Part II, Table E.17.

1. maximum ambient concentrations of chemicals present in the Green River;
2. 7-d, 10-year low river flow;
3. average effluent discharge rate; and
4. maximum concentrations of chemicals present in the effluent.

Results of the analysis (Table 4.7) indicate that after complete mixing under these conditions, projected levels of cyanide, iron, manganese, mercury, and phenol will exceed the Kentucky water quality standards summarized in Table H.1. Also, the fully mixed concentrations of residual chlorine, selenium, and perhaps phenol are equal to or slightly above the state standards and the concentrations of cadmium, copper, and zinc will exceed EPA's 1980 criteria for toxic materials. The maximum ambient river concentrations (without the plant) of cadmium, copper, iron, manganese, mercury, zinc, and perhaps phenol are all in excess of the standards. For copper, iron, manganese, and mercury, and zinc the SRC-I effluent causes no increase or very slight increase in the fully mixed concentrations; therefore, no significant degradation in water quality can be attributed to the discharge of these constituents. However, the SRC-I discharge results in significant increases in the concentrations of cadmium, phenol, and selenium. The concentration of cyanide rises from below the criteria level in the ambient river water to a level higher than the criteria with the contribution of the plant's wastewater effluent. Under the worst-case assumptions of this model, the SRC-I discharge of cadmium, cyanide, phenol, and selenium will significantly degrade water quality and could require occasional plant shutdown to maintain water quality standards during periods of low flow. As discussed in Sect. 4.2.2.4, such water quality degradation may adversely affect aquatic biota in the Green River. (Kentucky's standard for toxic substances based on bioassay tests are further considered in Tables 4.12 and 4.13.)

The worst-case assumptions used above are based on a low river flow with a recurrence interval of ten years [11,156 liters/s (394 cfs)]. In order to consider a less extreme case, the dilution of SRC-I effluent was modeled for a low flow of 30,355 liters/s (1072 cfs). This value is the average of 13 minimum flows between 1966 and 1978 (Table 4.8), that is, it represents a low flow that could be expected annually. Results of this analysis (Table 4.9) indicate that when SRC-I effluent is diluted by this average annual low flow, the fully mixed concentrations of chlorine, selenium, and cyanide are below the state standards, and the increase in the concentrations of cadmium and phenol due to the discharge are negligible. Thus, for an average year's low flow, the SRC-I discharge would cause minimal degradation of water quality. Under conditions of normal river flow, the plant's discharge is not expected to affect water quality measurably.

Table 4.8. Minimum daily flows for the Green River Lock Number 2 near Calhoun, Ky.

Year	Minimum flow	
	Liters/s	Ft^3/s
1966	13,818	488
1967	34,829	1,230
1968	28,882	1,020
1969	24,069	850
1970	38,510	1,360
1971	39,926	1,410
1972	17,443	616
1973	28,316	1,000
1974	40,492	1,430
1975	21,010	742
1976	33,413	1,180
1977	30,015	1,060
1978	34,829	1,230
Av	30,355	1,072

Source: U.S. Geological Survey, *Water Resources Data for Kentucky*, 1966-1978.

Table 4.9. Compliance of chemical constituents in projected plant effluent with water quality standards or criteria (after mixing using average annual minimum flow, 1966–1978), as mg/liter

Chemical constituent	Water quality standard (or criterion)[a]	Maximum effluent concentration	Maximum ambient concentration[b]	Total mixed concentration[b]	Compliance with standard (or criterion)
Ammonia	0.05 as un-ionized NH_3 (0.02)	20	0	0.60	Uncertain; pH and temperature dependent
Arsenic	0.05	0.25	0.004	0.005	Yes
Barium	1.0	2	0.09	0.09	Yes
Beryllium	1.1 in hard water	0.01	Assume 0	2E–5	Yes
Biochemical oxygen demand		30	4.0	4.1	
Cadmium	0.012 (0.00003)	0.3	0.003	0.003	Yes (EPA criterion not met)
Chemical oxygen demand		300	39	39.5	
Chlorine, residual	0.01	1	Assume 0	0.002	Yes
Chromium, total	0.05	2	0.01	0.014	Yes
Copper	1.0 (0.006)	2	0.07	0.07	Yes (EPA criterion not met)
Cyanide, free	0.005	0.9	0.002	0.004	Yes
Fluoride	1.0	TBD[c]	0.22	0.25	Yes
Iron	1.0	4	3.28	3.28	No
Lead	0.05	0.4	0.007	0.008	Yes
Manganese	0.05	4	0.48	0.49	No
Methylindane		2.1	Assume 0	0.005	
Mercury	0.002 (0.00057)	0.002	0.003	0.003	No
Nickel	(0.12)	1.6	0.10[d]	0.10	EPA criterion met
Nitrate, as N	10	TBD	0.38	0.51	Yes
Oil and grease		20	Assume 0	0.04	
Phosphorus		10	0.16	0.18	
PAH compounds, individual[e]		0.003–0.28	0	1E–5–1E–3	
Phenol	0.005 (0.001)	0.6	0.01[d]	0.01	No
Selenium	0.01 (0.04)	0.7	0.006	0.006	Yes
Silver	0.05	0.2	0.003	0.003	Yes
Solids, total suspended		35	108	108	
Sulfide	0.002 as undissociated H_2S	0.09	0.1[d]	0.1	Uncertain; pH dependent
Zinc	5.0 (0.05)	2	0.26	0.26	Yes (EPA criterion not met)

[a] Concentrations listed (from Table H.1) are not to be exceeded. Values in parentheses are water quality criteria, Hardness-dependent criteria are calculated assuming 131-mg/liter hardness.

[b] Mixed concentration calculated by the following formula:

$$C_m = [C_e(Q_e) + C_o(Q_o)]/(Q_e + Q_o) ,$$

where

C_m is the total mixed concentration when combined with ambient levels,
C_e is the concentration of the undiluted effluent,
C_o is the average ambient concentration,
Q_e is the effluent volume,
Q_o is the average annual minimum flow (1059 cfs).

[c] TBD = to be determined.

[d] Maximum ambient concentration not an exact number (e.g., expressed as < a certain number). For purposes of calculation, assumed to be equal to that number.

[e] PAH, polycyclic aromatic hydrocarbon.

The temperature in the Green River has not always complied with Kentucky water quality standards. The maximum temperatures reported on the Green River have been 31.0°C (at Lock and Dam No. 1, mile point 9.1) and 33.0°C (at Lock and Dam No. 2, mile 63.1) (ref. 31). The maximum temperature of the projected SRC-I effluent is 37.8°C. Even under worst-case assumptions, the discharge will not raise the fully mixed river temperature measurably. Because the effluent will be discharged via a diffuser, the mixing zone is anticipated to be very small and in compliance with State of Kentucky standards.

Although the maximum biochemical and chemical oxygen demands in the discharge are 40 and 300 mg/liter, respectively, complete mixing in the Green River will result in concentrations only slightly above the ambient values (Table 4.7). Sanitary wastes will be treated in the

bioreactors with other wastes. The combined waste stream will be disinfected with ozone before it is discharged. Fecal coliform levels in the effluent stream are projected to be in compliance with the water quality standard for recreational use (see Appendix H, Table H.1).

In addition to the water quality constituents considered in Table 4.7, wastewater from the SRC-I facility will contain many organic compounds for which no criteria or standards have been established. Organic compounds that have been identified in the untreated effluent from a SRC-I pilot plant are listed in Table 4.10. The projected concentrations are compared with existing draft criteria and Estimated Permissible Concentrations (EPCs). When diluted in the 7-d, 10-year low flow the projected instream concentrations are less than the draft criteria concentrations or EPCs, suggesting that the organic compounds in the discharge do not pose a threat to water quality. However, EPCs are based on limited data and no regulatory significance can be attached to the draft criteria or EPCs. Further research and monitoring are needed to fully assess the impacts of even occasional discharge of some organic compounds. The possible bioaccumulation of PNA is discussed in Sect. 4.2.2.4, and monitoring that will be conducted is described in Sect. 4.5.

Table 4.10. Organic compounds in the projected SRC-I effluent

Chemical compound	Untreated effluent concentration,[a] (mg/liter)	Bio-unit effluent[b] (mg/liter)	After activated carbon filtration, 75% reduction[c] (mg/liter)	After dilution by 7-d, ten-year low flow (μg/liter)	Most stringent draft criteria or estimated permissible concentration (μg/liter)
Methyl-indane	15	2.4–8.4	2.1	13	none
Tetralin	0.1	0.5 (15%)[d]	0.01	0.1	500
Dimethyltetralin	0.5	0.08–0.4	0.10	0.6	none
Naphthalene	5	0.81 (80%)[e]	0.20	1.2	143
Dimethylnaphthalene	0.3–2	0.05–1.12	0.28	1.7	none
2-Isopropylnaphthalene	0.7	0.11–0.39	0.10	0.6	none
1-Isopropylnaphthalene	2	0.32–1.12	0.28	1.7	none
Biphenyl	0.2	0.03–0.11	0.03	0.2	14
Acenaphthalene	<0.1	0.01–0.06	0.02	0.1	20
Dimethylbiphenyl	0.2–0.5	0.79–1.1	0.28	1.7	none
Dibenzofuran	0.6	0.09–0.32	0.08	0.5	none
Xanthene	0.1	0.01–0.06	0.02	0.1	none
Dibenzothiophene	1.5	0.24 (60%)	0.01	0.4	none
Methyldibenzothiophene	<0.1	0.01–0.06	0.02	0.1	none
Thioxanthene	0.1	0.01–0.06	0.02	0.1	none
Fluorene	0.3	0.08 (64%)[e]	0.02	0.1	none
9-Methylfluorene	0.3	0.05–0.17	0.04	0.2	none
1-Methylfluorene	0.2	0.04 (76%)[e]	0.01	0.1	none
Anthracene/phenanthrene	1.1	0.26 (70%)[d]	0.07	0.4	280
Methylphenanthrene	0.2–0.3	0.05–0.11	0.03	0.2	none
C_2-Anthracene	<0.05	0.01 (62%)[e]	0.003	0.02	none
Fluoranthene	0.4	0.06–0.63	0.16	1.0	200
Bihydropyrene dihydropyrene	<0.05	0.007–0.03	0.008	0.1	none
Pyrene	0.6	0.24 (50%)[e]	0.06	0.4	8333
Dimethyldibenzothiophene	<0.05	0.007–0.03	0.008	0.1	none

[a]Data from Table 3, J. S. Fruchter, M. R. Peterson, J. C. Laul, P. W. Ryan, *High Precision Trace Element and Organic Constituent Analysis of Oil Shale and Solvent Refined Coal Materials,* Battelle Pacific Northwest Labs, BNWL-SA-6001, 1976, 31 pp.

[b]A 30–80% degradation is assumed unless otherwise noted (from Table Q.1, Appendix Q, ER).

[c]Taken from W. G. Schlinger, "Coal Gasification Development and Commercialization of the Texaco Coal Gasification Process," presented at the *6th International Conference on Coal Gasification, Liquefaction and Conversion* (no date or place).

[d]Isolated organisms known to degrade naphthalene and/or phenanthrene (from Table Q.1, Appendix Q, ER).

[e]Removal efficiencies for a sludge that degrades petrochemicals in Colgate Creek, La. (from Table Q.1, Appendix Q, ER).

Source: Modified from Table Q.1, ER, Appendix Q.

Because the SRC-I facility can operate in the zero-discharge mode, impacts due to wastewater discharge will occur only during operation in the wastewater discharge mode. Significant degradation of water quality is expected to occur only if wastewater recycling equipment is inoperable during low-flow periods. The probability of this occurrence cannot be predicted, since the reliability of the wastewater recycling system is uncertain. However, if periods of low stream flow do coincide with periods when zero-wastewater discharge cannot be achieved, plant shutdown or reduction of plant throughput might be required to prevent adverse effects on water quality and aquatic biota and to ensure compliance with standards. The actions necessary to ensure compliance and to protect biota will be fully addressed in the NPDES permitting process involving EPA and the Kentucky Department for Natural Resources and Environmental Protection (KDNREP).

In addition to the occasional wastewater discharge, water quality in the Green River may be affected by

1. occasional maintenance dredging of the water-intake channel, at an estimated frequency of once every two to four years, and

2. accidents/spills of raw materials, intermediates, or the product.

Spills of organic material at the SRC-I facility will be contained by dikes. Process and storage areas will be paved or lined to prevent infiltration. Spilled material and contaminated runoff will be routed to oil/water separators to recover product. Wastewater will be routed to the treatment system. Although these control measures will minimize the impacts of spill, it must be assumed that accidents and errors will occasionally result in releases of materials to surface waters. Such nonroutine releases could cause impacts ranging from the trivial to the extremely serious effects associated with a major product spill (Appendix DD). Appendix Y discusses the effects on water quality of three scenarios for barge use.

Decommissioning and mothballing impacts

Impacts associated with decommissioning or mothballing of the facility depend on the fate of the site following shutdown. While the alternatives for decommissioning appear to be continued industrial use or reversion to agricultural use, it is probable that once the site is industrialized it will remain that way even if the specific user of the site changes. During decommissioning or mothballing, wastewaters in retention ponds would have to be appropriately treated before discharge into the Green River. Also, leachates from coal and solid waste storage and process area runoff would also have to be treated and discharged to the Green River. If an alternate industry is developed at the site after the demonstration plant is decommissioned, necessary permits for point-source discharges or for dredging will have to be obtained from State and Federal agencies. If the land reverts to agricultural usage, the impacts to the Green River and onsite watercourses are expected to be similar to those occurring prior to SRC-I construction and operation.

Impacts of expansion to a commercial facility

Water quality impacts resulting from expansion of the SRC-I demonstration plant to commercial scale are difficult to predict. The fivefold expansion in plant capacity will probably cause less than a fivefold increase in the demand for water. Capability for wastewater recycling would be included, but wastewater discharge is considered as an occasional occurrence. For a worst-case analysis of water quality impacts, a fivefold increase in the volume of wastewater discharged was considered (Table 4.11). When the 295 liters/s discharge from the commercial plant is fully mixed with the 7-d, 10-year low flow of the Green River (11,156 liters/s), it is expected to cause violations of water quality standards for cadmium, chromium, cyanide, iron, manganese, mercury, phenol, and selenium. The discharges of cadmium, chromium, phenol, and selenium will substantially degrade water quality to a clearly unacceptable level. This analysis indicates the need for high reliability in the wastewater recycling system.

During the demonstration phase, much experience will be gained in wastewater handling. The characteristics of the raw wastewater and the performance of treatment systems will be determined under a variety of loading, operating, and environmental conditions. Performance and reliability of the wastewater recycling system will be established. In addition, the impacts of the demonstration plant on the Green River will be monitored. The information and experience thus gathered will provide a basis for the design of the commercial-scale wastewater system. If necessary, back-up systems can be included in the design to ensure that no discharge occurs when river flows would provide insufficient dilution. The ultimate impacts to water quality from

Table 4.11. Compliance of chemical constituents in worst-case commercial plant effluent with water quality standards or criteria (after mixing using $Q_{7\text{-}10}$), in mg/liter

Chemical constituent	Water quality standard (or criterion)[a]	Maximum effluent concentration	Maximum ambient concentration	Total mixed concentration[b]	Compliance with standard (or criterion)
Ammonia	0.05 as un-ionized NH_3 (0.02)	20	0.59	1.14	Uncertain; pH and temperature dependent
Arsenic	0.05	0.25	0.004	0.01	Yes
Barium	1.0	2	0.09	0.14	Yes
Beryllium	1.1 in hard water	0.01	Assume 0	0.0003	Yes
Biochemical oxygen demand		40	4.0	5.06	
Cadmium	0.012 (0.00003)	0.3	0.003	0.011	Yes (EPA criterion not met)
Chemical oxygen demand		300	39	46.4	
Chlorine, residual	0.01	1	Assume 0	0.03	No
Chromium, total	0.05	2	0.01	0.07	No
Copper	1.0 (0.006)	2	0.07	0.13	Yes (EPA criterion not met)
Cyanide, free	0.005	0.9	0.002	0.027	No
Fluoride	1.0	TBD[c]	0.22		
Iron	1.0	4	3.28	3.3	No
Lead	0.05	0.4	0.007	0.02	Yes
Manganese	0.05	4	0.48	0.58	No
Methylindane		2.1	Assume 0	0.06	
Mercury	0.002 (0.00057)	0.002	0.003	0.003	No
Nickel	(0.012)	1.6	0.10[d]	0.14	EPA criterion not met
Nitrate, as N	10	TBD	0.38		
Oil and grease		20	Assume 0	0.57	
Phosphorus		10	0.16	0.44	
PAH compounds, individual[e]		0.003–0.28	0	0.0001–0.008	
Phenol	0.005 (0.001)	0.6	0.01[d]	0.027	No
Selenium	0.01 (0.04)	0.7	0.006	0.026	No
Silver	0.05	0.2	0.03	0.04	Yes
Solids, total suspended		35	108	108.0	
Sulfide	0.002 as undissociated H_2S	0.09	0.1[d]	0.1	Uncertain; pH dependent
Zinc	5.0 (0.05)	2	0.26	0.31	Yes (EPA criterion not met)

[a] Concentrations listed (from Table H.1) are not to be exceeded. Values in parentheses are water quality criteria. Hardness-dependent criteria are calculated assuming 131-mg/liter hardness.

[b] Mixed concentration calculated by the following formula:

$$C_m = [C_e(Q_e) + C_o(Q_o)]/(Q_e + Q_o) ,$$

where

C_m is the total mixed concentration when combined with ambient levels,
C_e is the concentration of the undiluted effluent,
C_o is the average ambient concentration,
Q_e is the average effluent volume (295 liters/s).
Q_o is the 7-d, ten-year river low flow (11,156 liters/s) minus projected water withdrawal (1,040 liters/s) = 19,116 liters/s.

[c] TBD = to be determined.

[d] Maximum ambient concentration not an exact number (e.g., expressed as < a certain number). For purposes of calculation, assumed to be equal to that number.

[e] PAH, polycyclic aromatic hydrocarbon.

commercial-scale plant operations will depend on the operating experience and several unknown factors, including effluent limitations, other regulations applied to the solvent refining process, and possible changes in the process technology.

Commercial operations will also produce small indirect effects on water quality through consumptive use of up to 747 liters/s or 6.7% of the Green River's low flow. Reducing flow by this amount will reduce the Green River's capacity to dilute wastewaters in downstream reaches. For water quality constituents that have very low ambient concentrations, a 6.7% reduction in dilution capacity means roughly a 7% increase in the concentration of a material discharged after complete mixing. For instance, the projected SRC-I discharge of chlorine results in a concentration of 0.026 mg/liter when fully mixed with the Green River's low flow (11,156 liters/s) minus the water withdrawal (1040 liters/s). Without the SRC-I withdrawal, the fully mixed chlorine concentration would be 0.052 mg/liter, about 7% less concentrated. During droughts,

reduced flow in the Green River and reduced dilution capacity resulting from SRC-I commercial operation would magnify water quality impacts of coal conversion facilities proposed for construction downstream. A regional analysis of water availability and water quality is clearly a prerequisite for planning additional coal conversion facilities downstream on the Green and Ohio Rivers (Sect. 4.2.5).

Increased barge traffic associated with the commercial plant may contribute to increased turbidity of the Green River.

4.2.2.4 Aquatic ecology

Construction impacts

Construction activities will cause both permanent and temporary impacts to biota inhabiting the bodies of water on or near the proposed SRC-I site. Permanent impacts will result from the removal of habitat by site preparation activities (clearing, grading, and general earth-moving operations), by construction of the site drainage system, and by the installation of water intake, waste discharge structures, and barge slip (see Appendix C for the intake and discharge structures and Appendix Y for the barge slip). Because the aquatic environments on or near the proposed plant site are not unique or extensive in area, destruction of some habitat for plant construction is not expected to produce significant ecological impacts. Temporary impacts may be associated with inferior water quality resulting from the site preparation activities, excavation, and dredging. These impacts, however, will be mitigated by control of site drainage and other measures, as described in Sects. 4.6.5 and 4.6.6 on mitigation.

Five of the six onsite farm ponds, a total surface area of approximately 600 m^2 (6400 ft^2), will be eliminated during site preparation. Pond habitat [0.55 km^2 (0.21 sq mile)], created by the construction of retention ponds, may be colonized by the same types of aquatic organisms that were present in the original ponds. The diversion of Bryant Ditch through the plant's drainage system will functionally remove this part of the stream as well as the three retention ponds from the natural drainage to Richland Slough. Only water in excess of 84,000 m^3 (300,000 ft^3) (combined capacity of the three retention ponds) will flow into the segment of Bryant Ditch between the proposed plant site's western boundary and Richland Slough. Significant impacts to aquatic organisms in this relatively short segment [approximately 1.5 km (0.93 mile)] are not anticipated, primarily because the intermittent nature of the stream does not provide year-round aquatic habitat. It should also be noted that the Richland Slough watershed contains over 4000 ha (9000 acres), and Bryant Ditch contributes only 1% of the flow into the slough. On the Green River's shore, excavation and dredging associated with the construction of the intake and discharge structures and of a barge slip will eliminate benthic organisms and their habitat. Shoreline perturbations are considered to be minor impacts to the Green River because of their limited areal extent and the possibility of post-construction recolonization of at least part of the disturbed areas.

Higher loads of dissolved and suspended materials resulting from site preparation activities may adversely affect aquatic habitats in Bryant Ditch and the Green River. Because of the temporary and localized nature of these construction-related disturbances and the already disturbed existing site and river conditions, only minor impacts are anticipated. The potential impacts of increased sediment and turbidity to aquatic organisms are severalfold.[32] Increased sedimentation may modify or destroy benthic habitat, thereby reducing or eliminating food available for fish. In addition, increased sedimentation may disturb fish spawning habitat and affect the viability of fish eggs and larvae. Similar water quality perturbations may result from floodplain excavation and shoreline dredging and excavation operations. Standards for certain water quality parameters may be violated in localized reaches of the Green River for short periods of time. Many of the organisms inhabiting this part of the river were those associated with silty environments or having wide ecological tolerances (see Sect. 3.2.2.3).

Endangered species

No unique areas, such as habitats of endangered or threatened species, will likely be affected during construction activities. The baseline monitoring program (see Sect. 3.2.2.3) did not encounter any aquatic organisms included on the list of threatened and endangered species maintained by the U.S. Fish and Wildlife Service.[33] (See Appendix I for a letter from the U.S. Fish and Wildlife Service.)

Operational impacts

The aquatic biota of the Green River will be affected primarily by changes in water quality resulting from the occasional discharge of treated wastewater and by water intake effects. The discharge of treated wastewater into the river will occur at approximately mile-point 19. The water quality impacts of the projected SRC-I discharge have been discussed above (Sect. 4.2.2.3) in terms of those constituents for which firm water quality standards have been established. However, for those materials considered to be toxic, water quality criteria for the protection of freshwater aquatic life and wildlife specify that concentrations must not exceed a certain fraction of the 96-h median lethal concentration (LC_{50}) for a representative indigenous aquatic organism. For nondegradable toxic pollutants, the Commonwealth of Kentucky requires that this fraction of the LC_{50} be 0.44 in mixing zones and 0.01 in the fully mixed stream (see Appendix H, Table H-1). To evaluate whether the SRC-I effluent complies with these standards, the following assumptions were made.

1. The concentrations in the mixing zone range from the maximum effluent concentration to the fully mixed concentration (Table 4.12).

2. The worst-case instream concentrations are assumed to be the highest concentrations projected after mixing (Table 4.13 and Table 4.9 in Sect. 4.2.2.3) using the 7-d, 10-year low flow, the maximum concentration of pollutants in the effluent, and the average discharge rate.

3. Toxicity-based standards were calculated using the data base from the 1980 water quality criteria documents (see Table J.7).

Table 4.12. Compliance of projected mixing zone concentration of potential toxicants with Kentucky water quality standard

Chemical consituent	Range of concentration in mixing zone[a] (mg/liter)	Bioassay organism	Standard[b] (mg/liter)	Compliance with Kentucky mixing zone standard[c]
Arsenic	0.006–0.25	Bluegill[d]	8.57	Yes
Beryllium	0.00005–0.01	Fathead minnow[d]	1.43	Yes
Cadmium	0.005–0.3	Fathead minnow[d]	2.83	Yes
Chlorine, residual	0.006–1.	Golden shiner[e]	0.08	No
Chromium	0.02–2	Fathead minnow[d]	16.2 (hexavalent, Cr^{6+})	Yes
Copper	0.08–2	Fathead minnow[d]	0.15	No
Cyanide	0.007–0.9	Fathead minnow[d]	0.12	Yes
Lead	0.009–0.4	Fathead minnow[d]	2.03	Yes
Manganese	0.5–4	Goldfish embryo-larvae[e]	3.62	Yes
Mercury	0.003–0.002[f]	Fathead minnow[d]	0.07	Yes
Nickel	0.11–1.6	Fathead minnow[d]	8.03	Yes
Phenol	0.013–0.6	Fathead minnow[d]	15.84	Yes
Selenium	0.01–0.7	Fathead minnow[d]	1.35	Yes
Silver	0.004–0.2	Fathead minnow[d]	0.02	No
Vanadium	0.05–5	Goldfish embryo-larvae[e]	2.02	No
Zinc	0.27–2	Fathead minnow[d]	5.90	Yes

[a] Fully mixed concentration to maximum effluent concentration (data from Table 4.7 and Table C.16).

[b] Standard equal to 0.44 mg/liter of bioassay LC_{50} for representative indigenous organism (Table J.7).

[c] Compliance depends on whether the median mixing zone concentration exceeds 0.44 mg/liter of the bioassay LC_{50}.

[d] Source of bioassay data: 1980 EPA Water Quality Criteria Documents.

[e] Source: W. J. Birge, "Aquatic Toxicology of Trace Elements of Coal and Fly Ash," pp. 219–240 in J. H. Thorp and J. W. Gibbons, Eds., *Energy and Environmental Stress in Aquatic Systems*, Technical Information Center, U.S. Department of Energy, 1978.

[f] Maximum ambient concentration greater than maximum effluent concentration.

Table 4.13. Compliance of fully mixed concentrations (projected highest using Q_{7-10}) with Kentucky water quality standards for toxic substances

Chemical consituent	Highest fully mixed concentration in mixing[a] (μg/liter)	Bioassay organism	Standard[b] (μg/liter)	Compliance with Kentucky standard
Arsenic	6	[c]	50	Yes
Beryllium	0.05	[c]	1100	Yes
Cadmium	5	[c]	12	Yes
Chlorine, residual	10	[c]	10	Yes
Chromium	20	Fathead minnow[d]	368.2	Yes
Copper	80	Fathead minnow[d]	3.4	No[f]
Cyanide	7	[c]	5	No
Lead	9	Fathead minnow[d]	46.1	Yes
Manganese	500	Goldfish embryo-larvae[e]	82.3	No[f]
Mercury	3	Fathead minnow[d]	1.6	No[f]
Nickel	110	Fathead minnow[d]	182.5	Yes
Phenol	13	[c]	5	No
Selenium	10	Fathead minnow[d]	30.7	Yes
Silver	4	Fathead minnow[d]	0.44	No[f]
Vanadium	50	Goldfish embryo-larvae[e]	45.9	Yes
Zinc	270	Fathead minnow[d]	134.1	No[f]

[a] See Table 4.7.

[b] Standards equal to 0.01 mg/liter of the bioassay LC_{50} for a representative indigenous organism (Table J.7) (phenol bioassay data multiplied by 0.1), except where a specific standard has been set.[c]

[c] Specific Kentucky quality criteria currently exist for this parameter for the protection of warm aquatic habitats.

[d] Source of bioassay data: 1980 EPA Water Quality Criteria Documents.

[e] Source of bioassay data: W. J. Birge, "Aquatic Toxicology of Trace Elements of Coal and Fly Ash," pp. 219–240, in J. H. Thorp and J. W. Gibbons, Eds., *Energy and Environmental Stress in Aquatic Systems*, Technical Information Center, U.S. Department of Energy, 1978.

[f] Maximum ambient concentration exceeds water quality standard.

4. Compliance with the mixing zone standard depends on whether the mediam mixing zone concentration exceeds 0.44 of the LC_{50} concentration.

5. Compliance with the instream concentration depends on whether the highest fully mixed concentration exceeds 0.01 of the LC_{50} concentration.

Results presented in Tables 4.12 and 4.13 indicate that several constituents will not comply with mixing zone and instream standards for pollutants based on this worst-case analysis. However, the maximum ambient concentrations of mercury, silver, zinc, and copper currently exceed the instream standards. In general, SRC-I effluent discharge will cause only very small increases in the in-stream concentrations of potentially toxic trace elements. Some chronic sublethal effects to biota may result from the SRC-I discharge, but impacts are unlikely to be severe if the wastewater treatment facility operates as expected.

Because the SRC-I facility can operate in the zero-discharge mode, impacts due to wastewater discharge will occur only during operation in the wastewater discharge mode. Significant degradation of water quality is expected to occur only if wastewater recycling equipment is inoperable during low-flow periods. The probability of this occurrence cannot be predicted, because the reliability of the wastewater recycling system is uncertain. However, if periods of low streamflow do coincide with periods when zero discharge cannot be achieved, plant shutdown might be required to prevent adverse effects on water quality and aquatic biota and to assure compliance with Kentucky water quality standards.

The analysis of a less severe case (using average annual low flow, see Table 4.5) indicates the same concerns (Table 4.14). Several trace elements, however, are still higher than recommended for organisms, primarily because the maximum ambient levels are high.

Table 4.14. Compliance of fully mixed concentrations (projected highest using average annual minimum flow from 1966 to 1978) with Kentucky water quality standards for toxic substances

Chemical constituent	Highest fully mixed concentration[a] (μg/liter)	Bioassay organism	Standard[b] (μg/liter)	Compliance with Kentucky standard
Arsenic	5	*c*	50	Yes
Beryllium	0.02	*c*	1100	Yes
Cadmium	3	*c*	12	Yes
Chlorine, residual	4	*c*	10	Yes
Chromium	14	Fathead minnow[d]	368.2	Yes
Copper	70	Fathead minnow[d]	3.4	No[f]
Cyanide	4	*c*	5	No
Lead	8	Fathead minnow[d]	46.1	Yes
Manganese	490	Goldfish embryo-larvae[e]	82.3	No[f]
Mercury	3	Fathead minnow[d]	1.6	No[f]
Nickel	100	Fathead minnow[d]	182.5	Yes
Phenol	10	*c*	5	No
Selenium	6	Fathead minnow[d]	30.7	Yes
Silver	3	Fathead minnow[d]	0.5	No[f]
Vanadium	20	Goldfish embryo-larvae[e]	45.9	Yes
Zinc	260	Fathead minnow[d]	134.1	No[f]

[a]See Table 4.8.

[b]Standard equal to 0.01 μg/liter of the bioassay LC_{50} for a representative indigenous organism (Table J.7) (phenol bioassay data multiplied by 0.1), except where a specific standard has been set.[c]

[c]Specific Kentucky water quality criteria currently exist for this parameter for the protection of warm water aquatic habitats.

[d]Source of bioassay data: 1980 EPA Water Quality Documents.

[e]When bass data not available, source of goldfish bioassay data: "Aquatic Toxicology of Trace Elements of Coal and Fly Ash," pp. 219–240 in J. H. Thorp and J. W. Gibbons, Eds., *Energy and Environmental Stress in Aquatic Systems*, Technical Information Center, U.S. Department of Energy, 1978.

[f]Maximum ambient concentration exceeds water quality standard.

The bioassay data in Tables 4.12, 4.13, and 4.14, although useful, are not representative of broad taxonomic groups of aquatic organisms tested under a wide variety of conditions. These conditions are met in information[34] based on data compiled by Cushman et al.[35] Selected portions of this data are presented in Table 4.15 to illustrate rough measures of relative toxicities. Data were generated by averaging elemental concentrations that produced lethality in tests conducted for at least 24 h (ref. 34).

Comparisons between the maximum concentrations of trace elements in the SRC-I effluent and average toxicity should be made cautiously because of the sensitivity of bioassay responses to small changes in test conditions. In most cases the maximum effluent concentrations are lower than the average toxicity data, suggesting that the levels of individual inorganic components in the effluent may not be acutely toxic to many aquatic organisms. When diluted in the receiving waters, potential toxicity appears more unlikely. Synergistic effects could be produced by two or more components of the effluent; however, this possibility cannot be properly addressed without bioassay data.

Sublethal effects may be produced from chronic exposure to concentrations of trace elements which are much lower than the average values presented in Table 4.15. For instance, fish or other organisms may suffer increased susceptibility to infection, decreased reproductive

Table 4.15. Potential toxicity and bioaccumulation of selected elements in SRC-I effluent

Numbers in parentheses indicate numbers of determinations

Chemical constituent	Projected maximum maximum effluent (mg/liter)	Mean concentration toxic to aquatic organisms[b] (ppm)						Bioaccumulation potential	
		Fish	Crustaceans	Insects	Molluscs	Phytoplankton	Macrophytes	In general[c]	In aqueous coal conversion effluents[d]
Cadmium	0.3	8.2 (29)	0.035 (2)			0.27 (3)	7.4 (1)	Readily accumulated by marine and freshwater organisms, particularly shellfish	Low potential for hazard
Chromium	2	100.2 (90)	6.8 (13)	76.3 (5)	17.1 (2)	1.8 (11)	5.4 (2)	Accumulated by fish and invertebrates; may be rapidly eliminated	High potential for hazard
Copper	2	2.9 (114)	0.95 (14)	3.8 (11)	0.27 (12)	0.66 (59)	0.25 (1)	Accumulated by freshwater and marine fish, shellfish, and aquatic insects	High potential for hazard
Iron	4	482. 7 (40)	8.1 (5)	10.8 (3)	200.0 (4)			Accumulated by fish; readily accumulated by some marine organisms	High potential for hazard
Lead	0.4	40.8 (53)	1.8 (5)	37.3 (3)		2.5 (1)	363.0 (1)	Accumulated by fish and invertebrates, particularly shellfish	High potential for hazard
Manganese	4	838.0 (20)	12.4 (3)			1.4 (18)		Accumulated by marine and freshwater organisms	High potential for hazard
Mercury	0.002	0.80 (21)	0.009 (2)	2.0 (3)		1.3 (13)	3.4 (1)	Methylmercury readily accumulated by aquatic organisms	Medium potential for hazard
Nickel	1.6	31.3 (26)	0.32 (2)	33.8 (3)		1.0 (2)		Does not appear to be accumulated in significant amounts amounts by aquatic organisms	High potential for hazard
Selenium	0.7	23.9 (7)				2.5 (1)		Not as well studied as other elements; some evidence for accumulation in aquatic organisms, particularly invertebrates	High potential for hazard
Silver	0.2							Does not appear to be accumulated in significant amounts in aquatic animals	
Vanadium	5	24.1 (7)							
Zinc	2	8.8 (134)	2.3 (7)	24.3 (111)	2.9 (27)	1.7 (14)	16.3 (2)	Readily accumulated by marine and freshwater organisms	High potential for hazard

[a] Source of data: ER, Sect. 2.4.7, Table 2.6.

[b] Data taken from H. M. Braunstein, ed. *Environmental and Health Aspects of Disposal of Solid Wastes from Coal Conversion: An Information Assessment,* ORNL-5361, Oak Ridge National Laboratory, Oak Ridge, Tenn., September 1978, Table 3.4, p. 3–7. Source of data contained in this table: compiled from R. M. Cushman, S. G. Hildebrand, R. H. Strand and R. Anderson, *The Toxicity of 35 Trace Elements in Coal to Freshwater Biota: A Data Base with Automated Retrieval Capabilities,* ORNL/TM-5793, Oak Ridge National Laboratory, Oak Ridge, Tennessee, June 1977, 41 pp. 00).

[c] References include D. J. Wilkes, "Animals: Bioenvironmental Effects," Ch. 9 in H. M. Braunstein, E. D. Copenhaver, and H. A. Pfuderer, ed., *Environmental Health, and Control Aspects of Coal Conversion: An Information Overview, vol. 2,* ORNL-5361, Oak Ridge National Laboratory, Oak Ridge, Tennessee, April 1977; G. R. Phillips and R. C. Russo, *Metal Bioaccumulation in Fishes and Aquatic Invertebrates: A Literature Review,* EPA-600/3-78-103, U.S. Environmental Protection Agency, Duluth, Minn., December 1978, 115 pp.

[d] From S. G. Hildebrand, R. M. Cushman, and J. A. Carter, "The Potential Toxicity and Bioaccumulation in Aquatic Systems of Trace Elements Present to Aqueous Coal Conversion Effluents," p. 311 in *Trace Elements in Environmental Health-X. 1976. A Symposium.* D. D. Hemphill ed., University of Missouri, Columbia, Mo., Table III.

capability, decreased growth rates, or other effects. In particular, benthic organisms may show sublethal responses because they inhabit environments which are "sinks" for trace elements. Many of these organisms also effectively accumulate trace elements from their environments. Table 4.15 summarizes the bioaccumulation potentials of trace elements; the majority of these elements are accumulated by aquatic organisms. Based on chemical data from a pilot coal conversion plant and known bioaccumulation factors for fish, most of the elements included in Table 4.15 have a high potential for bioaccumulation in environments receiving aqueous coal conversion wastes.[36]

Much less is known about the potential biological impact of complex organic compounds such as PNAS. Although both adsorbed and soluble fractions may be present in the aquatic environment, most PNA compounds will probably be adsorbed on the surfaces of particles and, therefore, will be more available to sediment and suspension feeding animals.[37] If the draft criteria and EPCs (Table 4.11) are representative of PNA compounds, the levels of PNA compounds in the projected SRC-I effluent are unlikely to be acutely toxic to biota in the receiving waters (Table 4.11). However, sublethal effects may occur at much lower concentrations.

Although the thermal component of the SRC-I wastewater discharge will meet the Kentucky criteria (Appendix H, Table H.1), in winter months the discharge will create a small area of warmer water which may be attractive to fish and other organisms. If aquatic organisms are attracted to this area, they may be subjected to greater chemical stresses from potentially hazardous substances in the SRC-I effluent. The use of an effluent diffuser will reduce the extent of this impact, and, because the discharge is expected to meet the Kentucky standard for temperature, impacts are not expected to be substantial.

In summary, impacts to aquatic ecology will be greatly reduced by the practice of wastewater recycling. Any impacts of the wastewater discharge on aquatic biota are likely to result primarily from chronic exposures, bioaccumulation, and synergistic effects rather than from acute toxicity. Under low-flow conditions, the mixing zone concentrations of chlorine, cyanide, and heavy metals such as copper, cadmium, and silver may be toxic to sensitive organisms. However, planktonic organisms will be exposed for only a few minutes rather than the hours or days of exposure typically needed to produce mortality. Although few organisms are likely to die because of the discharge, ecological degradation may still result. Sublethal effects may occur, including decreased reproduction. Such impacts cannot be accurately predicted, and monitoring of ecological effects is needed (Sect. 4.5.3.3). The zero discharge alternative (Sect. 2.3.2.2 and Appendix C) would eliminate effluent-related impacts and would meet all state and Federal standards.

Other water quality perturbations may result from maintenance dredging, runoff exceeding the capacity of the retention system (10-year, 24-h storm), and accidents or spills (Sect. 4.2.2.3). Appendix Y discusses the impacts on aquatic ecology of three scenarios of barge use. The potential impacts of the above activities are considered to be relatively minor in terms of the biological well-being of the Green River or Richland Slough because of their low probability of occurrence or limited areal extent.

The maximum withdrawal of water from the Green River would occur during the occasions when treated wastewater is discharged. Operation of the proposed SRC-I facility would then require an average of 217 liters/s (3445 gpm) of water from the Green River; a minimum of 59 liters/s (931 gpm) would be returned in the effluent. The projected withdrawal is 1.95% of the 7-d, 10-year low flow [11,156 liters/s]. When the SRC-I plant operates in the zero-discharge mode, water withdrawal would constitute 1.4% of the 7-d, 10-year low flow. Only minor impacts to the Green River's ecology should result from entrainment and impingement of aquatic organisms in the plant's water intake system. Entrainable biota include phytoplankton, zooplankton, ichthyoplankton, juvenile fish, and adults of small fish species. Of these aquatic organisms, fish are susceptible to impingement although screens and other suitable design measures will be provided to reduce this possibility. Because the raw water withdrawal is an insignificant fraction of normal river flow and a rather small fraction of low flow, no significant impacts to aquatic ecology due to water withdrawal are expected. Operational monitoring will be directed toward assessing the vulnerability of specific fish populations to entrainment and impingement losses (Sect. 4.5).

Endangered species

No unique area, such as habitat of endangered or threatened species, will likely be affected during plant operation. The baseline monitoring program did not encounter any aquatic organisms

included on the list of endangered and threatened species maintained by the U.S. Fish and Wildlife Service.[33] Consultation with the U.S. Fish and Wildlife Service (Appendix I) indicates that no endangered or threatened aquatic species are present near the site.

Decommissioning and mothballing impacts

Impacts associated with decommissioning or mothballing of the facility depend on the fate of the site following shutdown. If, after decommissioning of the demonstration plant, an alternate industry is developed at the site, necessary measures will have to be taken to protect the aquatic biota in the Green River or in the onsite watercourses. If the land reverts to agricultural usage, the impacts to aquatic organisms are expected to be similar to those occurring prior to SRC-I construction and operation. If the facility is mothballed, coal pile runoff, process area runoff, and solid waste leachates would have to be suitably treated and discharged to the Green River.

Impacts of expansion to a commercial facility

Operation of the commercial plant will require a maximum withdrawal of 1040 liters/s of raw water during the occasions when wastewater recycling is not practiced. Withdrawal of 1040 liters/s constitutes 9.3% of the Green River's 7-d, 10-year low flow, but only 0.3% of the average flow. Operating in the zero-discharge mode, water withdrawal will be 747 liters/s, constituting 6.7% of the 7-d, 10-year low flow.

Raw water withdrawal can cause losses of aquatic organisms through impingement and entrainment. The maximum loss of aquatic organisms would require the simultaneous occurrence of low-flow conditions and the maximum density of particularly vulnerable forms of ichthyoplankton. The most detrimental sequence of events would be the occurrence of fish spawning followed by minimum flow conditions. Under these conditions and assuming that the organisms are evenly distributed in the river, potentially 9.3% of the susceptible organisms could be killed by the commercial plant's withdrawal. Because both spawning activity and minimum flow conditions are variable, it is difficult to predict the probability of this worst-case event. However, extreme low-flow conditions usually do not occur during June and July, the months in which ichthyoplankton densities are the highest in the Green River. Because increased stream flow often triggers spawning, high ichthyoplankton densities and low-flow conditions are unlikely to coincide. Nevertheless, in times of drought, the possibility exists that water withdrawal for the commercial SRC-I facility might stress biological productivity within the river.

4.2.3 Air

This section discusses the construction and operational impacts predicted for the proposed site in the areas of air quality and noise. Section 4.5 discusses recommended construction and operational monitoring, and Sect. 4.6 discusses recommended mitigation measures.

4.2.3.1 Air quality

Construction

Minor impacts on air quality in the vicinity of the site are expected from construction activities. During construction, fugitive dust will be caused by vehicular movements on untreated or unpaved road surfaces or by dry unvegetated areas during high wind speed conditions. The fugitive dust from these sources can be controlled by acceptable standard procedures such as periodic wetting of the roads, the use of chemical dust suppressants, and enforcement of low speed limits. With implementation of these procedures, fugitive dust is not expected to cause noticeable adverse impacts offsite.

Concentrations of carbon monoxide, hydrocarbons, and oxides of nitrogen in the atmosphere will increase because of engine exhaust from construction equipment and from automobiles used by the construction work force to travel to and from the site. Appendix C provides an estimate of vehicular emissions during construction. These increases are not expected to significantly alter the air quality of the area. The timing and site of construction activities will determine the effects.

Open burning of cleared vegetation or other construction debris is not planned. Should open burning become necessary, it will be performed according to applicable Kentucky regulations. The impact of open burning on local air quality would vary from minor to moderate, depending on the amount and type of material burned and on atmospheric conditions. Any offsite impacts would be short term.

During construction, a worst-case peak of 5000 persons will be employed at the site (see Sect. 4.2.4). Construction is planned for a 5-d work week. The average round trip commuting distance is estimated to be 40 miles. The average carload is assumed to be 1.9 persons. This will result in 27.4 million vehicle miles per year.

Emission factors for all highway vehicles are given by AP-42.[38] These factors include a mix of vehicle types based on nationwide data. This mix includes 7.8% heavy-duty vehicles, which would not be used by the construction workers for commuting. Deliveries of materials to the construction site would, however, be made by heavy-duty vehicles. Therefore, the construction worker vehicle distance traveled is increased by 7.8% to include truck deliveries to the site.

Total highway vehicular travel associated with construction is estimated to 27.4 million miles/year. Estimates of total emissions are shown in Table 4.16. The traffic has been assumed to be heavily congested with a traveling speed of 10 mph throughout the entire trip length.

Table 4.16. Air emissions from highway vehicles during combined peak 1982 traffic with and without SRC-I and W. R. Grace plants, assuming worst-case meteorological conditions

Traffic period	Maximum predicted concentrations of carbon monoxide ($\mu g/m^3$)	
	1 h	8 h[a]
Morning, 7–8 AM[b]		
Without plants	2918	2049
With plants	8143	5718
Evening, 4–5 PM[c]		
Without plants	2174	1527
With plants	5445	3824

[a] Estimated on the basis of the power law, concentration $\alpha\ t^{-0.17}$.

[b] Wind speed, 2 m/s; wind direction, 240°; stability class, E.

[c] Wind speed, 1 m/s; wind direction, 270°; stability class, B. Stability classes A through D were modeled because the hours of concern are daytime. Class B was found to be the worst case.

Only a small portion, perhaps 10%, of the emissions in Table 4.16 would occur at the demonstration plant site. These represent worst-case emissions, estimated before implementation of mitigation measures for traffic congestion problems. These mitigation measures should reduce emissions below these worst-case estimates.

Highway 60 between Route 41 and Tillman Bethel Road was modeled using the HIWAY model (U.S. EPA guideline model) under worst-case traffic and meteorological conditions.

The highway specifications used were:

total pavement width = 15 m (48 ft),
number of lanes = 2,
width of each lane = 4.9 m (16 ft),
width of each shoulder = 2.4 m (8 ft), and
width of center strip = 0 m (0 ft).

The road section with the heaviest traffic indicated a peak traffic flow at 7 to 8 AM of 1180 vehicles per hour without the plants and a 4 to 5 PM peak of 1405 vehicles per hour. Using 1982 emission factors from the U.S. EPA Mobile Source Book (1978), the total emissions were estimated and ground-level pollutant concentrations obtained for a number of assumed meteoro-

logical conditions. The worst-case meteorological condition was thus determined. For these same conditions, the peak W. R. Grace plant plus SRC-I plant traffic of 2113 vehicles per hour was then superimposed and the analyses repeated. (The receptors were located on the road's right-of-way.) The results are shown in Table 4.16.

For comparison, the CO ambient standards are 40,000 $\mu g/m^3$ (1-h average) and 10,000 $\mu g/m^3$ (8-h average). Neither is threatened by traffic emissions.

Some photochemical oxidant is likely to result from the combined effects of the HC and NO_x emissions; however, due to the rural setting of the emissions, the net impact on photochemical oxidant (ozone) is likely to be minor when compared to normal urban precurser emission rates and corresponding impacts.

In summary, the peak 1982 traffic is unlikely to cause air pollution problems of any significance. The principal concern, therefore, is not air pollution but rather the capacity of U.S. 60 to take the traffic. Current indications are that even without the SRC-I plant construction, the U.S. 60 traffic in the section of interest is at capacity and that it will be exceeded by 1982 because of normal developmental growth east of the city of Henderson, leading to delays and an unacceptable level of service. (Traffic is discussed in Sect. 4.2.4.)

Operation

Table 4.17 presents the estimated air emissions of criteria pollutants from the demonstration plant. Operation of the proposed facility will increase ground-level concentrations of EPA-regulated pollutants and other airborne pollutants. The demonstration plant, in conjunction with existing emissions sources and proposed facilities in the area, will result in a moderate increase in total suspended particulates (TSP). The SRC-I facility is not expected to cause high values of sulfur dioxide (SO_2), carbon monoxide, or oxides of nitrogen or lead, nor is the cooling system likely to cause a significant impact. The impact area of the SRC-I plant is limited to within a few kilometers from the property; it will not threaten the nonattainment status of the areas nearby.

The air quality impacts of operating the proposed SRC-I facility were predicted using the EPA's Industrial Source Complex Model (Appendix S). The results of this dispersion modeling analysis of the air quality impact of the SRC-I plant alone, and in conjunction with other sources are presented in Table 4.18. Cumulative impacts are detailed in Sect. 4.2.5. Two other sources were found to consume SO_2 PSD increments in the vicinity of the SRC-I plant. They were the Indiana and Michigan Electric Company's Rockport Generating Station 26 km (16 miles) east-northeast of the SRC-I site, and Southern Indiana Gas and Electric Company's A. B. Brown Generating Station, located 37 km (23 miles) west-northwest of the SRC-I site. There were also two other sources found to consume the particulate matter PSD increments. They were Anaconda Company's Sebree Reduction Plant, 25 km (15 miles) southwest of the SRC-I site, and Peabody Coal Company's Camp No. 3 facility, 47 km (29 miles) west-southwest of the SRC-I site.

Existing, or baseline, concentrations of SO_2, TSP, nitrogen oxide [all oxides of nitrogen assumed to be nitrogen dioxide (NO_2) for this study], as monitored at the proposed SRC-I plant site, were assumed to represent the pollutant concentrations contributed by all existing sources. These concentrations were added to the predicted concentrations caused by the SRC-I plant and all other plants having been granted PSD permits but not yet in operation. In conformance with EPA modeling guidelines, the baseline data used in the short-term air quality analyses are the second-highest monitored values, and the projected concentrations are the second-highest predicted values.

Sulfur dioxide and acid rain. As the data in Table 4.18 show, predicted increases in sulfur dioxide levels generated by the proposed SRC-I facility alone and in conjunction with all other sources are small. The maximum consumption of the PSD increment is 13% of the 24-h standard. The maximum ambient concentrations are predicted to increase to approximately 25%, 55%, and 69% of National Ambient Air Quality Standards (NAAQS) for annual, 24-h, and 3-h time periods, respectively. Results of the analysis are given in Figs. 4.1 to 4.3. The points of maximum concentrations are just beyond the fenceline to the northwest and southeast of the plant for the annual and to the west for the 3-h and 24-h averages (see Figs. 4.1 through 4.3).

Table 4.17. Estimated emissions to air for normal operation

Type	Rate (g/s)				
	CO	SO_2	TSP[a]	NO_x	NMHC[b]
Flue gas from combustion					
Raw material handling	0.22	0.008	0.120	1.82	0.040
SRC process and deashing	1.03	0.053	0.613	11.59	0.062
Coke and liquid fuels	0.14	0.008	0.081	1.78	0.018
Gas systems	0.002	0.0001	0.002	0.05	0.0001
Utilities[c]	0.74	0.569	0.660	10.2	0.043
Baghouse emissions					
Raw material and product handling and storage			1.750		*d*
Coke and liquid fuels			0.493		
Gas systems			0.024		
Offsites			trace		
Storage tanks and bin					
Raw material and product handling and storage					0.0002
Coke and liquid fuels					0.008
Gas systems	0.0001				0.0001
Miscellaneous types					
Cryogenic system					0.03
Gas systems (CO_2 vent)	21.1				
Coker/calciner flue gas	0.13	2.28	0.613	0.73	0.025
Fugitive			0.37		1.77
Total	23.3	2.92	4.72	26.2	2.0

[a] Total suspended particulates.
[b] Nonmethane hydrocarbons.
[c] Includes flares and controlled combustors.
[d] Coal volatiles will be added after studies are complete.

Sulfur dioxide emitted from the proposed SRC-I plant will oxidize to form suspended sulfate aerosols. The rates are dependent on ambient relative humidity, temperature, and ozone concentration. Generally, the reaction rates of SO_2 oxidation will be on the order of 2 to 3% per hour. Relative humidity greater than 75% (such as would be the case during sulfur dioxide plume interaction with cooling tower plumes, fog, or natural clouds) will cause higher reaction rates. When SO_2 contacts water droplets in cooling tower plumes, fog, or natural clouds, it reacts with the water to form H_2SO_3, which is rapidly oxidized by oxygen or ozone to form sulfuric acid (H_2SO_4).

Generally, a significant portion of sulfur dioxide emitted by the plant will not convert to sulfates until it has traveled a good distance downwind [80 to 160 km (50 to 100 miles)] and the SO_2 is dispersed. It is possible that, under certain atmospheric conditions, the cooling tower plume and SO_2 from the proposed SRC-I plant will interact to cause higher sulfate formation rates.

Precipitation passing through the SO_2 will also absorb it and form acidic sulfates in the rainwater. Data are not available to define existing levels of acidity in precipitation near the proposed plant site. Neither acid rain nor the formation of sulfate aerosol can be adequately modeled with state-of-the-art techniques. Sufficient data to evaluate the chemical reaction processes and to relate these with resultant rainfall acidity or aerosol concentration are not available. Further, any such evaluation would be unduly complex because of the number of existing major SO_2 sources in the area. However, the SO_2 emissions from the proposed SRC-I facility represent less than 1% of the SO_2 emitted from all sources within 50 km (31 miles) of the site. As such, the incremental impact of the SRC-I facility upon precipitation acidification (acid rain) is likely to be small.

Table 4.18. Projected maximum pollutant concentrations from the SRC-1 Plant during normal operation, $\mu g/m^3$

Pollutant	Averaging time	Baseline air quality[a]	Concentration due to SRC-I Plant alone	Concentration due to all PSD sources within 50 km[b,c,d]	Class II PSD increment	Projected air quality[d]	NAAQS	
							Primary	Secondary
Sulfur dioxide	Annual	20	0.2	0.7	20	20.7	80	
	Highest 24 h[b]	190	2.4	12.2	91	202.2	365	
	Highest 3 h[e]	842[f]	9.5	53.7	512	895.7		1,300
Particulate matter	Annual	42	0.9	1.3	19	43.3	75	
	Highest 24 h[e]	54[f]	6.7	8.1	37	62.1	260	150
Nitrogen dioxide	Annual	16	2.7	3.7		19.7	100	100
Carbon monoxide	Highest 8 h[e]	2,000	909	909		2,909	10,000	10,000
	Highest 1 h[e]	4,000	2,490	2,490		6,490	40,000	40,000
Lead	Quarterly	0.017	0.82	0.82		0.84	1.5	

[a] Monitored at the SRC-I Plant site, May 1979–April 1980.
[b] Includes SRC-I plant plus all sources that have been granted PSD permits but are not yet in operation.
[c] PSD = prevention of significant deterioration.
[d] Includes SRC-I plant and all PSD sources with overlapping impact areas.
[e] Baseline concentration plus concentration due to all PSD sources.
[f] Direction-dependant baseline values to account for influence of nearby existing point sources.

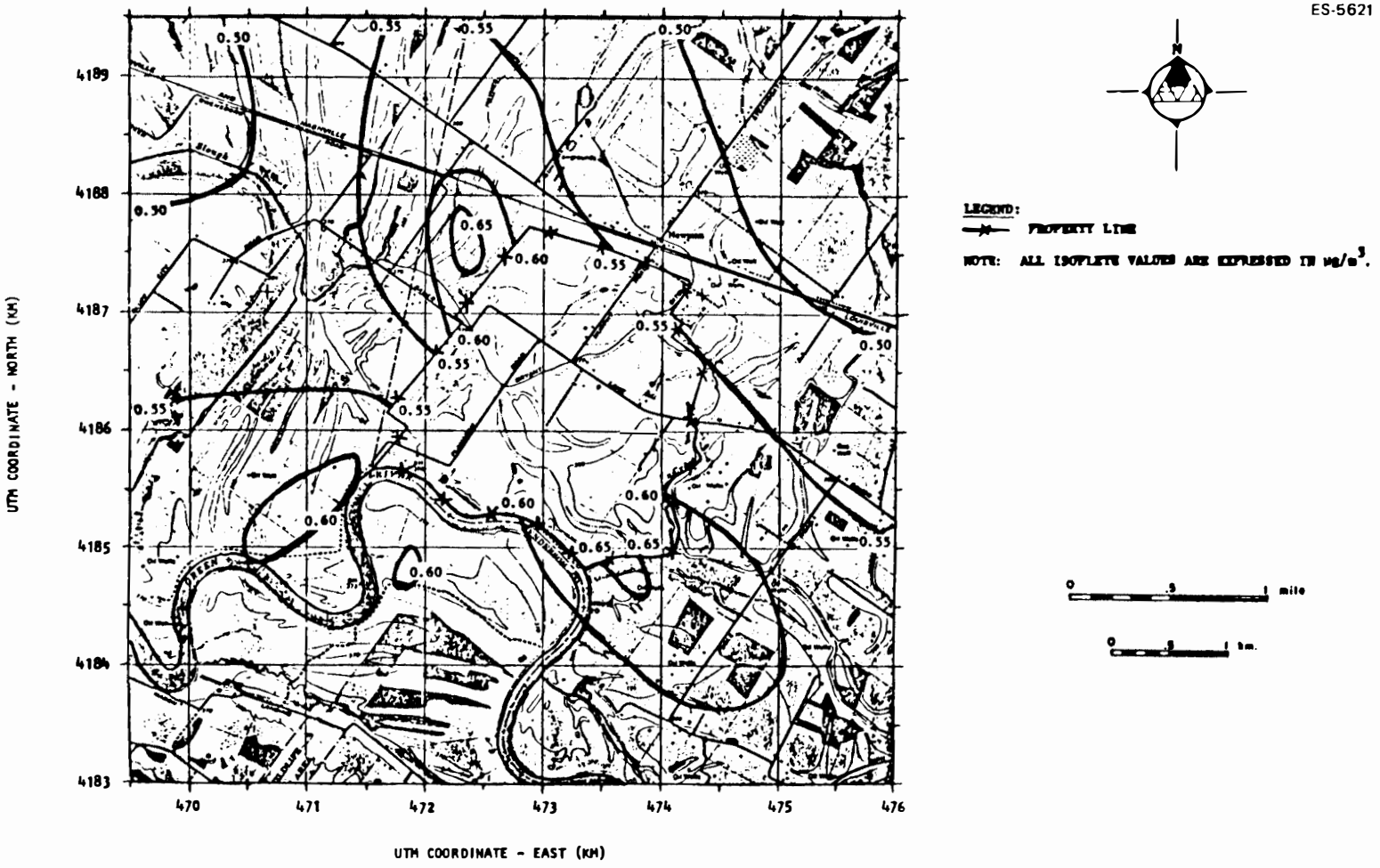


Fig. 4.1. Isopleths of predicted annual mean SO_2 concentrations from all PSD sources within the study area.

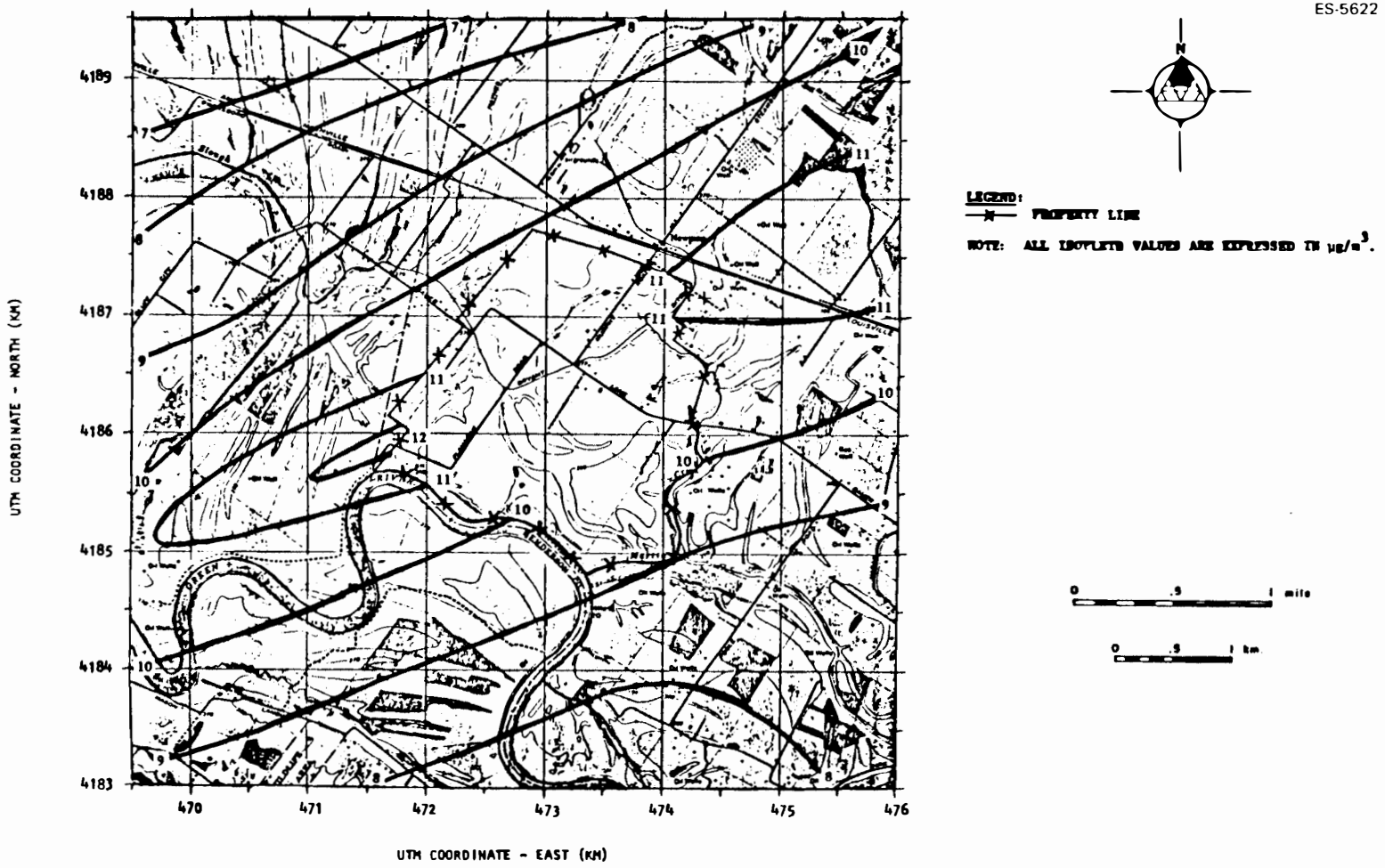
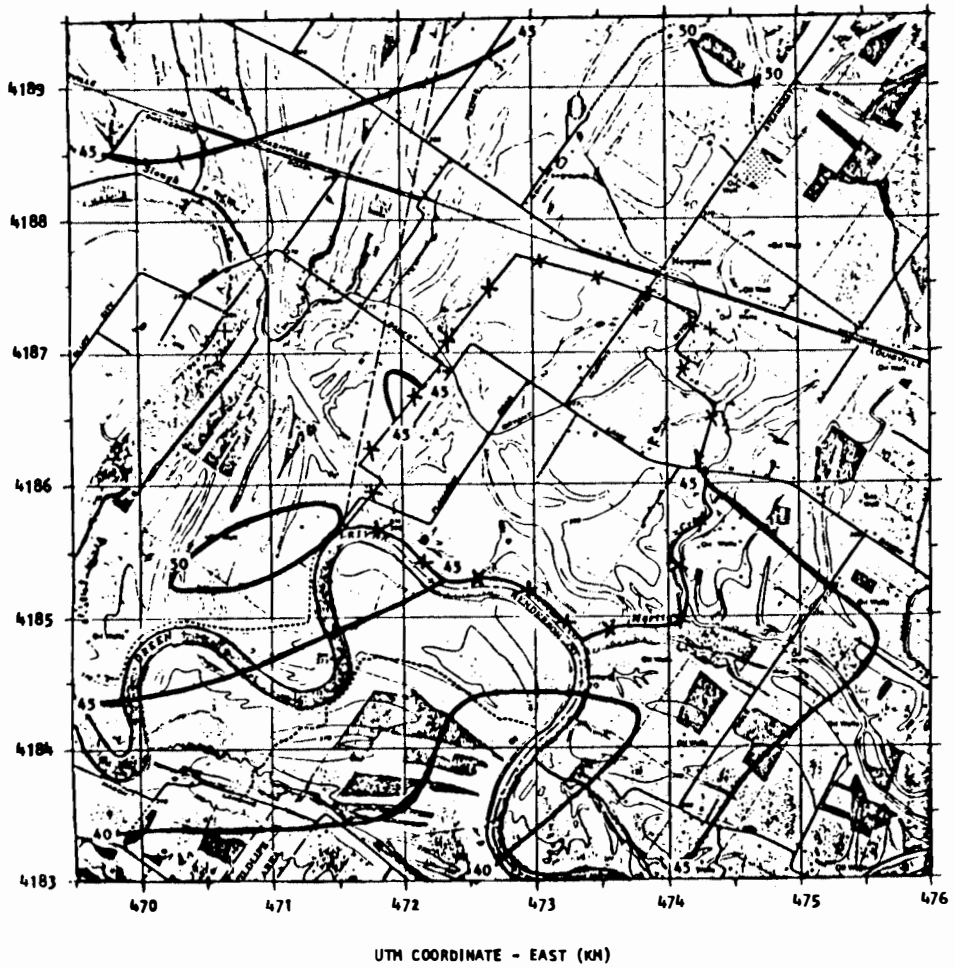
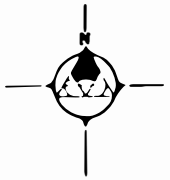


Fig. 4.2. Isopleths of predicted second highest 24-h SO_2 concentrations from all PSD sources within the study area.





LEGEND:
PROPERTY LINE

NOTE: ALL ISOPLETH VALUES ARE EXPRESSED IN $\mu g/m^3$.

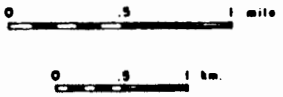


Fig. 4.3. Isopleths of predicted second highest 3-h SO_2 concentrations from all PSD sources within the study area.

Particulates. The DEIS states that an estimated 73% of the 24-h PSD increment for particulates will be consumed by the demonstration plant. Updated Industrual Source Complex (ISC) dispersion modeling analyses, however, have reduced that estimate to 18.3%. The DEIS predicted a maximum 24-h ground-level concentration of 26.9 $\mu g/m^3$; the new estimate is 6.74 $\mu g/m^3$ for the demonstration plant alone and 8.1 $\mu g/m^3$ for all PSD sources in the area. The new estimated average annual concentration for all PSD sources in the area is 1.26 $\mu g/m^3$. The points of maximum particulate concentrations are to the northwest near the plant boundary as shown in Figs. 4.4 and 4.5.

Based on overly conservative emissions assumptions it was estimated in the DEIS that 20 of the 26.9 $\mu g/m^3$ maximum 24-h concentration was due to fugitive emissions alone. New results have reduced this contribution to 2.41 of the 6.74 $\mu g/m^3$ total demonstration plant concentration.

The reduction in fugitive particulate air quality impact was achieved by considering three key factors: the effect of wind speed on SRC- and coal-pile wind erosion losses, the impact of scheduling SRC- and coal-loading and unloading operations for only 8 out of 24 h, and the effects of using prewashed coal. Each factor is discussed in more detail in Appendix S.

Total suspended particulates exhibit greater levels of impact. However, all predicted TSP concentrations are well below the appropriate increments and standards. Results of the analysis are in Table 4.18, and in Figs. 4.4 and 4.5. Table 4.18 shows that the maximum annual average and second-highest 24-h TSP due to the SRC-I plant are predicted to be 0.9 and 6.7 $\mu g/m^3$, respectively. The concentrations will account for 4.7 and 18.1% of the increments and 1.2 and 4.5% of the NAAQS for annual average and 24-h maxima, respectively. The TSP concentrations from the SRC-I plant together with all existing and PSD sources are predicted to be 43.3 and 62.1 $\mu g/m^3$, or 57.7 and 41.4% of the annual average and 24-h NAAQS, respectively.

The estimate of fugitive particulate emissions was reduced from the value used in the DEIS largely because of an allowance for coal washing, which removes the small particles prone to be scattered by the wind as fugitive dust. This added mitigation measure and other modeling procedures are discussed in Appendix S.

Nitrogen oxides. After the SRC-I plant is in operation, the maximum annual average concentrations of nitrogen dioxide (NO_2), as Table 4.18 and Fig. 4.6 show, increases less than 4 $\mu g/m^3$ above the ambient concentration of 16 $\mu g/m^3$. The projected NO_2 concentration is 20 $\mu g/m^3$, which is less than 20% of NAAQS. Therefore, the impact is insignificant. The point of maximum concentration is about 0.5 miles north-northwest of the plant boundary as shown in Fig. 4.6.

Carbon monoxide. The impact on CO standards from the SRC-I facility is also small. For 8-h averaging time, the SRC-I plant would add 909 $\mu g/m^3$ to the baseline value of 2000 $\mu g/m^3$. The NAAQS is 10,000 $\mu g/m^3$. Likewise the 1-h NAAQS standard will not be violated; the projected air quality after the SRC-I plant is on-stream is only 6490 $\mu g/m$ or 16% of the standard. The points of maximum concentration are shown in Figs. 4.7 and 4.8 to be at the southern and northwestern plant boundary lines.

Ozone. The air quality models that are currently available to predict ozone concentrations are still in a developmental stage. This situation has been caused by limitation in the state of the art in (1) predicting ambient ozone concentrations resulting from long-range transport of urban reactive hydrocarbons and photochemical oxidants, including urban ozone itself, (2) determining the frequency and severity of stratospheric ozone intrusions, and (3) understanding the atmospheric chemistry and kinetics that affect ozone formation. Hydrocarbon emissions are thought to be the most important precursor pollutant in ozone formation. Because best available control technology will be used at the proposed SRC-I plant to limit routine hydrocarbon emissions from point sources and fugitive sources, the total emissions will be about 62 tons per year (Appendix C, Sects. C.2.2.2 and C.3.1.5). No significant impact on local ozone concentration is expected.

Heavy metals and reduced sulfur compounds. Operation of the proposed SRC-I plant will result in small emissions of heavy metals and reduced sulfur compounds. As discussed in Sect. 2.2.1, the types and amount of these emissions will depend on the type of coal processed and the efficiency of pollution control equipment, which will be more accurately analyzed during detailed design of the plant (Appendix C). The following preliminary analysis is based on conservative assumptions.

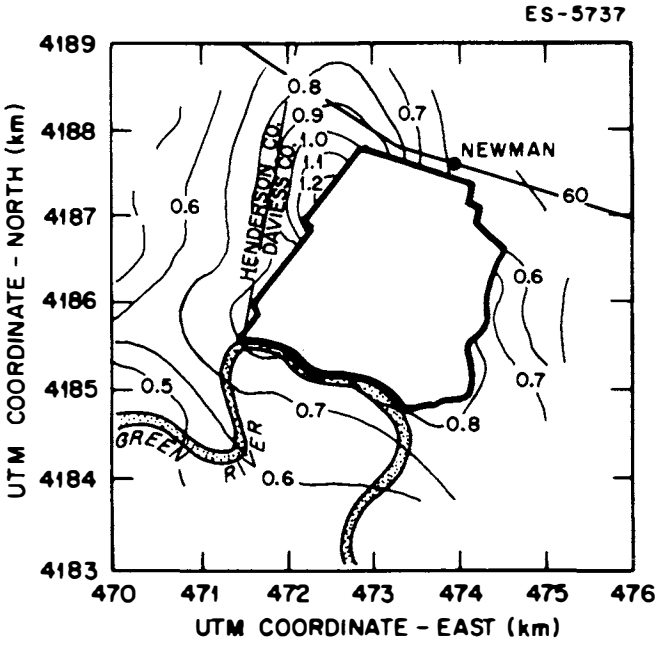


Fig. 4.4. Isopleths of predicted annual mean TSP concentrations from all PSD sources within the study area.

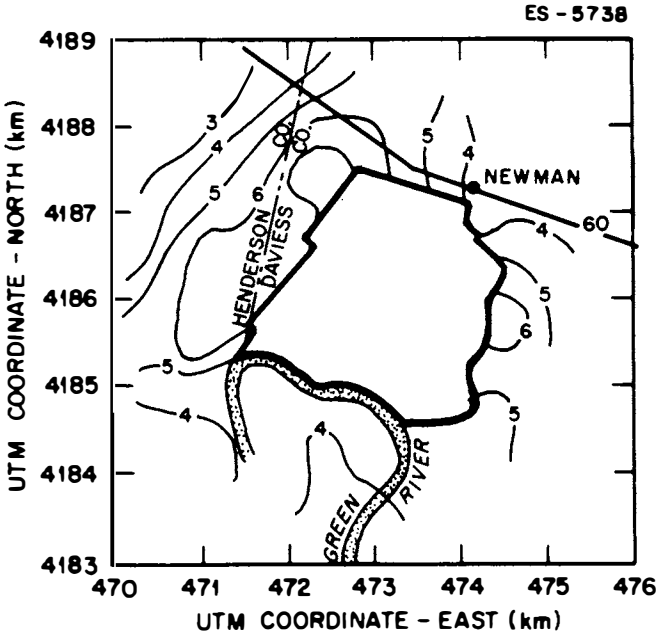


Fig. 4.5. Isopleths of predicted second highest 24-h TSP concentrations from all PSD sources within the study area.

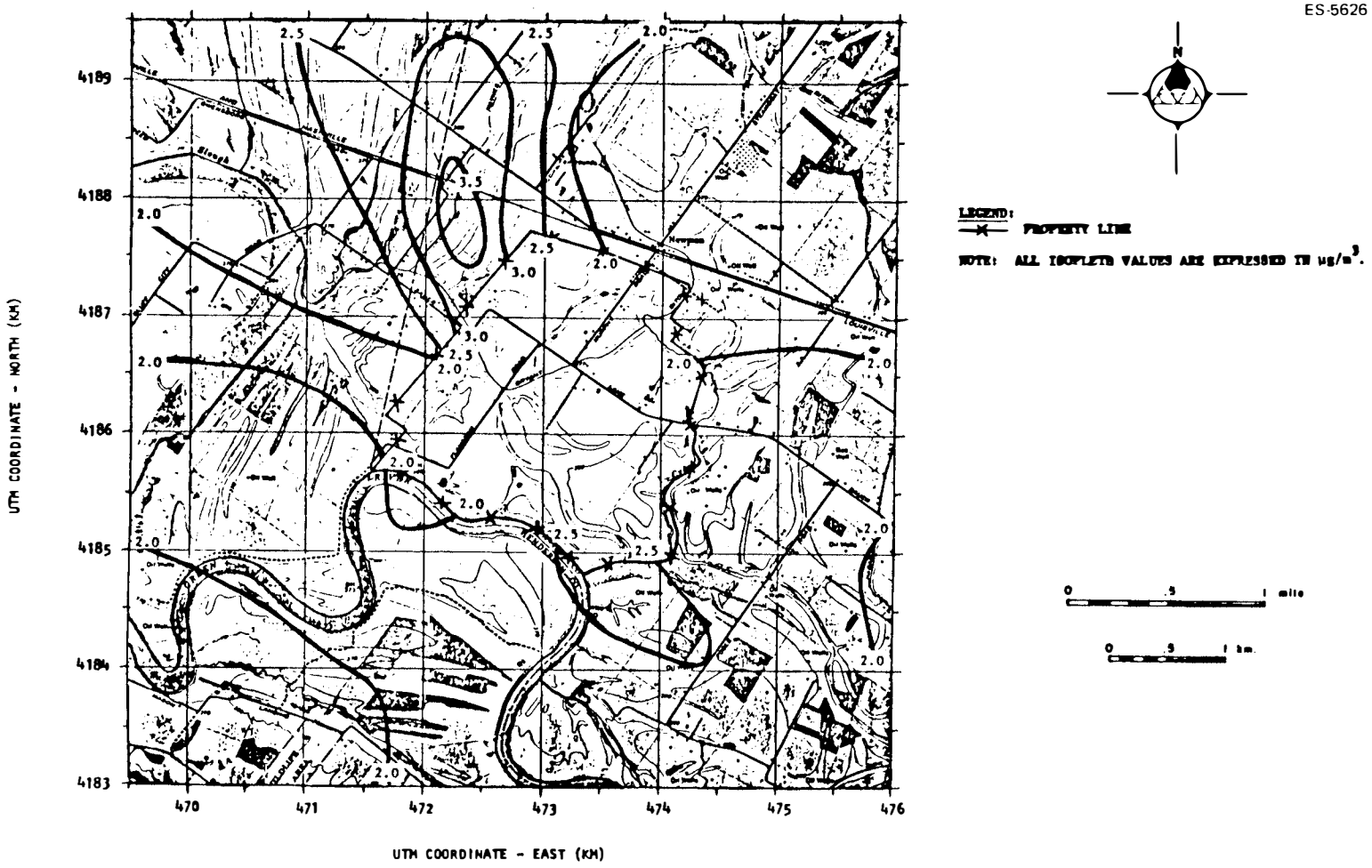


Fig. 4.6. Isopleths of predicted annual mean NO_2 concentrations from all PSD sources within the study area.

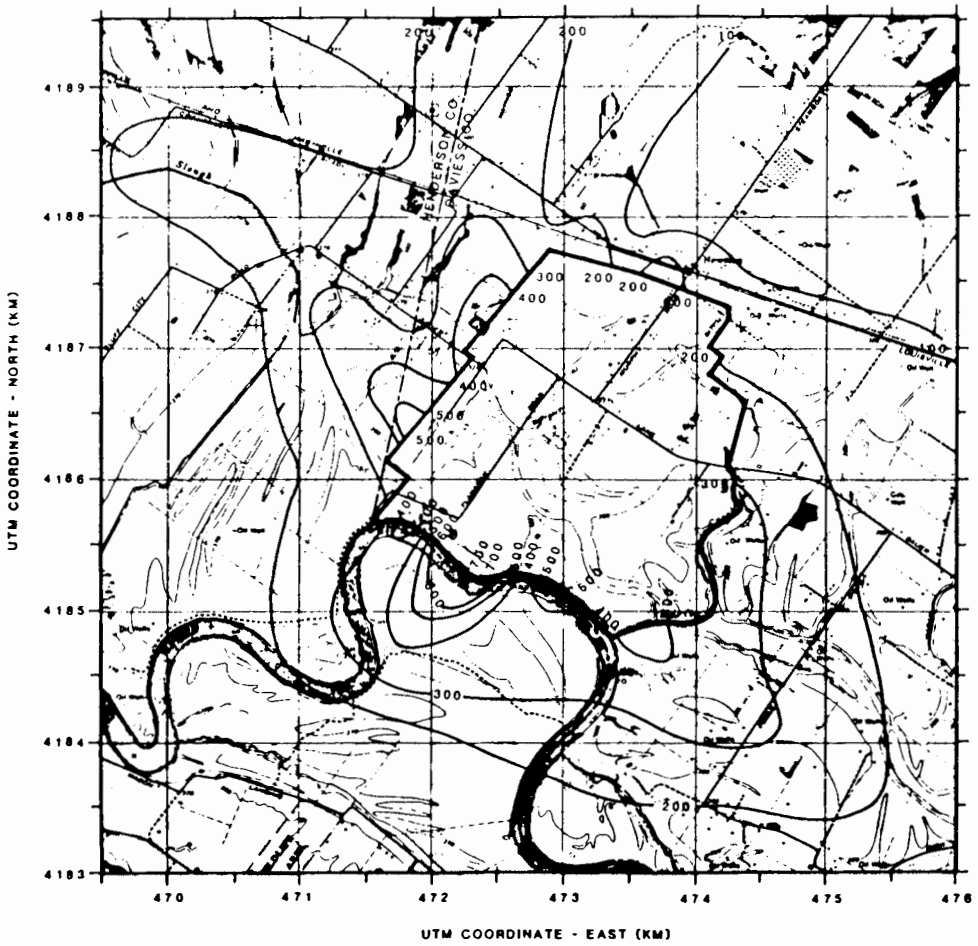
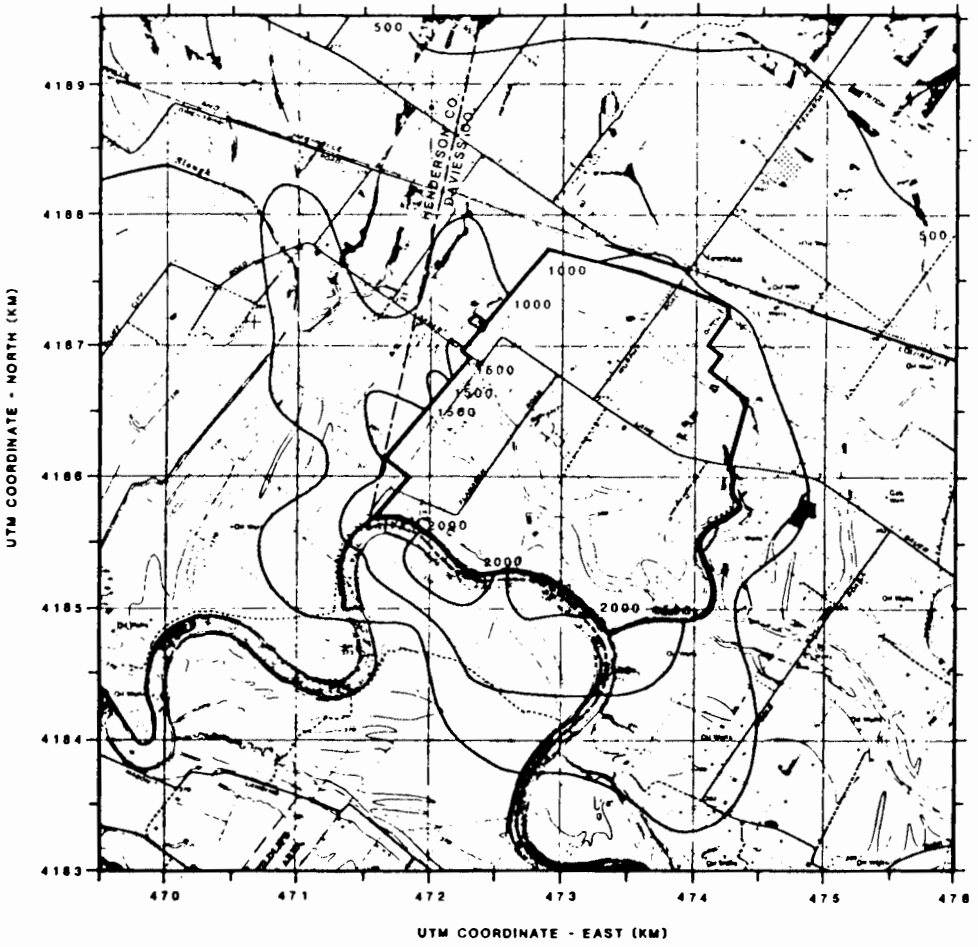
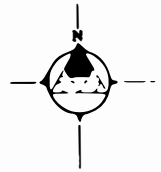


Fig. 4.7. Isopleths of predicted second highest 8-h CO concentrations from all PSD sources within the study area.





LEGEND:

PROPERTY LINE

NOTE: ALL ISOPLETH VALUES ARE EXPRESSED IN $\mu g/m^3$



Fig. 4.8. Isopleths of predicted second highest 1-h CO concentrations from all PSD sources within the study area.

1. Table 4.18 shows that the second-highest calendar-quarter average Pb concentration due to the SRC-I plant is predicted to be 0.82 $\mu g/m^3$ or 54.7% of NAAQS. The highest predicted 8-h concentration within plant property is 19.7 $\mu g/m^3$ or 13.1% of the TLV for Pb. Thus, based on very conservative estimates, Pb emissions from the SRC-I plant will not threaten the air quality in the vicinity of the site, nor the health of plant workers.

2. Assuming conservatively that all Hg not contained in the facility's products would be emitted to atmosphere, the record highest Hg concentration outside the plant property is 0.004 $\mu g/m^3$, well below the 1-$\mu g/m^3$ protective level for a 30-d period established by EPA. Within the plant boundary, the highest predicted average concentration is 0.87 $\mu g/m^3$ for an 8-h period, which is low compared to the 10-$\mu g/m^3$ TLV adopted by American Conference of Governmental Industrial Hygienists (ACGIH).

3. The SRC-I plant will emit negligible quantities of Be and F. Preliminary data have shown that almost all the beryllium entering the plant in the feed coal will stay with the gasifier slag and fly ash. Fluorides are expected to end up in the wastewater.

Flaring of the Beavon tail gas has not been planned because, based on dispersion calculations, flaring does not appear to be necessary. The tail gas from the Beavon unit has a design concentration of less than 5 ppm of H_2S. A simulation of the dispersion of this plume, using the ISC model indicates that, at 5 ppm H_2S, the maximum 1-h average impact at ground level is 1.45 $\mu g/m^3$. This is well within the Kentucky standard of 14 $\mu g/m^3$. Thus, it can be concluded that the concentration of H_2S in the Beavon tail gas would have to be 50 ppm (10 times more concentrated in H_2S) for a violation to occur. Such a condition is not expected to occur. However, if this condition should occur, proper measures, such as operating the plant at a reduced rate, will be taken to ensure compliance.

If the Beavon unit goes off-line, about 125 g/s of sulfur will be emitted to the atmosphere. The sulfur will appear as 250 g/s of SO_2 because the stream (Claus tail gas) will be flared through the thermal oxidizer. The impact of flaring the Claus tail gas continuously was determined by simulating the dispersion of the plume using the ISC model. The highest-second-highest 3-h and 24-h average SO_2 concentratins were 149.9 and 29.3 $\mu g/m^3$, respectively. These concentrations account for 29.3 and 32.2% of the allowable PSD Class II increments. The 24-h concentration accounts for 8% of the NAAQS for SO_2. This concentration was not compared to the annual NAAQS for SO_2 because this is an upset condition, which will not normally be encountered; thus, this upset condition does not result in a violation of standards.

Nonmethane hydrocarbons. The emission rate of nonmethane hydrocarbons (NMHCs) from point and fugitive sources is estimated to be about 62 tons per year. The average annual concentration of heavy (BP $\geq$ 500°) NMHC emissions or PNA components was simulated using the EPA Industrial Source Complex (ISC) model (Appendix S). The maximum annual average concentration beyond the plant boundaries was simulated at 1.8 $\mu g/m^3$ for heavy PNA components and 7.9 $\mu g/m^3$ for total NMHCs. The simulation included some of the nearby communities such as Stanley, Spotsville, and Hebbards; the average annual exposure to total NMHCs was less than 0.4 $\mu g/m^3$ in these areas (less than 0.1 $\mu g/m^3$ of heavy constituents).

The second highest exposure outside plant boundaries during any one hour of the year was simulated at 236 $\mu g/m^3$ for total NMHCs and 47 $\mu g/m^3$ of heavy hydrocarbons, which is well within the OSHA limit of 200 $\mu g/m^3$ for coal tar pitch volatiles (CTPV). This maximum occurred close to the plant boundary and was found to steadily decrease in proportion to distance from the plant.

It must be pointed out that the ISC model is not strictly applicable to hydrocarbons. The results of the ISC model should be very conservative because the model assumed that the hydrocarbons remain dispersed. This assumption is questionable, especially for heavy hydrocarbons. Because of a high boiling point and low volatility, some heavy hydrocarbons have a tendency to condense and settle out.

Modeling of the heavy (BP >500°F) fugitive hydrocarbons predicted the second highest ground-level concentration to be 58 $\mu g/m^3$ (one hour) inside plant boundaries. This level is considerably higher than would be expected based on the worker-exposure air monitoring data collected at

Wilsonville. Workers at the pilot plant conducted their activities during plant operation with portable hydrocarbon analyzers attached to their clothing. These individuals were at the source of emissions, and detected levels of aromatics and other heavy organics were well below the OSHA standard for coal tar pitch volatiles (see Appendix Z).

Two major reasons could account for the large discrepancy between actual monitored emissions at the pilot plant, and the modeling results for the demonstration plant. First, existing Gaussian dispersion models do not take reactivity of substances into account and are consequently not recommended for estimating hydrocarbon concentrations. The highly reactive nature of organic emissions makes any modeling results skeptical at best. Second, both the Gaussian dispersion models and the methods for estimating for fugitive hydrocarbons are primitive. The model tends to predict higher concentrations than may actually occur. No extensive operating data on fugitive hydrocarbons from plant valves, flanges, and other fittings exist for a coal conversion facility the size of the proposed demonstration plant.

The most appropriate means of determining the impact of heavy fugitive hydrocarbon emissions will be to monitor emissions during demonstration plant operation. An extensive onsite air quality monitoring program is planned (Sect. 4.5). Data from this program will determine the adequacy of the present best available control procedures for process line and equipment fitting leaks. Best available control technology, or, in some cases, lowest achievable emissions rate, will be implemented at the plant.

Emissions during upset and emergency conditions. Emissions of process materials resulting from such an event cannot be predicted at this time. These streams will contain organic compounds and various compounds of sulfur. If flaring is incomplete, materials that present long-term health hazards may be released. Large quantities of SO_2 will be emitted, but for short duration. Emissions during flaring represent a potential health hazard. In a worst-case scenario, public exposures resulting from acute emergency conditions in the plant, though brief, could be significant. Process upsets or operating difficulties may occur that are so severe that they require immediate pressure reduction to prevent loss of equipment or major fire and explosion hazards to personnel. Emergencies may result in process materials being directed to the elevated flare.

Cooling tower. The visible plume characteristics from a mechanical draft cooling tower and their impact on the ground at the proposed site were assessed using a proprietary cooling tower model developed by Dames and Moore (Appendix S). The results of the modeling analysis using this model indicate that

1. The visible plume will extend farther than 1000 m (3500 ft) from the tower less than 50% of the time and farther than 3000 m (10,000 ft) 22% of the time. The plume will be visible at greater distances from October through March and at shorter distances from April through September, to the west during the first half of the year and to the north and northeast during the second half.

2. Ground-level fogging will occur 13% of the time, rarely (11 times during the year) farther than 3000 m (10,000 ft) from the tower and usually to the east through south and to the west of the tower. The highest frequencies of occurrence are predicted for January through March (30%) and for October through December (21%).

3. Ground-level icing will occur 6% of the time rarely (once during the year) farther than 3000 m (10,000 ft) from the tower and usually to the east and south of the tower. Of the 466 hourly incidences of icing, 292 are predicted to occur from January through March; one is predicted to occur from April through June; 208 are predicted to occur from October through December.

4. Relative humidity increases of 1% will occur beyond 500 m (1500 ft) less than 50% of the time. These increases will be primarily to the north of the tower.

5. Temperature increases of 0.5°C will occur less than 50% of the time, be within 500 m (1500 ft), and occur most frequently to the north and west of the tower.

The impacts from cooling tower operation will be localized and have been reduced by siting the cooling towers at the southern portion of the site. Impacts to traffic are expected to be minimal. Actual experience on cooling towers at a large commercial complex in western Kentucky suggests that no noticeable icing condition exists at more than 76 m (250 ft) from the tower at ground elevation. The maximum known distance for appreciable fogging effects was 305 m (1000 ft). The complex contains six chemical plants with at least 12 boilers, having a combined generating capacity at approximately 13 MM lb/h; at least 10 cooling towers; 35-40 large furnaces and incinerators; and numerous steam and other condensible plumes within a 1.5-mile distance along the Tennessee River. This represents a much worse set of conditions than those of the plant and environment at Newman, Kentucky. In addition, because the conservative model for the cooling tower plume developed by Dames & Moore may be more accurate in determining a worst-case condition than in precisely defining normal conditions, it is suggested that the specific model results be viewed as a worst-case analysis, and not be expected to occur in the lifetime of the plant.

From this analysis, the operation of the proposed cooling system is not expected to cause significant offsite adverse impacts.

Odors. Many odorous compounds will be handled within the plant, including hydrogen sulfide and hydrocarbons. Hydrogen sulfide is a toxic gas, and streams containing it will be incinerated before being released to the atmosphere except in the case of the CO_2-rich stream from the Beavon unit. The emissions of H_2S from the Beavon unit will be about 5 ppm. The incineration process will convert virtually all of the H_2S to SO_2, which has a higher threshold of odor detection. Hydrocarbons are a broad category of compounds with varying types of odors and varying thresholds of detection. Fugitive releases are the predominant sources of non-methane hydrocarbons, and extensive controls will be implemented to reduce their emission rates. In all likelihood, odors from these organic emissions will be detectable in the plant and at some offsite locations. The frequency, severity, and location of offsite odors cannot be predicted, given the lack of available information on the composition of these emissions.

Impacts of expansion to and operation of a commercial facility

The commercial plant, which will process five times as much coal as the demonstration plant, should not result in five times as much impact on air quality. The emission rates from the commercial plant will depend on many factors, such as product slates and process design. Because planning for the commercial plant is still in an embryonic stage, the emission rates cannot be estimated with a high degree of certainty. A worst-case analysis is used in the EIS in lieu of a definitive design.

The emission rates of the commercial plant are estimated to be less than five times those of the demonstration plant for all pollutants. The emission rates for SO_2 and particulates will be less than directly proportional to the plant capacity because the capacity of the coker/calciner, which is the major source (75-80%) of these pollutants in the demonstration plant, would not be greatly expanded beyond the demonstration plant capacity. Also, emerging process and control technologies, such as flash coal drying, which could greatly reduce emissions but are not commercially proven, probably, will be employed for the commercial plant. Extensive monitoring in the demonstration plant, too, may reduce emissions in the commercial plant by providing more accurate emission data that can be used for design improvement.

Increases in ground-level concentrations of the pollutants may not be directly proportional to increases in the plant capacity either. About 75% of the site would be occupied by the commercial plant; some sources of emissions are separated by hundreds of meters. The relatively large distances separating the sources minimize the additive impact of each source.

The first key assumption is that the production rate of coke of the commercial plant will be about the same as that of the demonstration plant and that the production rates of the other products will be about five times that of the demonstration plant.

The PSD standards for an expanded commercial plant are expected to be met. It should be noted, however, that the availability of PSD increments cannot be projected to the date of operation of the commercial plant. Monitoring data recorded during demonstration will indicate the actual dispersion characteristics and will be applied to calibration of an appropriate dispersion model to project increases for the commercial plant. This will result in greater accuracy in the model, which should help in designing the plant to meet guidelines.

Sulfur dioxide. The SO_2 emissions from the commercial plant are estimated at less than two times those of the demonstration plant. The commercial plant is anticipated to be a minor source of SO_2 in the area. No violations of the NAAQS are anticipated, and the plant is expected to consume a very small portion of the PSD increment. Even if increases in the ground-level concentration were directly proportional to increases in the emission rate, it is estimated that only 8% of the 24-h increment for SO_2 would be consumed by the commercial plant.

Particulates. The particulate emission rates for the commercial plant are derived by scaling up the estimated emission rates from the demonstration plant. Since issuance of the DEIS, changes have occurred in the plant design and operating plants resulting in lower demonstration plant particulate emissions and consequently lower air quality impacts. The following discussion describes these changes and how they have affected the prediction of emissions and air quality impacts for the commercial plant. The particulate emission rate from point sources is expected to increase by a factor of 4.0 (because the coker/calciner area will not be expanded greatly beyond demonstration plant capacity), and fugitive emissions by a conservative factor of five over the demonstration plant. The total commercial plant particulate emissions are expected to be about 615 tons per year. Considering point and fugitive sources, preliminary modeling indicates that about 56% of the allowable 37-$\mu g/m^3$, 24-h increment for particulates would be consumed. Modeling results indicate that the commercial plant can be constructed within the 24-h and annual incremental restrictions, if point source contributions increase by four, and fugitive emissions are conservatively assumed to increase fivefold at the commercial-size plant.

Accurate fugitive particulate emission predictions cannot be made at this time; only monitoring during demonstration plant operation can give a reliable estimate from which to scale. Fugitive particulate emissions from the demonstration plant were estimated using a variety of EPA publications and sources. The available fugitive particulate emissions literature is not very reliable because the information is typically not based on actual testing of coal dust sources and the emission factors do not take into account many important factors that can affect the emissions, such as surface area of coal piles and their orientation with respect to the prevailing wind, whether the coal has been washed to reduce silt content, or the effects of wind speed on pile losses. Only actual monitoring can accurately determine fugitive emission rates from the demonstration plant and provide a better basis for estimating fugitive emissions and the effectiveness of control measures from the commercial plant.

Hydrocarbons. The hydrocarbon emissions from point sources in the demonstration plant, as well as the commercial plant, will be small. As for the demonstration plant, hydrocarbon emissions from the commercial facility will depend on control of the fugitive sources. Fugitive sources of hydrocarbons in the demonstration plant are estimated to contribute almost 90% of the plant's overall hydrocarbon emission rate. The estimates utilized for the demonstration plant emission inventory in Appendix C are based on the EPA guideline document *Assessment of Atmospheric Emissions from Petroleum Refining.*[39] This document is based on emission measuring activities at 13 petroleum refineries throughout the United States. Overall fugitive emission rates from fittings such as valves, flanges, pumps, and compressors varied greatly among the refineries investigated, and none of the refineries studied employed maintenance or design consideration programs as stringent as those planned for the SRC-I plant. Consequently, the emissions inventory for the demonstration plant may be conservative. Operating experience at the demonstration plant would allow for more precise estimation of emissions for expansion to commercial capacity. If analysis prior to commercialization indicates that plant could be a major source of hydrocarbons, appropriate design considerations will be employed by the plant operator. As a worst-case assumption, the hydrocarbon emission rate from point and fugitive sources in the commercial plant can be assumed to be five times that of the demonstration plant, or less than 350 tons per year. These hydrocarbon emissions from the commercial facility would not result in a known significant impact.

Nitrogen oxides. The nitrogen oxide emission rate of the commercial plant is estimated to be four to five times that of the demonstration plant. The resulting maximum increase in nitrogen dioxide due to the commercial plant is not anticipated to violate NAAQS for nitrogen dioxide even if the ground-level concentration were to increase fivefold.

Carbon monoxide. The commercial plant would emit a maximum of five times the CO of the demonstration plant. The plant commercialization may result in only 2.5 times the CO emissions of the demonstration plant, if the large CO_2 vent stream (which also contains 50% of the facility's CO emissions) can be pipelined to a tertiary oil recovery operation, rather than vented to the atmosphere. This option appears feasible for a commercial-size plant. Even if CO emission is five times that of the demonstration plant, no violation of the NAAQS is expected.

Hydrogen sulfide. Modeling for H_2S concentrations carried out for the PSD permit application for the demonstration plant indicates that the odor threshold for the demonstration plant (10 parts per billion) will not be exceeded. If the H_2 emissions are conservatively estimated to scale upward by a factor of 5 for the commercial plant, the odor threshold for H_2S could be exceeded under certain meteorological conditions. Anlaysis during the demonstration phase will determine whether H_2S emissions must be lower than these conservatively estimated rates to meet odor standards for the commercial plant. Mitigation measures will be taken in the design of the commercial plant if required.

Lead. Lead concentrations for the demonstration plant were predicted using very conservative estimates of atmospheric lead emissions (i.e., all lead entering with the coal was assumed to be vented to the atmosphere at each of two locations, thus doubling accounting.) Actual lead emissions from the demonstration plant are expected to be much less than this conservative estimate, and emissions from the commercial plant are thus expected to be much less than a 5 times scale-up of this conservative estimate. The resulting lead concentrations will be lower than the ambient air quality standards. Monitoring during the demonstration phase will be done to confirm this analysis.

Impacts of mothballing and decommissioning

If the plant is mothballed, emissions from the facility would cease. The air quality would return to the levels that would be experienced without the facility. That pollutant increment allotted to the facility by PSD review would remain unavailable to other industries for some time, probably 18 months.

If the plant is decommissioned and dismantled, air quality impacts would be similar to those experienced during construction. Upon revegetation or return to prior use, the air quality would return to those levels that would be experienced without the facility.

4.2.3.2 Noise

Construction

Table 4.19 lists estimated construction sound levels at noise sensitive locations (e.g., residences) beyond the site boundaries. For a worst-case analysis, it is assumed that construction will take place during two shifts. Construction activities should have a negligible effect on sound levels at these noise sensitive locations and are below the U.S. EPA's short-term goal of 65 dB day-night equivalent sound level (see Sect. 3.2.3.2) for residences.

During construction of the rail car marshalling yard, day-night sound levels at the nearest residence at the eastern boundary are not expected to increase.

Although morning and evening traffic at the site on U.S. 60 is expected to increase by approximately 2500 to 2900 vehicles during peak construction, the predicted hourly equivalent sound level is expected to increase only 1 db at 60 m (197 ft) from the roadside. Any significant increase in truck traffic could result in an additional increase in highway sound levels.

A one-time event, steam blowout, is used to clean the high pressure piping systems. This occurrence produces high noise levels of short duration; the typical blowout operation A-weighted sound level is 103 db measured at 304 m (1000 ft). The blowout noise may startle people and will affect verbal communications during its 2.5 min duration, but the impact can be minimized by use of a muffler, notification of local residents of the steam blowout schedule

Table 4.19. Estimated daytime (L_d), nighttime (L_n), and day-night (L_{dn}) sound levels for general construction (excavation phase)[a]

Location[b]	Background ambient (dB)			Construction ambient (dB)			Change (dB)		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
Residence, Steamboat Road	59.4	50.0	59.6	59.8	51.5	60.5	+0.4	+1.5	+0.9
Residence, Murphy Road[c]	53.5	47.0	55.1	55.5	50.6	58.1	+2.0	+3.6	+3.0
Sauer Lane near Martin Creek	61.8	47.0	60.5	62.2	50.9	61.8	+0.4	+ 3.9	+1.3
Residence, Sauer Lane[d]	62.1	52.0	62.1	62.5	53.7	63.0	+0.4	+1.7	+0.9

[a]The excavation phase is generally the noisiest phase of construction.
[b]See Fig. 3.13 for locations.
[c]Within plant boundary.
[d]Excludes sound levels during construction of rail car marshalling yard.
Source: ER, Table 4.5.

limiting blowout scheduling to daylight hours, and explanation to local residents of the operation and associated noise.

Quieted construction equipment will be used for all activity near the periphery of the site.

If decommissioning of the plant involves returning the site to current conditions, sound levels during decommissioning would be similar to those expected during plant construction.

Expansion of the plant to commercial size would require excavation activity to within about 610 m (2000 ft) of homes in Newman and east of the site boundary. However, the equivalent sound level for excavation would probably be slightly below the existing ambient sound levels.

Mitigation measures are discussed in Sect. 4.6.1.

Operation

Table 4.20 lists estimated operation sound levels at nearby noise-sensitive locations.

The noise of steady plant operation (assuming operation 24 h/d) is expected to result in time-averaged sound levels slightly higher but comparable to existing ambient sound levels. Cooling tower sound levels will also contribute slightly to ambient sounds, particularly to the east of the facility. Based on current design information and the above assumptions these predicted sound levels are below the EPA short-term goal of 65 dB day-night equivalent sound level but could be in excess of their long-term goal of 55 dB (see Sect. 3.2.3.2), identified as being necessary to protect the public health and welfare at residential locations. It should be noted that the existing background sound level already exceeds EPA's long-term goal.

Rail marshalling yard activities alone contribute a day-night sound level of 54 dB at the Sauer Lane intersection with Martin Creek (Location 3). This is below the EPA identified sound level to protect health and welfare. Coupling noise is impulsive. It will reach a sound level of 57 dB at Location 3. Proposed EPA regulations for noise from rail car marshalling yards permit short duration car coupling noise up to 95 dB. Thus this activity would be in compliance with these proposed regulations.

Compliance with the proposed regulations relating to rail car activities, expected to be promulgated in 1982, should not be difficult, considering the distance of residences from the rail yard.

Table 4.20. **Estimated daytime (L_d), and nighttime (L_n), and day-night (L_{dn}) sound levels for plant operation**

Location[a]	Background ambient (dB)			Operation ambient (dB)			Change (dB)		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
Residence, Steamboat Road	59.4	50.0	59.6	59.5	50.6	59.9	+0.1	+0.6	+0.3
Residence, Murphy Road[b]	53.5	47.0	55.1	53.9	48.7	56.3	+0.4	+1.7	+1.2
Sauer Lane near Martin Creek	61.8	47.0	60.5	61.9	48.6	60.9	+0.1	+1.6	+0.4
Residence, Sauer Lane[c]	62.1	52.0	62.0	62.2	52.7	62.4	+0.1	+0.7	+0.4

[a]See Fig. 3.13 for locations.
[b]Location 2 is within site boundaries.
[c]Operation increases exclude noise from marshalling yard activities and the cooling tower. (See text.)
Source: ER, Table 4.6.

Commercialization

The commercial plant will be larger than the demonstration plant and therefore closer to noise sensitive locations such as residences. Also, since the commercial plant will be considerably larger than the demonstration plant, there will be more noise generated.

Table 4.21 lists distances from the principal noise sources at the facility to noise sensitive areas. The baseline sound level in all of the noise impact analyses assumes no plant construction or operation.

The computations in Table 4.22 are based on a 15-h daytime and 4-h nighttime construction work period. According to this modeling, changes in nighttime sound levels would be significant, especially at the nearest neighbor to the west and at the neighbors at Sauer Lane to the east. Day/night sound levels would change from 5 to 10 dB as seen in Table 4.22. Nighttime noise

Table 4.21. **Distances in feet to noise-sensitive areas**

Location	Coal handling	Process plant	Cooling towers	Marshalling yard
Steamboat Road	6375	7000	8250	4250
South Lane, east	4750	5750	6500	2250
Sauer Lane, west	4750	4250	4750	6500
Nearest home, west	3750	3250	4000	5500

Table 4.22. **Construction effects on equivalent sound levels in decibels[a]**

Location	Daytime				Nighttime				Day/night		
	Baseline L_{do}	Construction L_A	Construction and baseline L_{dc}	Change L_d	Baseline L_{no}	Construction L_A	Construction and baseline L_{nc}	Change L_n	Baseline L_{dn}	Construction L_{dn}	Change L_{dn}
Steamboat Road	59.4	57.2	61.4	+2.0	50.0	57.2	55.2	+5.2	59.6	63.2	+3.6
Sauer Lane, east	61.8	61.0	64.4	+2.6	47.0	61.0	57.9	+10.9	60.5	66.1	+5.6
Sauer Lane, west	62.1	62.0	65.1	+3.0	52.0	62.0	59.4	+7.4	62.0	67.2	+5.2
Nearest home, west	62.1	68.1	69.1	+7.0	52.0	68.1	64.8	+12.8	62.0	72.1	+10.1

[a]The letters used for the subscripts in the headings have the following meanings: d, daytime; n, nighttime; o, ambient; A, A-weighted; and c, construction.

levels might disturb sleep, particularly in those homes where the windows are open. The construction effort will be of relatively short duration, thus reducing construction noise impact somewhat. The excavation phase of construction produces the highest sound levels. Offsite sound levels at the nearest home at the western boundary will increase the most during the construction period when excavation is being accomplished. These predicted sound levels may exceed both EPA's short-term guidelines for residential locations and the U.S. Housing and Urban Development (HUD) standards for regulations (see Sect. 3.2.3.2). Section 4.6.2.1 identifies mitigation measures that would reduce this impact.

Commercial plant operation sound levels do not significantly change current ambient sound levels (Table 4.23).

Table 4.23. Plant operation effect on day (L_d), night (L_n), and day/night (L_{dn}) sound levels in decibels

Location	Baseline			Future			Change		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
Steamboat Road	59.4	50.0	59.6	59.8	52.5	61.0	+0.4	+2.5	+0.4
Sauer Lane, east	61.8	47.0	60.5	61.9	49.0	61.0	+0.1	+2.0	+0.5
Sauer Lane, west	62.1	52.0	62.0	62.2	52.7	62.4	+0.1	+0.7	+0.4
Nearest home, west	62.1	52.0	62.0	62.7	55.8	64.1	+0.6	+3.8	+2.1

The maximum change of 3.8 dB occurs at the nearest home to the western boundary. It is mostly due to coal-handling activities. This change is small, although the day-night equivalent sound level approaches EPA's short-term goal of 65 dB for residential locations.

4.2.4 Economic, social, and cultural impacts

4.2.4.1 Socioeconomic impacts from project construction

Introduction

This section discusses the potential socioeconomic impacts of construction of the demonstration facility. These impacts would occur during the 38-month period allotted to construction activities. Relevant categories of impacts that are considered include labor and employment, population, income, prices, housing, public services and finance, transportation, and historical and archaeological resources. Section 4.5 discusses recommended construction and operational monitoring, and Sect. 4.6 discusses recommended mitigation measures.

Labor force and employment

The primary factor in the analysis of socioeconomic impacts resulting from the construction of the proposed facility is the level of in-migration by the construction work force to communities in the site area. Other concerns or impacts (e.g., housing, education, and transportation) are largely determined by the extent to which the work force resides near the site or commutes to the site from their present residences. Once the level of in-migration is estimated for the project site and facility, the socioeconomic impacts resulting from this in-migration can be estimated.

The size, composition, and distribution of the labor force used to construct and operate the proposed coal conversion facility are all key determinants of the direction and magnitude of socioeconomic impacts in local communities.

To assess the availability of labor in a manner that produces results useful for impact analysis, the labor market area surrounding the site is defined as a maximum of 90 min of commuting or a 116-km (70-mile) radius of the site. Labor supply is estimated on the basis of an analysis of government labor statistics, and labor demand associated with other large construction projects

in the commuting zone is compiled from government, labor, and industry sources. The work force required to construct the coal conversion plant is compared with the labor force estimated to be available within the 90-min or 116-km (70-mile) commuting zone.

Details on the composition of the SRC-I impact area labor force by occupation and industry, as well as recent employment conditions, were discussed in Sect. 3.2.4.2. Consequently, emphasis in this section is directed at the supply of labor for the specific skills required for SRC-I construction. Cumulative socioeconomic impacts are addressed in Sect. 4.2.5.

Demand for construction labor. The skills and quantities of labor required for construction of SRC-I are identified in Table 4.24. In general, the skill profile needed for SRC-I is not unlike that used in chemical plant or refinery construction. Construction of the plant is estimated to last 38 months and require a peak construction work force of from 3500 to 5000 on-site workers. This wide range was used instead of the 3500 workers projected in the DEIS because actual work force requirements for large-scale construction projects often deviate substantially from the original projections. As an example, a recent study[40] of nuclear power plant construction work forces revealed that all 33 plants selected for analysis experienced larger man-power requirements than had been originally projected; 14 of the plants exceeded their projections by between 100 and 300%. Given this history of underprojections for a relatively mature technology, it is not unreasonable to believe that the earlier peak projection of 3500 construction workers used in the DEIS for this emerging technology may be low. Accordingly, the following sections will discuss potential socioeconomic impacts for a case of 3500 construction workers at peak and a worst case of 5000 direct workers. It must be recognized that an even larger source of socioeconomic impacts will be the cumulative effect of the nine energy projects proposed, planned, or under construction within 70 miles of the proposed site (see Sect. 4.2.5).

The estimated duration of the construction phase of the project is 38 months, presently estimated to begin in the fall of 1981 and ending in late 1984. This estimate must also be regarded as subject to the uncertainties of large-scale construction projects, including such factors as weather, delivery of components, design changes, regulatory consideration, strikes, and financing considerations. Labor demand is expected to peak 18 months after the start of construction. Nearly 99% of all construction-craft man-hour requirements are projected to occur during the 25-month period from March 1982 through March 1984; about 68% are projected to occur during the 12-month period around the project peak alone (Table 4.24).

It is projected that demand for craftsmen will peak at approximately 3500 to 5000 workers 18 months after the start of construction. The projected demand for 1600 to 2250 pipefitters at the peak of construction is much greater than for any other craft and represents 45% of total projected demand at the peak. The projected monthly craft mix shown in Table 4.24 differs somewhat from recent projections made by Dames & Moore for the applicant, which predict that only 36% of the peak work force will be pipefitters. In either case, however, there is a clear demand for large numbers of highly skilled crafts people within the SRC-I impact region.

Estimated availability of craft-specific construction labor. The availability of labor within commuting distance of the SRC-I facility must be established in order to assess accurately the level of impacts on local communities. The most useful estimates of the availability of construction labor in the vicinity of the SRC-I site are given in Table 3.4 and are discussed in Sect. 3.2.4.2. These construction employment estimates are derived from state-collected county-level unemployment compensation data adjusted for the most recently available craft ratios.

Craft-labor shortages. The comparison of projected SRC-I peak labor requirements with the current number of craft workers within commuting ranges of the plant site is contained in Table 4.25.

Examination of Table 4.25 reveals that, with a peak work force of 3500, SRC-I-induced labor demand will exceed 25% of the total number of crafts workers currently employed within the 90-min commuting zone for six of the thirteen crafts required. For three of these crafts — millwrights, pipefitters, and boilermakers — SRC-I demand will equal or surpass the *total* number of craftsmen currently employed in the region. If the peak work force reaches 5000, project-related demand will exceed 25% of currently employed workers for seven crafts and will surpass 100% for four crafts — millwrights, pipefitters, boilermakers, and ironworkers. Because many of the currently employed crafts workers in the SRC-I region will continue to be employed at other projects and because the number of unemployed construction workers is limited, it is expected that a substantial number of craftsmen will become in-migrants to the SRC-I impact area, taking up residence there on either a part-time (traveler) or full-time (mover) basis.

Table 4.24. Projected manpower schedule for SRC-I by construction craft
(peak workforce of 5000)

Craft	Construction month											
	1	2	3	4	5	6	7	8	9	10	11	12
Boilermakers						2	2	2	40	70	103	151
Brick masons										6	10	19
Carpenters			3	9	9	90	123	234	299	314	319	304
Cement finishers						40	80	81	60	61	67	79
Electricians						11	23	80	104	116	119	144
Insulators											2	16
Ironworkers			1	3	3	26	41	129	146	167	273	384
Laborers	17	20	20	21	29	144	233	289	340	397	427	389
Millwrights						2	2	2	19	27	40	107
Operating engineers	116	116	116	116	116	140	154	179	187	210	251	256
Painters											11	29
Pipefitters						46	90	150	227	364	591	759
Teamsters	3	6	7	9	11	27	40	47	51	53	53	60
Sheetmetal workers											2	2
Pile drivers								3	9	9	9	6
Others						33	74	83	107	154	144	213
Total	136	142	147	158	168	559	660	1279	1589	1948	2421	2918

Craft	Construction month											
	13	14	15	16	17	18	19	20	21	22	23	24
Boilermakers	210	260	290	243	277	294	223	191	190	216	167	109
Brick masons	20	27	20	9	6	3	3	3	3	3		
Carpenters	286	263	283	383	246	236	211	186	141	136	133	139
Cement finishers	70	71	66	56	54	54	43	33	36	36	36	36
Electricians	181	229	306	379	423	458	416	421	399	370	356	333
Insulators	2	2	2	23	61	87	161	266	257	260	313	416
Ironworkers	470	484	429	391	413	383	363	309	304	250	211	126
Laborers	359	339	313	287	270	281	289	286	247	206	188	176
Millwrights	143	186	213	220	224	276	251	237	223	213	156	151
Operating engineers	234	231	234	226	226	210	203	191	197	170	147	134
Painters	31	26	50	81	117	139	174	183	177	100	100	99
Pipefitters	1047	1299	1540	1809	1969	2262	2243	2176	2004	1459	1230	1139
Teamsters	60	61	60	60	57	54	51	49	47	37	34	34
Sheetmetal workers	2	2	33	43	16	16	16	30	30	26	26	26
Pile drivers	3	2										
Others	140	240	306	267	224	251	74	141	233	170	147	169
Total	3258	3722	4145	4260	4583	5004	4721	4702	4488	3652	3236	3087

Craft	Construction month													
	25	26	27	28	29	30	31	32	33	34	35	36	37	38
Boilermakers	21	11	10	2	2	2								
Brick masons														
Carpenters	113	84	67	44	14	3								
Cement finishers	34	27	21	14	11	4								
Electricians	316	90	173	137	96	20								
Insulators	387	289	241	199	199	126	40							
Ironworkers	103	89	80	63	39	29	10							
Laborers	176	127	86	69	69	63	3	3	3	2	2	2		
Millwrights	121	109	97	74	54	31								
Operating engineers	114	94	81	71	51	31	13	6	3	2	2	2		
Painters	96	77	77	69	46	51	9	2	2	2	2	2		
Pipefitters	909	756	580	431	257	177	36							
Teamsters	27	27	27	27	24	21	3	2						
Sheetmetal workers	26	26	26	4	4	4	4							
Pile drivers														
Others	316	109	169	284	126	154	43			2	2		3	3
Total	2759	1915	1735	1488	992	716	161	13	8	8	8	6	3	3

Source: Adjusted upward proportionally from labor mix projected for workforce of 3450 in ER, vol. 2, Table L14, pp. L74–L75.

Table 4.25. Baseline and projected construction employment in SRC-I impact region

Craft	Estimated 1979 construction employment within 90 min. of SRC-I (1)	Projected demand from SRC-I during peak construction (1983): work force of 3500 (2)	Ratio 2 ÷ 1 (3)	Projected demand from SRC-I during peak construction (1983): work force of 5000 (4)	Ratio 4 ÷ 1 (5)
Insulators	168	60	0.36	86	0.51
Boilermakers	203	203	1.00	290	1.43
Bricklayers/stone masons	607	2		3	
Carpenters	2529	163	0.06	233	0.09
Concrete finishers	558	37	0.07	53	0.09
Electricians	1090	316	0.28	451	0.41
Ironworkers	368	264	0.72	377	1.02
Laborers	1415	195	0.14	279	0.20
Millwrights	84	190	2.26	271	3.23
Operating engineers	1002	145	0.14	207	0.21
Painters	471	96	0.20	137	0.29
Pipefitters	983	1560	1.59	2229	2.27
Teamsters	455	36	0.08	53	0.12
Total	9933	3267		4398	

Competing demands for construction labor in the SRC-I area. Adding to the projected craft labor shortages is the competition for labor by other nearby large construction projects, including fossil-fuel power plants (Table 4.26). Assuming that SRC-I and the power plants are built on schedule, the competition for construction labor from the fossil-fuel power plants alone will be considerable. For example, during the six-year period from 1983 (SRC-I peak construction labor force) to 1989, there are expected to be up to eight coal-fired units under construction and scheduled for completion around the SRC-I area. These units will total 6090 MW of capacity and are estimated collectively to cost more than $3 billion.[41] Construction of these eight units would cause a tight labor situation during peak construction labor force months, even *without* SRC-I construction, because they represent a substantial increase over the level of power plant construction currently in the area. With the power plants *and* SRC-I, it is certain that the manpower requirements for many crafts will increase substantially between now and the completion of SRC-I will exceed the number of locally available workers.

Even if the current construction schedules of the fossil-fuel power plants slip because of a slowed growth in demand for electricity in the region, there may be competition for labor from other synfuel plants proposed to be built in the SRC-I region (i.e., W. R. Grace, Tri-State Synthetic Fuels Project, and the H-Coal Project). This potential cumulative impact is addressed more fully in Sect. 4.2.5.

Construction labor force in-migration

The primary factor in evaluating the socioeconomic impacts of SRC-I construction is the estimated number of in-migrating workers. In-migrants can either commute on a weekly or more frequent basis (travelers) or relocate on a permanent basis (movers). These relocation patterns serve as the basis for assessing increased area population and the resultant impacts on secondary employment, income, housing, schools, and a variety of other important social and economic considerations.

The estimates of SRC-I construction force origins and relocation patterns are presented in Table 4.27. These estimates are based on recent experience (post-1976) of TVA nuclear power plant construction labor forces in the eastern United States. The findings differ somewhat from those presented in the DEIS because (1) a range of 3500 to 5000 workers is used instead of the 3450 indicated in the DEIS, and (2) certain refinements and modifications have been made in the predictive model and its application. Accordingly, distance in-movers (those coming from outside the 21-county region) are distinguished from local in-movers (those prior residents relocating within the region). But movers and travelers are combined into a single category.

Table 4.26. Synfuels facilities and power plants scheduled for completion, 1981–1995
90-min zone around SRC-I

Owner/sponsor	Plant name	Plant type	Location (county, state)	Capacity (MW)	Completion date
Public Service of Indiana	Gibson 5	Coal	Gibson Co., Ind.	650	1982
Big Rivers Electric Co.	D. B. Wilson 1	Coal	Ohio Co., Ky.	395	1984
Southern Indiana Gas and Electric Co.	A. B. Brown 2	Coal	Posey Co., Ind.	250	1985
Indiana-Michigan Electric Co.	Rockport 1	Coal	Spencer Co., Ind.	1300	1985
Big Rivers Electric Co.	D. B. Wilson 2	Coal	Ohio Co., Ky.	395	1986
Indiana-Michigan Electric Co.	Rockport 2	Coal	Spencer Co., Ind.	1300	1986
W. R. Grace	W. R. Grace	Synfuels	Daviess Co., Ky.		1988
Texas-Eastern	Tri-State	Synfuels	Henderson Co., Ky.		1988
Ashland Oil	H-Coal	Synfuels	Breckenridge Co., Ky.		1988
Southern Indiana Gas and Electric Co.	A. B. Brown 3	Coal	Posey Co., Ind.	500	1988
Kentucky Utilities	Hancock 1	Coal	Hancock Co., Ky.	650	1987
Kentucky Utilities	Hancock 2	Coal	Hancock Co., Ky.	650	1994

In translating TVA's experience into a predictive model for SRC-I, a number of highly important variables which influence the relocation behavior of construction workers were incorporated.[41] These include: (1) travel time to the construction site; (2) size of the resident construction labor force; (3) size of the area population; (4) contemporary unemployment rates; and (5) the size of project construction labor force at peak project employment. All of these factors are combined to produce construction work force relocation estimates for the SRC-I project (Table 4.27). These estimates do not, however, take into account the effects of two potentially significant factors that may affect the relocation and/or commuting behavior of SRC-I construction employees: (1) the traffic problems attendant to commuting to the plant site (Sect. 3.2.4.5 and transportation subsection), and (2) the cumulative effects of multiple synthetic fuel facilities and electric generating plants in the SRC-I region (Sect. 4.2.5).

With a peak construction labor force of 3500, about 72% of this number (2512 workers) is expected to be local commuters, that is, prior area residents who travel to the site on a daily basis from the 21 counties surrounding SRC-I (Table 4.27). Some 205 workers (5.9%) already living in the 21-county region are expected to seek residential accommodations in the immediate area of the plant, and 632 workers (18.1%) are expected to move into the area from outside the region either permanently (movers) or on a weekday basis (travelers). The last two groups (local movers/travelers and distance movers/travelers), combined and termed in-movers, total some 837 workers, or 24% of the SRC-I construction labor force. While all these workers will change their place of residence as a result of employment at the SRC-I project, only the 632 distance movers/travelers represent an actual net increase to the population of the 21-county commuting zone. Three counties — Henderson and Daviess in Kentucky, and Vanderburgh in Indiana — account for 57% of all in-movers (474 workers). Of those, Daviess County, Kentucky, containing the city of Owensboro, is expected to absorb the largest number of in-migrants, accounting for some 250 in-migrating SRC-I employees.

Comparable figures for the 5000 peak employment case are also shown in Table 4.27. The number of in-movers has been adjusted upward from those actually predicted by the TVA model because the model's predictions were based on past experience with construction projects located within commuting distance of a large metropolitan area, resulting in a larger indigenous work force than is the case here. About 61% (3065) of peak construction man-power is expected to be local commuters. Some 454 workers (9%) already living in the region are expected to seek accommodations close to the site, and 1302 workers (26%) are expected to move into the area from outside the region. The expected number of in-movers totals 1756, or about 35% of the total SRC-I

Table 4.27. Projected number and distribution of construction workers, SRC-I demonstration peak employment, 1983

County/state	Peak work force of 3500						Peak work force of 5000					
	Local commuters[a]	Local movers/ weekend travelers[b]	Distance commuters[c]	Distance movers/ weekend travelers[d]	Total	Total as percentage of all construction workers	Local commuters[a]	Local movers/ weekend travelers[b]	Distance commuters[c]	Distance movers/ weekend travelers[d]	Total	Total as percentage of all construction workers
Breckenridge, Ky.	19	3		4	26	1%	24	6		8	38	1%
Butler, Ky.	17	2		4	23	1%	20	5		8	33	1%
Daviess, Ky.	803	46		205	1054	30%	986	100		423	1509	30%
Hancock, Ky.	73	8		19	100	3%	90	18		38	146	3%
Henderson, Ky.	170	18		78	266	8%	191	37		161	389	8%
Hopkins, Ky.	55	5		11	71	2%	67	12		23	102	2%
McLean, Ky.	38	8		15	61	2%	146	17		30	93	2%
Muhlenberg, Ky.	50	5		11	66	2%	61	12		23	96	2%
Ohio, Ky.	30	5		7	42	1%	38	11		15	64	1%
Union, Ky.	22	7		11	40	1%	26	15		23	64	1%
Webster, Ky.	53	6		15	74	2%	61	14		30	105	2%
Dubois, Ind.	55	4		11	70	2%	72	11		23	106	2%
Gibson, Ind.	44	5		11	60	2%	53	12		23	88	2%
Perry, Ind.	64	4		11	79	2%	86	9		23	118	2%
Pike, Ind.	21	3		7	31	1%	26	8		15	49	1%
Posey, Ind.	73	9		19	101	3%	88	20		38	146	3%
Spencer, Ind.	122	13		37	172	5%	160	29		76	265	5%
Vanderburgh, Ind.	511	22		105	638	18%	610	46		215	871	17%
Warrick, Ind.	81	8		22	111	3%	104	18		46	168	3%
Gallatin, Ill.	31	4		7	42	1%	36	6		15	57	1%
White, Ill.	25	2		4	31	1%	30	5		8	43	1%
Other	155	18	148	18	209	6%	190	43	186	37	456	9%
Total	2512 (71.8%)	205 (5.9%)	148 (4.2%)	632 (18.1%)	3497 (99.9%)[e]	97%[e]	3065 (61.3%)	454 (9.0%)	186 (3.7%)	1302 (26.0%)	5007 (100%)[f]	99%[f]

[a] Local commuters are residents of county prior to SRC-I employment who drive to and from the project daily.

[b] Local movers/weekend travelers are prior residents of the 21-county area who move from one county within the impact region to another as a result of employment at SRC-I. Movers will change their residence permanently while weekend travelers maintain their original permanent address and travel home on weekends or less frequently.

[c] Distance commuters travel to and from work at SRC-I on a daily basis from outside the 70-mile zone.

[d] Distance movers/weekend travelers relocate in the vicinity of the SRC-I site from outside the 21-county area. Movers will change their residence permanently while weekend travelers maintain a permanent address outside the area and travel home on weekends or less frequently.

[e] Total differs from 3500 and/or 100% due to rounding error.

[f] Total differs from 5000 and/or 100% due to rounding error.

construction labor force requirement. The three-county impact area (Henderson and Daviess in Kentucky, and Vanderburgh in Indiana) accounts for almost 1000 (56%) of all in-movers (Table 4.28). Again, Daviess County, Kentucky, is expected to experience the largest single share of this in-migration, absorbing some 520 employees.

Table 4.28. Distribution of direct workers for four major impact counties
SRC-I demonstration peak employment, 1983

County, state	Peak work force of 3500				Total as percentage of all direct employment	Peak work force of 5000				Total as percentage of all direct employment
	Local commuters[a]	Local movers/ travelers[a]	Distance movers/ travelers[a]	Total[a]		Local commuters[a]	Local movers/ travelers[a]	Distance movers/ travelers[a]	Total[a]	
Daviess, Ky.	800	50	210	1050	30.0	990	100	420	1510	30.0
Vanderburgh, Ind.	510	20	110	640	18.0	610	50	220	870	17.5
Henderson, Ky.	170	20	80	270	7.5	190	40	160	390	7.7
Spencer, Ind.	120	10	40	170	5.0	160	30	80	270	5.3
Total	1600	100	440	2130	60.5	1950	220	880	3040	60.5

[a]Numbers rounded to nearest zero.

It is not possible to estimate the extent to which the behavior of in-migrating construction workers will be consistent with or will diverge from the dominant behavioral patterns of current residents of the tri-county impact area. To the extent that a substantial majority (67%) of the peak construction work force is expected to bring families with them, behavioral patterns should be compatible.

Indirect employment. At peak construction employment, the creation of about 2300 to 3400 additional indirect jobs is expected to result from the direct employment of the 3500 to 5000 construction workers at the SRC-I project site. The distribution of these indirect jobs among the counties of the SRC-I region (Table 4.29) makes allowance for both the type (mover/traveler, commuter) and number of employees expected in each county. Indirect job estimates are derived from the RIMS multipliers that were presented in the baseline environmental section (Table 3.17). Indirect employment at peak construction may be somewhat larger if there is a significant amount of local purchase of construction materials and plant equipment.

Impacts on nearby small communities

As mentioned in Sect. 3.2.4.1, there are a number of small unincorporated communities near the SRC-I site, including Newman, Stanley, Reed, Spottsville/Beals, Carlinburg, Baskett, and Birk City, which are served by U.S. 60. This highway will be the primary transportation route for the SRC-I construction work force. Construction of SRC-I will likely be a major disruption in the lives of these community residents unless appropriate mitigating measures are implemented. The major disruption will be traffic problems related to the commuting by SRC-I construction workers to the site (see Transportation subsection). At various hours of the day, it will be quite difficult for these residents to travel to and from their homes in a reasonable time period. The few retail establishments serving these communities and travelers along U.S. 60 may also be adversely affected by SRC-I-related traffic problems, but the retail establishments may also enjoy increased business. The existing view shed of residents of these communities may also be altered, not only by the presence of construction activities but also by SRC-I-induced mobile-home development that could develop near the site. Finally, school bus transportation of these communities' school children will also be adversely affected by traffic problems because there are numerous school bus stops along U.S. 60 (see Transportation subsection). Because of the unavailability of data, it is impossible to quantify impacts associated with the construction of SRC-I on these small communities. Traffic mitigation measures described in Sect. 4.6.2.2 should reduce the impacts on these small communities considerably. In addition to traffic-related impacts to the communities adjacent to U.S. 60, some increased population growth could be induced in those rural areas outside of the Evansville and Owensboro SMSAs because of the less stringent land-use controls in effect there. Finally, there will be a significant impact to the the 24 families currently residing on the project site who will have to relocate as a result of this project.

Table 4.29. Projected indirect employment and immigration at peak of SRC-I demonstration-phase construction, 1983

County, state	Direct work force of 3500		Direct work force of 5000	
	Indirect employment[a]	In-moving indirect workers	Indirect employment[a]	In-moving indirect workers
Breckenridge, Ky.	20	2	30	3
Butler, Ky.	20	2	20	2
Daviess, Ky.	790	79	1130	113
Hancock, Ky.	30	3	40	4
Henderson, Ky.	180	18	270	27
Hopkins, Ky.	60	6	80	8
McLean, Ky.	40	4	60	6
Muhlenberg, Ky.	30	3	40	4
Ohio, Ky.	20	2	30	3
Union, Ky.	20	2	20	2
Webster, Ky.	30	3	50	5
Dubois, Ind.	50	5	80	8
Gibson, Ind.	50	5	70	7
Perry, Ind.	50	5	70	7
Pike, Ind.	20	2	40	4
Posey, Ind.	60	6	80	8
Spencer, Ind.	70	7	110	11
Vanderburgh, Ind.	520	52	700	70
Warrick, Ind.	40	4	60	6
Gallatin, Ill.	20	2	30	3
White, Ill.	30	3	40	4
Other	140	14	320	32
Total	2290	229	3370	337

[a]Numbers rounded to nearest zero.

Demographics

The relatively brief duration of the construction phase of the project can be expected to stimulate daily commuting and weekly traveling (part-time movers) and could lead to a minimum of permanent movers. This is especially true for construction craftsmen who are on the payroll only part of the construction period. On the other hand, if the availability of fuel for commuting and traveling becomes increasingly problematic, more workers may find it desirable to relocate permanently to the local area either full-time (as movers) or part-time (as travelers) and travel home less frequently.

When the factors of labor availability, site accessibility, and job-worker characteristics are considered jointly for peak construction activity, patterns of migration can be estimated. The results of this examination are presented in Table 4.30.

Worker in-migration is anticipated to be generated not only from direct SRC-I employment but also from indirect employment. Because experience shows that indirect employment can be met largely by otherwise unemployed area residents, new labor-force entrants, or dependents of in-migrating construction employees, it is assumed that only 10% of secondary jobs are to be filled by in-migrants who specifically move to the area for these secondary job opportunities (Table 4.29).

To determine change in population, it is necessary to utilize an employment-population ratio to adjust for those workers who in-migrate with their families. A series of recent studies of the TVA's nuclear power plant construction program indicates that about 67% of in-migrants brought families and that the average construction-worker family size was 3.2. Because of TVA's geographic proximity and recent experience, these factors were used to estimate SRC-I area population growth for the peak construction period. Estimated total population in-migration resulting from primary and secondary employment expansion is shown in Table 4.30 and is equal to about 2000 new residents with a peak direct work force of 3500 and 3800 new residents with a peak of

Table 4.30. Projected total in-migration[a] at peak of SRC-I demonstration phase construction, 1983

County, state	Peak construction work force of 3500				Peak construction work force of 5000			
	Total in-migration[a]			School-age children	Total in-migration[a]			School-age children
	Local movers/ travellers[b]	Local movers/ travellers	Total		Local movers/ travellers[b]	Local movers/ travellers	Total	
Breckenridge, Ky.	9	13	22	5	17	25	42	9
Butler, Ky.	7	13	20	4	14	22	36	8
Daviess, Ky.	149	666	815	171	301	1270	1571	330
Hancock, Ky.	22	52	74	16	46	101	147	31
Henderson, Ky.	51	230	281	59	103	452	555	117
Hopkins, Ky.	17	38	55	12	37	69	106	22
McLean, Ky.	22	45	67	14	47	84	131	28
Muhlenberg, Ky.	14	33	47	10	32	64	96	20
Ohio, Ky.	14	21	35	7	29	42	71	15
Union, Ky.	19	30	49	10	39	59	98	21
Webster, Ky.	17	32	49	10	40	81	121	25
Dubois, Ind.	12	37	49	10	34	69	103	22
Gibson, Ind.	14	37	51	11	35	69	104	22
Perry, Ind.	12	37	49	10	27	69	96	20
Pike, Ind.	9	19	28	6	22	44	66	14
Posey, Ind.	27	57	84	18	56	106	162	34
Spencer, Ind.	37	103	140	29	79	208	287	60
Vanderburgh, Ind.	76	365	441	93	144	674	818	172
Warrick, Ind.	22	61	83	17	49	124	173	36
Gallatin, Ill.	12	19	31	7	17	42	59	12
White, Ill.	7	15	22	5	17	25	42	8
Other	61	61	122	26	148	128	276	58
Total	630	1984	*c*	*d*	1333	3827	*c*	*d*

[a]Total in-migration consists of direct and indirect inmoving workers and their dependents; it is assumed that 2/3 of all inmoving workers bring families with an average size of 3.2.

[b]Direct and indirect inmovers are assumed to have the same ratio of distance movers/travellers to local movers/travellers.

[c]Local and distance movers/travellers cannot be combined to get total in-migration for the region as a whole because local movers are already residents of the 21-county area.

[d]School-age children accompanying local and distance movers/travellers cannot be combined to get the net increase for the region as a whole because the children of local movers are already residents of the 21-county area.

5000. Compared to 1985 population projections (Table 3.14), the estimated project-induced in-migration into the three-county area (Daviess, Henderson, and Vanderburgh) of approximately 1500 persons at the low end of the range and 2900 at the high end is less than or equal to 1% of the total population. These in-mover numbers represent the total of both distance *and* local movers/travelers to the tri-county area, on the assumption that most of these local movers will come from those counties farther away from the site and will not be prior residents of the three counties immediately surrounding the plant. The 1% increase to 1985 population engendered in the worst case is far below the threshold (annual 8-10%) at which extraordinarily disruptive in-migration has been experienced.[42] However, if other synfuels plants and fossil-fuel power plants are constructed during the same time frame as SRC-I construction, population increases in SRC-I's local and regional impact areas would likely be substantial and disruptive (Sect. 4.2.5).

Income. Estimates of construction-phase payrolls received by workers residing in the 116-km (70-mile) zone total over $110 million, with a peak work force of 3500 during the 12 months surrounding the construction peak. Respending of this primary payroll income is estimated in Table 4.31 and totals approximately $100 million to $140 million in induced local incomes. The major portion (67%) is anticipated to be respent in the three-county area of Daviess, Henderson, and Vanderburgh. These estimates of local-induced spending take into consideration the number and type of employees in each county, allow for leakages of income to sources outside the local area (e.g., Federal income tax), and applies the multipliers displayed in Table 3.17. Of course, if other nearby large construction projects are built concurrently with SRC-I, substantially greater amounts would be generated by these activities (Sect. 4.2.5).

Table 4.31. Incomes induced by SRC-I direct construction employment during twelve months surrounding 1983 construction peak

Region	Area	Total incomes generated by peak construction work force of 3500 (1000 1980 dollars)	Total incomes generated by peak construction work force of 5000 (1000 1980 dollars)
1	Daviess, Ky.	34,300	49,000
2	Hancock, Ky.	1,900	2,800
3	Henderson, Ky.	7,800	11,400
4	McLean, Ky.	1,400	2,100
5	Muhlenberg, Ky.	1,800	2,600
6	Ohio, Ky.	1,000	1,500
7	Union, Ky.	900	1,500
8	Webster, Ky.	1,900	2,600
9	Perry, Ind.	2,200	3,300
10	Posey, Ind.	2,800	4,100
11	Spencer, Ind.	4,600	7,100
12	Vanderburgh, Ind.	23,400	32,000
13	Warrick, Ind.	2,900	4,400
14	Sum of Butler, Ky. Breckenridge, Ky. Hopkins, Ky. Dubois, Ind. Pike, Ind. Gibson, Ind. White, Ill. Gallatin, Ill.	11,600	16,900
15	Regions 1–13	86,900	124,400
	Total (Regions 1–14)	98,500	141,300

Impact on prices

The 1% or less (1500-2900 persons) temporary increase in population in the three-county area of Daviess, Henderson, and Vanderburgh, and the addition of approximately 2000 to 3800 persons to all 21 counties should not cause prices of goods and services to rise beyond normal inflation. The prices for goods such as food, clothing, and automobiles which construction workers buy are established in much wider regional markets. Utility rates are rising and will continue to rise, but this increase is not a result of the SRC-I project. It is not anticipated that either the elderly or low-income groups will experience adverse economic impacts because of the construction of SRC-I. This conclusion may not apply with respect to the price of housing if project-related housing demand substantially reduces available supply, particularly with respect to the rental sector. If much greater numbers of workers in-migrate to work on other proposed synfuels facilities, some adverse impacts on the prices of good and services produced in the SRC-I region could also occur (Sect. 4.2.5).

Housing

Demands for housing attributable to SRC-I-induced direct and indirect population in-migrants will occur at peak levels in mid-1983. Because it is expected that the Henderson-Daviess-Vanderburgh tricounty area will experience the largest share of the housing demands, the analysis focuses primarily upon this area. Each of the remaining 18 counties constituting the region will also experience project-related housing demands, but to a much lesses extent. Table 4.32 presents SRC-I-induced housing demands for all counties in the region. As indicated, the Henderson-Daviess-Vanderburgh tri-county area is anticipated to experience a total demand for, roughly, 620 to 1200 housing units in 1982. Although it is not anticipated that SRC-I-induced housing demand will seriously affect overall housing availability in the three-county region (see below), the project may induce some shortages in the availability of apartment housing. The project sponsors will monitor the housing situation so that appropriate mitigation measures can be implemented if necessary (see Sect. 4.5).

Table 4.32. Housing requirements of SRC-I induced in-migrants (direct and indirect), peak construction year (1983)

County/state	Peak construction work force of 3500				Peak construction work force of 5000			
	Total housing units required	Single-family residences	Mobile homes	Other types of housing[a]	Total housing units required	Single-family residences	Mobile homes	Other types of housing[a]
Breckenridge, Ky.	9	5	2	2	17	9	4	4
Butler, Ky.	8	4	2	2	15	7	4	4
Daviess, Ky.	330	166	80	84	636	320	155	162
Hancock, Ky.	30	15	7	8	60	30	15	15
Henderson, Ky.	114	57	28	29	225	113	55	57
Hopkins, Ky.	22	11	5	6	43	22	10	11
McLean, Ky.	27	13	7	7	53	27	13	13
Muhlenberg, Ky.	19	9	5	5	39	20	9	10
Ohio, Ky.	14	7	3	4	29	15	7	7
Union, Ky.	20	10	5	5	40	20	10	10
Webster, Ky.	20	10	5	5	49	25	12	12
Dubois, Ind.	20	10	5	5	42	21	10	10
Gibson, Ind.	21	11	5	5	42	21	10	10
Perry, Ind.	20	10	5	5	39	20	9	10
Pike, Ind.	11	6	5	5	27	14	6	7
Posey, Ind.	34	17	8	9	66	33	16	17
Spencer, Ind.	57	29	14	14	116	58	28	30
Vanderburgh, Ind.	179	90	44	45	331	167	80	84
Warrick, Ind.	34	17	8	9	70	35	17	18
Gallatin, Ill.	13	7	3	3	24	12	6	6
White, Ill.	9	5	2	2	17	9	4	4

[a] Apartments, sleeping rooms, hotels/motels, and trailers.

Henderson County is expected to receive from 110 to 230 new households in 1982, 85-90% of which are directly attributable to SRC-I construction, with the remainder resulting from in-migration generated by indirect employment opportunities. Of the new households anticipated during that year, about half are expected to seek single-family residences, while the remainder will seek about equally either mobile homes or other accommodations such as apartments, trailers, hotel/motel rooms, or sleeping rooms. It can be expected that households with families will prefer single-family residences, while single in-migrants will seek other forms of housing. This pattern was typical of in-migrants associated with construction of large projects (1000 construction workers) in the TVA region from 1976 to 1979, and will likely occur similarly within the SRC-I study region. Approximately 750 housing units have been identified as available for occupancy in Henderson County in 1980 (Sect. 3.2.4.3). When considering low rates of population growth and likely construction of additional housing between the period 1980 and 1982, it is expected that the effects of housing demands attributable solely to SRC-I upon Henderson County will be small.

Of those counties in the tri-county area, Daviess County is anticipated to receive the largest number of households generated by SRC-I in 1983. From 330 to 640 housing units are expected to be required, of which 170 to 320 are expected to be single-family residences; 80 to 160, mobile homes; and 80 to 160, other housing types. However, it is estimated that in excess of 1000 dwelling units are currently available in Daviess County. Because the county is expected to experience low rates of population growth subsequent to 1980 under normal growth conditions, and assuming continued housing construction, it is not likely that impacts upon housing availability solely attributable to SRC-I will be large.

Vanderburgh County is also not expected to experience housing demands attributable to SRC-I which would stress housing availability. In 1983, it is estimated that the county will receive a demand for roughly 180 to 330 housing units as a result of the project. The higher figure represents less than 15% of the units identified as currently available. Although certain portions of the county are experiencing rapid growth, particularly on the periphery of Evansville, the overall growth rate for the county was only 0.5% between 1975 and 1980, and the county population is projected to decline through the end of the century (Table 3.14). Additionally, housing construction in the county has kept pace with demand. As a result, SRC-I-related demands for housing are considered minor.

Although the regional housing supply appears adequate to accommodate SRC-I-related demands alone, implementation of other large-scale construction projects in the area may create competition for available housing. For information regarding the potential of such cumulative demands, see Sect. 4.2.5.

Public services

Schools. The effects of SRC-I upon educational facilities in Daviess, Henderson, and Vanderburgh counties are expected to be small. With the exception of the Owensboro Diocese school system, all other school systems in the tri-county area have been experiencing rapid enrollment declines in recent years. As a result, the overall excess capacity for the tri-county area is estimated at approximately 20%. The range of excess capacities between different school systems occurring in the area is between 39 and 12% (Table 3.21).

Daviess County is expected to receive from 170 to 330 enrollments as a result of SRC-I-related population in-migration. The estimated excess capacity of the Daviess County School District of 12% indicates room to accommodate approximately 1200 additional enrollments. The Owensboro Independent School System, with an excess capacity for 3350 students, also indicates ample room for enrollment increases. These excess capacities are unlikely to decrease by 1982, resulting in a more than adequate capability on the part of the school districts to accommodate SRC-I-related demands.

The Henderson County School District, which already has an excess enrollment capacity of approximately 14% (1300 students) in 1980, has new facilities in the planning stages in anticipation of in-migration caused by job opportunities in the area. Because SRC-I is expected to generate, roughly, 60 to 120 students in 1983, no problems are anticipated.

The Evansville-Vanderburgh School Corporation, which serves all of Vanderburgh County, is expected to receive from 90 to 170 additional students associated with SRC-I-related in-migration. The school system, which has been experiencing substantial enrollment decreases in recent years, possesses an excess enrollment capacity of approximately 17% or room for more than 5000 additional students. At the high end of the range, SRC-I enrollments would utilize less than 4% of the available excess capacity; therefore, impacts are considered to be negligible.

Although there is considerable excess school capacity in the tri-county area to accommodate potential SRC-I demands, implementation of other large-scale construction projects in the area may create competition for available classroom space. For information regarding the potential of such cumulative demands, see Sect. 4.2.5.

Law enforcement and fire protection. The effects of SRC-I upon the Henderson-Daviess-Vanderburgh tri-county law enforcement and fire protection resources in 1983 are primarily determined by (1) the extent of population in-migration into area communities and (2) the extent to which law enforcement and fire protection will be provided at the construction site.

Henderson County is expected to receive from 280 to 560 new residents as a result of SRC-I construction in 1983. It is likely that a large proportion of these in-migrants will reside in the city of Henderson, which had a 1979 officer-per-1000-population ratio of approximately 1.5. As a result, at least one additional policeman would be required in the community if current levels of service are to be adequately maintained. Because traffic volumes associated with SRC-I construction activities are anticipated to increase greatly (see Transportation subsection), it is possible that patrols along U.S. 60 between Henderson and Owensboro may be increased, resulting in the need for additional support from the Henderson County Sheriff's office or the Kentucky State Police.

Daviess County is expected to receive from 820 to 1570 SRC-I induced in-migrants in 1983, a large proportion of whom will likely reside in Owensboro. Based on a 1979 officer-to-1000-population ratio of approximately 1.6, it is estimated that as many as three additional policemen could be required in Owensboro if current levels of service are to be adequately maintained. As was the case in Henderson County, additional support from the Daviess County Sheriff's office or the Kentucky State Police may be required to adequately monitor the high level of traffic volumes projected to occur as a result of SRC-I construction.

It is estimated that two additional law enforcement personnel may be required in Evansville (Vanderburgh County) in order to adequately service the 440 to 820 in-migrants expected to

reside in the area as a result of SRC-I construction. This number is based upon the city's 1980 officer-per-1000-population ratio of approximately 1.9.

Estimates of the number of additional firefighters who would be required to accommodate SRC-I-induced in-migrants are accomplished in the same manner as those utilized for law enforcement personnel — according to the current level of service as expressed in the number of fire fighters per 1000 population. The cities of Owensboro, Henderson, and Evansville, which all have full-time municipal fire departments, maintained respective ratios of 1.8, 2.0, and 2.0 in 1980. As a result, Owensboro could require 2 to 3 additional fire fighters to accommodate the 820 to 1570 in-migrants expected in the area, while Henderson would require the addition of only one. Evansville could require two additional fire fighters to provide adequate services for the 440 to 820 new residents expected to reside in the area as a result of SRC-I construction during 1983.

The proposed SRC-I site falls under the jurisdiction of the Daviess County Fire Department. However, it is assumed that provisions for fire protection will be provided on site and that utilization of offsite fire-fighting resources would be confined to major emergencies. The fire department in Owensboro, however, is involved in the provision of emergency medical services. Potential effects upon emergency medical services delivery systems are described in the Health Care subsection.

Although requirements for additional law enforcement and fire-fighting personnel by SRC-I in-migrants are minor, concurrent implementation of other large-scale construction projects in the area may serve to generate substantial needs for these types of services. For information regarding the potential of such cumulative demands, see Sect. 4.2.5.

Health care. Health services provided for the Henderson-Daviess-Vanderburgh tri-county residents are considered to be of adequate to very good quality as indicated by service standard ratios for doctors and hospital beds provided (see Sect. 3.2.4.5). Population in-migration associated with SRC-I during the peak year (1983) is not estimated to require additional health personnel or facilities. Although the ratios of hospital beds per 1000 population in all three counties imply that several additional beds may be required, these beds actually may not be necessary because the utilization rate of existing beds falls between 75 and 90%. Therefore, adding additional beds may decrease utilization ratios, a situation that would be contrary to Federal guidelines that encourage 80% utilization as a minimum effective operational standard.

It is expected that the emergency medical services units (Emergency Medical Subsystems) operating in Henderson and Daviess counties may require additional personnel and one additional ambulance in order to respond adequately to medical emergencies that may occur at the proposed site and along U.S. 60, where traffic associated with SRC-I construction is anticipated to be substantial (see Transportation subsection). Emergency medical service coverage is determined to be good up to a distance of 32 km (20 miles) away from Owensboro and Henderson. Within this distance, there is a 99% probability that response times of ambulance units to the scene of a medical emergency would be of acceptable duration. Although the proposed site is located within 16 km (10 miles) of Owensboro, it is possible that the potential increase for traffic mishaps along U.S. 60 may result in service delays to both residents along this highway and to the proposed site in the event of a simultaneous emergency on the site. Coordination between providers of local emergency medical services and SRC-I principals will be encouraged in order to develop strategies aimed at minimizing potential response delays.

Water. Effects upon water supplies in the cities of Owensboro, Henderson, and Evansville resulting from demands of increased populations generated by SRC-I construction during peak year 1983 are anticipated to be small. Table 4.33 presents (1) the extent of population in-migration estimated to occur in each city, (2) the volume of water they may require daily, and (3) the percent of excess water supply capacity available in each city that these in-migrants would utilize.

It is estimated that the 820 to 1570 SRC-I-induced in-migrants expected to reside in or near Owensboro during 1983 will require from 0.60 million liters/d (0.16 mgd) to 1.15 million liters/d (0.30 mgd), or as much as 3.2% of the available excess capacity in 1979. Henderson is estimated to experience an influx of from 280 to 560 SRC-I-related residents. These in-migrants are estimated to require from 0.27 to 0.53 million liters/d (0.07 to 0.14 mgd), or 6.9 to 13.6% of the excess capacity available during 1979. In Evansville, less than 1% of the available excess capacity is anticipated to be utilized by the 440 to 820 in-migrants estimated to reside in the city during 1983. These in-migrants are anticipated to require from 0.28 to 0.52 million

Table 4.33. Water and wastewater treatment requirements as a result of project-induced population growth in Owensboro, Henderson, and Evansville, peak construction year (1983)

City	Projected number of In-migrants[a]	Peak construction work force of 3500				Peak construction work force of 5000			
		Water supply		Wastewater treatment		Water supply		Wastewater treatment	
		Water required[b] (MLD/MGD)[c]	Percentage of available excess capacity utilized	Volume of wastewater generated[d] (MLD/MGD)[c]	Percentage of available excess capacity utilized	Water required[b] (MLD/MGD)[c]	Percentage of available excess capacity utilized	Volume of wastewater generated[d] (MLD/MGD)[c]	Percentage of available excess capacity utilized
Owensboro	820–1570	0.60/0.16	1.7	0.43/0.11	2.6	1.15/0.30	3.2	0.83/0.22	4.9
Henderson	280–560	0.27/0.07	6.9	0.12/0.03	0.7	0.53/0.14	13.6	0.25/0.07	1.5
Evansville	440–820	0.28/0.07	0.2	0.24/0.06	0.3	0.52/0.14	0.3	0.44/0.12	0.5

[a] Based on range of 3500 to 5000 direct construction workers at peak and assuming (as a worst case) that all in-migrants to county will require city sewerage and water services.

[b] Estimated using historical per capita rates of daily consumption: Owensboro, 730 LD/person (193 GD/person); Henderson, 953 LD/person (252 GD/person); and Evansville, 638 LD/person (170 GD/person).

[c] MLD = million liters per day; MGD = million gallons per day.

[d] Estimated utilizing historical per capita rates of wastewater generated daily: Owensboro, 527 LD/person (139 GD/person); Henderson, 442 LD/person (117 GD/person); and Evansville, 539 LD/person (143 GD/person).

liters/d (0.07 to 0.14 mgd). These figures were derived utilizing historical per capita water requirements particular to each urban area. Because per capita figures include water consumed by the residential (domestic), commercial, and industrial sectors, the estimates presented here assume a proportional increase in commercial and industrial consumption to that which would be generated by SRC-I-induced in-migrants in the residential (domestic) sector. Should such a proportional increase in demand not occur, then the estimates presented herein should be considered high since even less utilization of available excess capacities than indicated will result. Water consumption associated with construction activities and subsequent operation of the proposed SRC-I facility is described in Sect. 4.2.2.1.

Although there is considerable excess water supply capacity in the tri-county area with which to accommodate SRC-I-induced population demands, implementation of other large-scale construction projects in the area may create competition for urban water supplies. For information regarding the potential of such cumulative demands, see Sect. 4.2.5.

Wastewater treatment. Table 4.33 also presents estimates of in-migrants' daily demands on municipal wastewater treatment facilities in Owensboro, Henderson, and Evansville and the percent of excess wastewater treatment capacity available in each city that these in-migrants are projected to utilize. As indicated, effects upon excess wastewater treatment capacity resulting from SRC-I-induced population demands are small.

The 820 to 1570 SRC-I-induced residents in Owensboro in 1983 would result in a contribution to the wastewater treatment facility of approximately 0.43 to 0.83 million liters/d (0.11 to 0.22 mgd) and utilize from 2.6 to 4.9% of the available excess capacity. In Henderson, the 280 to 560 in-migrants forecast for the area may generate 0.12 to 0.25 million liters/d (0.03 to 0.07 mgd), which would account for utilization of 0.7 to 1.5% of the available excess capacity. Less than 1% of the available excess wastewater treatment capacity in Evansville is estimated to be utilized by the 440-820 SRC-I-induced in-migrants expected to reside in the area. These individuals are expected to generate 0.24 to 0.44 million liters (0.06 to 0.12 mgd) of wastewater daily. As was the case with water, these figures were derived utilizing historical per capita wastewater contribution data particular to each urban area. Because per capita figures also include commercial and industrial contributions, the estimates here assume a proportional increase in commercial and industrial wastewater generation to that which would be generated by SRC-I-induced in-migrants in the residential sector. In the event such a proportional increase in demand should not occur, then the estimates presented herein should be considered high and will result in even less utilization of available excess capacities than indicated.

Although there is considerable excess wastewater treatment capacity available in these three cities with which to accommodate SRC-I-induced population demands, implementation of other large-scale construction projects in the area may create competition for the availability of excess wastewater treatment capacity. For information regarding the potential of such cumulative demand, see Sect. 4.2.5.

Public finance: general revenues. It is believed that direct fiscal impacts upon public finance in the SRC-I study region will be slight. The demonstration facility will not pay property taxes because it will be under Federal ownership. Removal of the proposed site from the local tax base will remove approximately $4200 per year in property taxes from the relevant taxing jurisdictions. Indirect effects upon finance are anticipated to be more significant, primarily in the area of tax revenues.

Project payrolls will be affected by both Federal and state income taxes. Assuming an average length of employment of one year and an average construction wage of $11.75/h, the gross annual income of these employees is estimated at $24,440 per worker. Assuming an annual average Federal income tax rate of 20% per worker, approximately $4900 in Federal income taxes will be gained from each worker. Assessed against the total gross construction wages of $160 million, this rate will yield Federal revenues of approximately $32 million, assuming a peak work force of 3500. The revenues should increase proportionately in the worst-case analysis.

Both Kentucky and Indiana have personal income taxes. In Kentucky, the rate is graduated and subject to numerous variables. In Indiana, there is a flat rate of 2%. For every Kentucky resident employed at the site and earning an average annual wage of $24,440, it is projected that annual State income taxes will amount to approximately $880 per worker with standard deductions. Indiana residents employed on the SRC-I project would contribute about $490 per worker to the State of Indiana. While the State of Kentucky does have a 5% sales tax, all revenues will go to the State, with no formal mechanism for the return of revenues to the locales in which they were collected.

The only local tax revenues expected to be affected as a result of SRC-I facility construction will be the property tax. Table 4.34 presents these tax revenues for affected Kentucky and Indiana counties. Property tax revenues are anticipated to affect only marginally the revenue structure of the impact region. Henderson and Daviess counties in Kentucky are projected to receive total property tax revenues of up to $18,400 and $42,000 respectively. Property tax revenues are calculated from the 1979 county tax rates (Tables 3.23 and 3.24), assuming a $32,000 average sale price of a new home[43] and assuming that only those movers with families (two-thirds of total) will purchase a house. These figures would be low in the sense that even renters indirectly pay property taxes. Because of higher tax rates and a different distribution of revenues to the county and school districts, property tax revenues in the Indiana region are significantly higher. It is expected that the Indiana impact area would collect over 60% of the total property tax revenues indirectly attributable to SRC-I. It must be noted that the property tax revenues shown in Table 4.34, while attributable to SRC-I employment, do not necessarily represent a net increase to current revenues. Only that portion of these taxes paid on newly constructed dwelling units are actually new revenues for the tri-county area.

Table 4.34. Projected property tax revenues for each jurisdiction within SRC-I impact area, peak construction year (1983)

County, state	Peak construction work force of 3500			Peak construction work force of 5000		
	County	School district	Total[a]	County	School district	Total[a]
Daviess, Ky.[b]	3,400	5,800	21,800	6,500	11,100	42,000
Henderson, Ky.[c]	1,200	3,400	9,300	2,400	6,700	18,400
Vanderburgh, Ind.	25,500	10,600	36,100	47,400	19,700	67,100
Other counties, Ky.[d]	2,100	2,400	11,700	4,300	4,800	23,900
Other counties, Ind.[e]	23,100	14,300	37,400	47,200	29,200	76,400
Total	53,300	36,500	116,300	107,800	71,500	227,800

[a] Total property tax revenues in Kentucky counties are greater than the county and school district sum because of state and miscellaneous contributions.

[b] Property tax revenues would be an additional $11,000 to 21,000 if all in-migration were in city of Owensboro.

[c] Property tax revenues would be an additional $4,600 to 4,200 if all in-migration were in city of Henderson.

[d] Other Kentucky counties are Hancock, Ohio, McLean, Webster, Union, Muhlenberg, Butler, Breckenridge, and Hopkins.

[e] Other Indiana counties are Posey, Pike, Perry, Warmick, Spencer, Dubois, and Gibson.

Other tax revenues such as business license fees, fines and fees, service charges, and state and Federal intergovernmental transfers would be available and are likely to provide moderate amounts of revenue to the county areas.

Public finance: education. The increase in pupil enrollments during the construction phase of the SRC-I demonstration facility will be concentrated largely in the bi-county area of Henderson and Daviess counties and the metropolitan region of Vanderburgh County. Table 4.30 presents the SRC-I-induced pupil enrollments expected for the entire 21-county region. As discussed earlier in this section, the school systems in the region appear to be capable of accommodating the additional enrollments. Any resource shortfalls occasioned by the construction of SRC-I should be adequately covered by monies collected from school district property tax revenues, as just discussed, and from state educational support programs as indicated in Table 4.35 (see Sect. 3.2.4.4).

Table 4.35. Projected state revenue contribution (in $) by school district, peak construction year (1983)

School district	3500 work force revenue sources				5000 work force revenue sources			
	Foundation fund revenue, Ky.	Power equalization fund revenue, Ky.	Basic grant revenue, Ind.	ADA flat grant revenue, Ind.	Foundation fund revenue, Ky.	Power equalization fund revenue, Ky.	Basic grant revenue, Ind.	ADA flat grant revenue, Ind.
Owensboro Independent[a]	182,000	5,300			352,000	10,200		
Daviess County[b]	153,000	4,700			296,000	9,100		
Henderson County	48,000	1,900			96,000	3,800		
Evansville-Vanderburgh			72,000	3,700			133,000	6,900

[a]Maximum amount of revenue received, assuming entire projected number of Daviess county pupils enroll in Owensboro Independent School District.

[b]Maximum amount of revenue received, assuming entire projected number of Daviess county pupils enroll in Daviess County School District.

Daviess and Henderson county school districts should be eligible for additional support from the State of Kentucky through both the Foundation Program Fund and the Power Equalization Program Fund. Assuming the 1978-79 State revenue-per-pupil rate of $897 for Daviess County, $1066 for Owensboro Independent School District, and $822 for Henderson County,[44] State revenue contributions to the local school districts from the Foundation Program Fund would range from $96,000 to $352,000 during the peak year of SRC-I construction, assuming maximum in-migration. The Power Equalization Fund, based on the fair cash value of property per pupil between counties, should contribute minor amounts of revenues to the school districts. These amounts are presented in Table 4.35.

The Vanderburgh-Evansville School Corporation should likewise be eligible for support from the State of Indiana through the Basic Grant program and the ADA Flat Grant Fund. Assuming the 1978-79 State revenue-per-pupil rate of $773 for the Vanderburgh-Evansville School Corporation,[45] State revenue contributions from the Basic Grant program would be approximately $133,000 in the peak year of construction, again assuming maximum in-migration. The ADA Flat Grant is a grant of $40 per pupil, based on average daily attendance, grades 1-12, which is allocated to all public school corporations. Monies from this program may be used for the general fund, debt service, or building fund expenditures. The estimated ADA Flat Grant revenue is expected to be as much as $6900. No adverse fiscal effects are expected for the Vanderburgh-Evansville School Corporation during the construction phase of the plant.

Transportation

The major adverse socioeconomic impact of the proposed SRC-I project is expected to result from increased traffic on U.S. Highway 60 (see Fig. 3.16 for transportation routes). Peak-hour demand during the construction period will exceed the current capacity of U.S. 60 near Henderson, Kentucky. The capacity of U.S. Highway 60 will also be exceeded from Owensboro, although not to the extent as from Henderson. Two-lane highways cannot accommodate the predicted volume of traffic at reasonable levels of service. Measures to address the potential traffic problems have been studied,[46] and a number of alternative forms of mitigation have been suggested which can reduce the potentially adverse impact of increased traffic on U.S. 60.

Expected traffic demand. The construction of the proposed plant is expected to require between 3500 and 5000 workers. These workers are assumed to be drawn from a 21-county region within a 70-mile commuting distance of the plant. Data for this analysis will use 3500-worker and 5000-worker cases. Based on present demographic and employment trends, almost all of these workers are expected to travel to the construction site via U.S. 60 either through Henderson or Owensboro. Of these, 58% (2080 to 2900) are expected to travel via Owensboro, with 42% (1470 to 2100) traveling through Henderson. While not all workers can be expected to travel to the construction site alone, if the national ratio of 1.9 workers per vehicle is maintained (G. Kulp et al., *Transportation Energy Conservation Data Book, Edition 4,* ORNL-5654, Oak Ridge National Laboratory for the U.S. Department of Energy), 1842 to 2632 additional vehicles can be expected to be traveling on U.S. 60, 1068 to 1526 to be traveling via Owensboro, with the remaining 774 to 1105 to be traveling via Henderson. These additional traffic volumes can be expected to be in addition to the normal peak volumes already established on all segments of U.S. 60. On all segments between Henderson and Owensboro, the expected increase in peak traffic volumes for both the low and high peak construction worker estimates will result in total traffic volumes in excess of the maximum vehicle volumes under level of service D (minimum acceptable). Level of service E (capacity) will be exceeded on almost all segments under conditions of the low estimate and will be exceeded on all segments under the conditions of the high estimate. Definitions of level of service are shown in Table 3.26. The use of trucks for delivery of construction materials would exacerbate predicted traffic problems. The project sponsors will attempt to schedule delivery during off-peak hours or use rail or barge for delivery to lessen the impacts.

Impacts of increased traffic. The impacts of the expected increase in traffic on U.S. 60 in the construction phase of the SRC-I project are significant, particularly in the case of reduced service to vehicles now using U.S. 60. These principal impacts are summarized in the following four areas.

1. Service. Under conditions of the low (3500) peak construction worker estimate, expected traffic on every segment of U.S. 60 would be in excess of the Kentucky Department of Transportation's (KDOT's) minimum acceptable level of service (level D), as well as in excess of level of service E (capacity) on almost all segments during periods of peak use. At those times that level of service E (capacity) vehicle volumes prevail, periodic breakdown in traffic flow can be expected. The resulting traffic jams can cause average delays traffic between Owensboro and the SRC-I site could be expected to average more than 40 min. In extreme cases, traffic delays from Henderson of more than 2 h in the morning and more than 3 h in the evening could be expected; delays from Owensboro of approximately 1 h in the morning and 2 h in the evening likewise could be expected. Under conditions of the high (5000) peak construction worker estimate, these traffic conditions would be further exacerbated. The E service levels (capacity) would be exceeded on all segments. The average travel time from the facility to Owensboro at the end of the day's work would be approximately 2 h and to Henderson approximately 2.5 h. In extreme cases, traffic delays would exceed 4 h. The impacts from such traffic conditions would be excessive, and planning to prevent impacts from occurring is necessary if the plant is to be built.

2. Safety. As with any increase in traffic, a concomitant increase in accident can be expected. It is estimated that the additional traffic will cause between 36 and 50 additional accidents per year, a 44 to 61% increase.

3. Road deterioration. With increased traffic, road deterioration will be accelerated. The estimated cost for maintenance of the section of U.S. 60 under consideration is $4240 per mile or $118,700 for the entire 28-mile section.[47] Assuming that road maintenance costs are directly related to vehicle miles traveled, the low estimate for construction workers (3500) results in a 44% increase in total vehicle miles traveled on the road per year. This increase would raise annual maintenance costs by approximately $47,000. The 5000 worker estimate results in an approximate 61% increase in vehicle miles traveled per year or an annual increase of $65,450 over present costs.

4. Air and noise pollution. The expected increase in traffic can be expected to slightly decrease air quality (in terms of carbon monoxide, hydrocarbons, nitrogen oxides, sulfur oxides, and particulates, see Sect. 4.2.3.1 for details) and to increase noise pollution somewhat.[47]

Transportation alternatives. Seven general categories of mitigation alternatives were considered as possible means to lessen or eliminate the expected adverse impact associated with the construction of the SRC-I plant. These mitigation alternatives were

1. Improvements to increase the capacity of U.S. 60. These improvements centered on proposed widening of U.S. 60, principally in the Henderson area.

2. Alternative road routes. Several alternate routes both for construction workers and local residents or commuters (nonplant workers) were considered. In all cases, these alternate routes were circuitous, while the two most efficient routes entailed the construction of new interchanges and/or plant access road from the Audubon Parkway.

3. Park-and-ride, bus. This mitigation alternative involves the use of parking areas near the urban areas of Henderson and Owensboro for worker parking with subsequent transport via bus to the plant site.

4. Park-and-ride, rail. This mitigation alternative involves the use of parking areas near the urban areas of Henderson and Owensboro for worker parking, with subsequent transport via commuter trains over existing L&N Railroad tracks to the plant site.

5. Park-and-ride, dedicated rail line (Henderson-Newman). This mitigation alternative considers the construction of a new rail line exclusively to serve the needs of the SRC-I plant site but is otherwise identical to measure 4.

6. Ride sharing. These mitigation alternatives consisted of various plans to encourage, organize, and/or finance structured carpooling or vanpooling arrangements.

7. Nonstructural alternatives. These mitigation alternatives focused chiefly on the use of a staggered daily work schedule and the use of offsite component fabrication.

Improvement of U.S. 60 concept. A recent study[48] identified the 1.6 mile section of U.S. 60 from the U.S. 41 intersection to just east of the Henderson city limits as currently at capacity during peak periods and further considered widening of U.S. 60 to four lanes from U.S. 41 east to Frontier Drive (1.1 miles of the 1.6 miles) as mandatory (Sect. 3.2.4.5). Two alternative U.S. 60 improvements explored in this same report were (a) continuation of the four-lane improvement 1.4 miles from the Henderson city limit to Tillman-Bethel Road (to, but not including, the railroad overpass); or (b) continuation of the four-lane improvement 2.8 miles from the Henderson city limit to Tscharner Road including replacement of the overpass. These two alternatives were to accommodate the anticipated traffic of the proposed W. R. Grace plant at Baskett.

Estimated costs for the three alternatives for widening U.S. 60 to four lanes divided near Henderson are as follows:

	Section	Miles	Estimate KDOT[a]	TAMS[b]
1.	U.S. 60 from U.S. 41 to 0.2 miles east of the Henderson limit	1.6	$4,300,000	$3,463,000
2.	Henderson limit to Tillman Road	1.4		4,215,000[c]
3.	Henderson limit to Tscharner Road	2.8		6,282,000[c]

[a]Personal communication with James W. Fehr, Transportation Planning Engineer, KDOT, Dec. 5, 1980.

[b]From ref. 48.

[c]Includes improvement for W. R. Grace plant.

Maintenance of the four-lane highway in lieu of present two-lane is estimated to increase present costs by about 75%. Estimated typical time needed for design and construction to widen U.S. 60 to four lanes for 1.6 miles at Henderson is 41 months based on State funding only, 51 months if Federal aid is involved (J. W. Fehr, personal communication, Transportation Planning Engineer, KDOT, Dec. 8, 1980). Given a high priority by the State of Kentucky, this improvement may be possible in less than the time period given here. The additional widening to 4.4 miles would not require significant additional time if designed and constructed at the same time. Any major improvements to U.S. 60 will result in utility relocation problems that will have to be addressed at that time.

Improvement of U.S. 60 to a divided four-lane highway would provide a capacity of approximately 2500 vehicles per hour (VPH) in either direction at level of service D. This would accommodate the 1980 single-direction local traffic peaks near Henderson indicated as 752 VPH in the AM and 769 VPH in the PM and the estimated Newman plant traffic of 774 to 1105 VPH (adjusted for undirectional flow).

If U.S. 60 is improved to four lanes divided only to the Henderson city limit, local traffic peaks plus the Newman plant traffic will exceed capacity at level of service D east of the city limits. If the improvement is extended east another 1.4 miles only, local and Newman plant traffic will exceed capacity at level of service D at the bridge over the L&N tracks.

Improvement of U.S. 60 to four lanes divided for any or all of the increments (to city limits, Tillman Road, or Tscharner Road) will provide capacity for all local traffic through the year 2000 and improve safety, thereby positively affecting an existing traffic problem. The additional right-of-way needed would require 13.6 acres (if to city limit only) to 37.3 acres (if to Tscharner Road), but no present residences or commercial structures would be affected. During the period of road reconstruction, adjoining residents would be subject to some inconvenience from the dust, dirt, and noise of road construction activities.

Any of the above improvements of U.S. 60 to a divided four-lane highway would significantly reduce impacts of the Newman plant traffic but would still require at least a ridesharing program to reduce traffic to acceptable levels on the remaining two-lane portions of U.S. 60.

The estimated time required for construction indicates it could not be completed in time to serve Newman plant construction forces, while highway construction during the Newman peak demand period would be counterproductive, exacerbating any bottlenecks. Accordingly the Kentucky Department of Transportation does not consider this a practical alternative to pursue.

Other improvements to U.S. 60 could be made as alternatives to widening it to four lanes. The existing two lanes of U.S. 60 could be widened from two 9-ft lanes to two 11-ft lanes with 2-ft shoulders. This section could be completed in approximately one year, at an estimated cost of $8.7 million. Another improvement is the construction of a plant entrance with turn lanes approximately 500 ft to the east and west of the plant. This action could be completed in less than six months, at an estimated cost of $430,000. Finally, the curves at the town of Stanley and the town of Reed could be realigned to improve traffic flow. Such changes could be completed in eighteen months or less, at an estimated cost of $1.2 million for each curve.

Alternate road routes. There is general agreement that both local residents and plant workers will voluntarily alter travel patterns to avoid congestion. Operators of slow-moving farm vehicles are likely to avoid use of U.S. 60 during peak plant vehicle traffic times. Plant workers will try alternate routes, subject to the location of the plant entrance(s). Some of these alternate routes will be advantageous and could be encouraged.

Because of the small number of bridges over the Green River, alternate routes available to construction workers driving to the Newman plant site are limited. The identified alternate routes are:

1. Use of Route 351 from Henderson, connecting via Rucker Road to U.S. 60 east of Tscharner Road, to avoid congestion on the Henderson portion of U.S. 60. This somewhat circuitous route passes through the community of Graham Hill.

2. Use of Route 351 from Henderson, connecting via Route 1078 to U.S. 60 at Spottsville, to avoid congestion on the Henderson portion of 60. This route is quite circuitous and passes through both Graham Hill and Zion and possibly Spottsville, depending on the point of connection with U.S. 60.

3. Use of Audubon Parkway from Henderson to Owensboro, then via U.S. 60 to Newman. This is a very circuitous route and not likely to be used.

4. Use of Audubon Parkway from Henderson to a proposed new interchange with Route 1554, then via 1554 and U.S. 60 or 1554 and Sauer Lane to plant.

5. Use of U.S. 60 from Owensboro to Sauer Lane, then by Sauer Lane to the plant site if plant access from Sauer Lane is available. This would avoid the railroad grade crossing at Stanley, which may be congested.

6. Use of Audubon Parkway from Owensboro to a new interchange with Route 1554, then via 1554 to Sauer Lane to the plant.

Some less likely alternate routes are possible. Of the six alternate routes identified, those most likely to be used are 1, 4, and 5. Only alternate routes 4 and 6 require investment in improvements.

KDOT has estimated the cost of a four-lane interchange at Route 1554 on the Audubon Parkway utilizing the existing 1554 bridge over the Parkway. It has also investigated the improvement of 1554 for 6.23 miles from the present two-lane, 18-ft pavement with 2-ft shoulders to 24-ft with 12-ft shoulders suitable for trucks, or improving to three lanes. The reconstruction of 1554 would very likely be required by a full interchange that would induce traffic in addition to plant traffic. As a subalternative, a recent study has estimated the cost of a temporary two-way interchange (to and from the west only) which would serve plant commuter traffic only. Cost of this subalternative therefore does not contemplate upgrading Route 1554.

Estimated costs for the two alternate routes using an interchange with the Audubon Parkway are as follows:

	Full interchange[a,b]	Limited interchange[c]
Interchange	$2,750,000	$400,000
1554 to 24 ft	$5,650,000	
1554 to three lanes	$7,700,000	

[a]Personal communication with James W. Fehr, Transportation Planning Engineer, KDOT, Dec. 5, 1980.

[b]1980 dollars.

[c]TERA estimate for 300-ft long, 15-ft wide temporary pavement.

Estimated annual cost of maintaining a full four-way interchange is $6450, based on 8000 lin ft of two-lane pavement and KDOT's 1979-1980 average annual maintenance cost of $2441 for two-lane pavements (E. H. Adams, Assistant Director, Division of Maintenance, KDOT, personal communication, Dec. 9, 1980).

Typical estimated construction times for the interchange alternate routes would not involve Federal aid funding requirements and are as follows (personal communication with James W. Fehr, Transportation Planning Engineer, KDOT, Dec. 5, 1980):

Limited interchange	6 months
Full interchange	24 to 30 months
Widen 1554 to 24 ft	36 months
Widen 1554 to three lanes	36 months

The residual capacities shown in Table 4.36 for the alternate routings provide a measure of their capacity to reduce traffic demand on U.S. 60.

The four most likely alternate routes are treated separately.

(1) Route 351 — Rucker Road in lieu of U.S. 60 West. This alternate route could eliminate plant traffic on the most heavily used section of U.S. 60. It would impact the small community of

Table 4.36. Residual capacities for alternate routing

	Alternate	Service capacity D[a]	Estimated 1980 maximum VPH[b]	Residual capacity
(1)	Route 351	859	423	436
	Holloway Road	839	N/A[c]	
	Rucker Road	821	30	790
(4A)	Audubon (full interchange)			
	1554 2-lane, 24'	1007	30	977
	1554 3-lane	1007		
(4B)	Audubon (temporary interchange)			
	1554 2-lane, 18'	836	30	830
	Sauer 2-lane, 16'	895	30	865
(5)	Sauer Lane (in lieu of Highway 60 east)	895	30	865

[a] A weighted average.
[b] Vehicles per hour.
[c] Not available.

Graham Hill with additional traffic and related noise and emissions, but otherwise this route is sparsely settled. Additional road maintenance of Route 351 would be 100% State responsibility, as it is on U.S. 60, but additional road maintenance of Holloway Road-Rucker Road would be 100% county responsibility unless the State agreed to maintenance.

(4A) Audubon full interchange with Route 1554. This alternate route could eliminate plant traffic on U.S. 60 west of Newman. Unless alternate plant access were provided via Sauer Lane, it would channel all plant traffic to and from the east and west on the 2.8 mile section of U.S. 60 between Route 1554 and Newman. The interchange with Audubon Parkway would satisfy an expressed desire of area residents for better access, but would induce additional local traffic on 1554 as well as plant traffic. This would impact residents along 1554 with increased traffic and associated noise and emissions on a continuing basis as well as during plant construction. Widening of 1554 would require the taking of about 15 acres of land for right-of-way. An unrestricted four-way interchange would present a legal issue for the state related to bond convenants by allowing free use of the Parkway to and from the east.

(4B) Audubon limited interchange with Route 1554 (to and from the west only). This alternate route could substantially reduce plant traffic on U.S. 60 west of Newman. As in alternate route 4A, it could impose an additional load on U.S. 60 between 1554 and the plant entrance or an additional load on Sauer Lane, depending on plant access. With limited access and no induced local traffic, 1554 could be adequate for plant traffic without improvement, assuming a peak work force of 3500. With a work force of 5000 and with Kentucky 1554 and Sauer Lane in their present condition, this alternative route could not accommodate all the vehicles from the west which may attempt to use it. This alternative would not satisfy the desire of local residents for improved access. The limited interchange would eliminate the legal issue related to Parkway bonds but would be contrary to KDOT policy not to build half-diamond interchanges for safety reasons (wrongway use of the one-way segment).

(5) Sauer Lane in lieu of U.S. 60 East. Plant access via Sauer Lane would almost be a necessity to utilize route 1554 for traffic to and from the west. This could induce traffic to and from the east to by-pass a portion of U.S. 60 and use the same plant entrance. This additional traffic on Sauer Lane would impact residents in that section of Stanley and impose a heavier traffic flow on the portion of Sauer Lane west of 1554.

In summary, any alternate route will decrease congestion on U.S. 60, at the cost of increasing congestion on the alternate routes. Additionally, at least a ridesharing program to reduce traffic volumes to below level of service D road capacities would still be needed if any alternate route were used to avoid traffic congestion on U.S. 60 near Henderson. Again, delays entailed in any new construction would negate many benefits of the alternate route.

Park-and-ride, bus. The proposed bus commuting system by Hughes Transit Company provides the best available detailed analysis for the Newman site. This analysis outlines the basic strategy for satellite parking and bus commuting to the work site. Satellite parking areas in Henderson would need to be convenient to major access routes such as the Audubon Parkway, Pennyrile Parkway, and Route 41. The bus route to the plant site could follow alternate routes. One alternate route would be Highway 1078, which connects with Route 60 east of the major congestion. Another alternate route is along the Audubon Parkway to the proposed exit at county road 1554 and then to the plant site from the south.

The projected costs for a park-and-ride system vary considerably but do provide a range in which competitive bidding would occur. The system cost estimated by Hughes for a peak construction work force of 3500 is $9.7 million. When 25% overhead and 10% profit are added to the base, a total cost of $13.4 million is proposed. A breakdown of these major expenses is presented in Table 4.37. For a peak work force of 5000, these costs would increase substantially. The Kentucky Department of Transportation, however, has estimated a $4 million cost for the contract period in 1980 dollars. Both estimates need to include a possible additional cost caused by overtime pay to workers who are required to commute by transit system. Assuming 1.5-h transit time per day per worker at a weighted average hourly pay of $17.66 and 100% ridership, the additional cost would be approximately $24 million annually for the 3500 construction worker estimate and $34 million for the worst case (5000 workers).

Table 4.37. Bus system

	Estimated costs for 3500 work force
Basic system operating cost	$2,181,200
Driver's wages and training costs	1,985,770
Lease cost of buses and radios	4,328,300
Amortized capital costs	1,220,000
Total base costs	$9,772,200
Overhead (25%)	2,430,550
Profit (10%)	1,215,275
Total estimated cost	$13,368,025

Source: Provision of Industrial Bus Service to the SRC-I Plant, Wilbur Smith Associates, Lexington, Ky. 1980, p. 29.

The proposed bus system would replace most commuting to the plant site. The system as proposed would have the capacity to accommodate 3500 workers or 100% of commuters from both the east and west. Analysis of the "practical" maximum use of this mitigation alternative indicates that 90% of the work force would commute on the bus system and 10% would still drive to the site. This would result in approximately 180 vehicles (30 buses and 150 cars) still using U.S. 60 near Henderson at peak travel times as compared to approximately 774 vehicles if no mitigation measures were used for the 3500-worker estimate. Assuming the same participation rate for 5000 workers, an estimated 250 vehicles would drive to the site via Henderson (40 buses and 210 cars) as compared to 1105 vehicles without this mitigation measure.

The construction of satellite parking will cause some impacts on the local land. It is assumed that most of the parking will be located on underutilized farm land and that the damage to the land should be insignificant. Some park-and-ride lots may be needed in Owensboro and Henderson to facilitate car, van, and/or bus pooling. Those lots should be chosen carefully to minimize traffic congestion and provide easy access to buses. The alternate routes to the Newman site via county road 1078 should cause little impact. If the new exit from the Audubon Parkway is built, this alternate route to the Newman site would not cause any problems.

Park-and-ride, rail (Henderson-Newman-Owensboro). A system to transport construction workers via rail to the plant site over existing L&N Railroad lines is feasible. This rail line is on the Louisville, Kentucky, to Evansville, Indiana, route, which has two freight trains operating each day in each direction (see Table 4.38 for freight schedule). The cities of Owensboro, Newman, and Henderson are along this route.

Table 4.38. Louisville and Nashville Railroad current freight train schedule

Daily trains	Leave	Arrive
No. 762	Louisville 5:00 AM	Evansville 1:00 PM
No. 760	Louisville 5:00 PM	Evansville 2:00 AM
No. 761	Evansville 5:00 AM	Louisville 3:30 PM
No. 763	Evansville 5:00 PM	Louisville 3:30 AM

Source: Jerry Crowe, Director of Industrial Development, L&N Railroad, Louisville, Ky.

A rail commuter system could accommodate a total work force of 3500 with two trains, each with twenty coaches. A standard size coach can carry 90 passengers. Each train would originate at either Henderson or Owensboro and make a single trip to the plant site. Each train would make a single return trip at the end of the shift. An additional locomotive and six spare coaches would be required for maintenance and backup. The estimated costs of locomotives and coaches are presented in Table 4.39. A work force of 5000 would require more standard size coach cars and perhaps an additional engine. The overall cost of the system will, as a consequence, be substantially larger than the base estimate provided for a 3500 work force.

Each train would originate in either Henderson or Owensboro and both locations would require a depot. A possible location for a depot in Henderson was identified at 14th Street, which has an inactive rail spur off of Evansville-Louisville line.[47] This depot also would have access to Highways 60 and 41, allowing commuters to drive to it. There is additional clear property close to the proposed depot which could be used for parking. The depot at Henderson would require construction of a platform and parking lot. The total costs of these items are presented in Table 4.39.

In Owensboro a potential site for a rail depot is in the Riverport Authority Industrial Park. This industrial park has access to the L&N rail line plus ample area for parking. To complete the Owensboro depot, a rail siding approximately 0.25 mile in length for passenger loading and train overnight storage would have to be constructed. The Riverport Industrial Park has plans to construct a new access road from Route 60 into the Industrial Park; this road would benefit the rail commuters. The estimated costs of the Owensboro depot are presented in Table 4.39.

Because the existing rail line is owned and operated by the L&N Railroad, the L&N would play a key role in the commuter system operation. The railroad has a legal agreement with Amtrak regarding passenger service operation; this agreement would need to be examined if this mitigation measure were pursued. The train crews which would operate the commuter service could possibly be L&N crews. Maintenance of the locomotives and coaches would require labor which the L&N probably would not provide. (The L&N Railroad officials were vague about their contribution to this proposed system, and they recommended that the system's proponents present the commuter rail plan to them for official comment.)

The proposed commuter rail service for 3500 workers would cost between $2.4 and $2.7 million to start operation. Yearly operating costs are estimated at between $0.7 million and $0.8 million and are presented in Table 4.40. An additional cost of overtime pay to workers who are required to commute by transit system may be required. All of these costs will increase with an increase in the construction work force to 5000. Assuming 1.5-h transit time per day per worker at a weighted average hourly pay of $17.66, the additional cost would be approximately $24 million for the 3500 work force and $34 million for the 5000 work force estimate, assuming 100% rideship.

Table 4.39. Rail equipment[a] and terminal costs for 3500 work force

Description	Cost range[d]
Rail Equipment	
Locomotives	
3 units	$225,000 to 375,000
Rolling stock	
40 coaches	
6 spare coaches	920,000 to 1,150,000
Total	$1,145,000 to 1,525,000
Terminal Costs	
Henderson Depot	
Lease–25 months[b]	$ 47,000
Parking–1,165 spaces[b]	932,000
Platform construction	50,000
Total	1,029,600
Owensboro Depot	
Lease–24 months[c]	50,000
Parking–1,362 spaces[b]	1,089,600
Platform construction[b]	50,000
Siding construction	125,000
Total	$1,314,600
Total	**$2,344,200**

[a]Source: Ed McCallum, Eveready Co., Bridgeport, Conn. Note: Locomotives should have between 1000 and 1700 horsepower. Coaches accommodate 90 passengers.

[b]Analysis of Traffic Impacts of the Synthesis Gas Demonstration Plant Program, Baskett, Ky., EBASCO Services Inc., March, 1980. pp. 4-24, 4-26 and 4-27.

[c]Cost estimate from Mr. Tony Rinaldo, Port Director, Owensboro, Ky.

[d]Assuming a peak work force of 3500. Costs would rise significantly in the "worst case."

Note: Parking construction assumes $800 per space cost.

Table 4.40. Commuter system yearly operating cost for 3500 work force

Operating costs	Cost range
Maintenance cost[a]	
(15% of acquisition)	$131,750 to 228,750
Crew costs	
(4) 4-man crews[b]	560,000
	$691,750 to 788,750

[a]Ed McCallum, Eveready Co., Bridgeport, Conn.

[b]*Analysis of Traffic Impacts of the Synthesis Gas Demonstration Plant Program*, Baskett, Ky., EBASCO Services, Inc., March 1980, p. 4-26.

The proposed commuter rail system designed with 20 coaches per train would accommodate 3600 workers. The two trains, one from Henderson and the other from Owensboro, could accommodate all workers to the plant site during its peak construction period. Analysis of the "practical" maximum use of this alternative indicates that 90% of the work force would commute on the rail system and 10% would still drive to the site. This would result in approximately 150 vehicles still using U.S. 60 near Henderson at peak travel times with a peak work force of 3500 as compared to approximately 850 vehicles if no mitigation measures were used. For a peak work force of 5000, 210 vehicles would drive to the site via Henderson as compared to 1105 vehicles without this mitigation measure.

The impacts from this mitigation alternative are limited. The construction of necessary terminals would be in remote locations and would not affect other operations. The operation of commuter rail system might affect one train in the existing L&N schedule. The train which now leaves Evansville at 5:00 PM would pass through Newman during the evening commuting period. Another minor impact of the commuter rail system would be additional wear on the rail line.

Park-and-ride, dedicated rail line (Henderson-Newman). If the L&N railroad did not wish to let a commuter train use the existing track from Henderson to the SRC-I site, than a dedicated rail line would serve exclusively the needs of the proposed SRC-I plant without impacting existing freight rail service. It is approximately 17 miles from the plant site to Henderson by the current rail line. The rail line crosses the Green River at Spottsville and additional small creeks and streams along the route. It also intersects U.S. 60 three times: once with a highway overpass and twice with highway grade crossings. A new rail line would also be approximately 17 miles long and traverse similar terrain, including the Green River.

The construction of an additional rail line along this route presents problems. The existing rail line owned by the L&N operates on a 50-ft right-of-way (ROW) with additional land for a second track. The width of new rail requires 15 ft on each side from the track's midpoint to accomodate ballast and grading of slope. Because the existing ROW is limited, land acquisition for the dedicated line becomes a factor.

The existing rail bridge at Spottsville also is limited to its existing single track. A new rail line would require another bridge to be constructed across the Green River to accommodate the dedicated rail line. Additional land would be required for the new bridge because its construction would interfere with the swing operation of the existing bridge. Another constraint on bridge construction is the time that would be required to obtain the permit required by the Coast Guard which has responsibility of granting permits for construction of rail structures across navigable water such as the Green River. Any delay associated with the application and approval processes could prove costly.

The estimated cost of constructing a new rail line with bridge from Henderson to Newman would exceed $20 million. Historically, the cost per mile of new track varies from $0.5 million to $5 million. The engineering estimates of cost range are between $0.5 million and $1 million per mile without construction of bridges or other major additional expenses. The 17-mile new rail segment would cost a minimum of $8.5 million; the additional component costs are presented in Table 4.41.

The approximate cost of a new bridge to traverse the Green River would be at least $11 million. The width of the river would require a wide swing span section with associated machinery. The track approaches, which cross wetlands and the shallow river waters, require special construction and would cost approximately $2 million each.

Two other options are available for the rail bridge. One is the construction of a double-rail bridge and the other is the use of the existing bridge by both the L&N rail line and the new dedicated rail line.

The construction of terminals at Henderson and the plant site require a wooden platform with shelter and rest facilities. The lease or purchase of land for the Henderson terminal and parking lot would add extra expense to the dedicated new rail line.

The cost of land to create additional ROW is approximately $500,000 including broker fees. Average farm land value is approximately $3000 per acre; total land required would be over 110 acres. The availability of land and time necessary to acquire the ROW would be major constraints.

Table 4.41. Estimated system costs dedicated rail line

Description	Costs (millions of dollars)
Rail line (17 miles)	$8.5
Bridge (new single track)[a]	
Swing span	7.0 (minimum)
Approach trust	4.0
Henderson depot	1.0
Newman depot	0.1
Land acquisition[b,c]	0.4
Proposed total	$21.0

[a] C. L. Gatten, Assistant Chief Engineer, L&N Railroad, Louisville, Ky.

[b] About 110 acres will be needed for the right-of-way.

[c] J. Anderson, Metropolitan Planning Office, City of Owensboro, Ky.

The dedicated rail line would be used instead of the existing L&N tracks but the reduction of traffic impacts on U.S. 60 would be identical to the previously discussed park-and-ride alternative. The necessary time to design the rail line and bridge, to acquire permits for construction, and to purchase required land, at minimum, is one year before construction can begin. During construction, traffic along U.S. 60 in the vicinity of the two existing grade crossings and the U.S. 60 overpass would be encroached.

In addition, the route of the proposed rail line would cross the Green River and other smaller streams and creeks, probably affecting the floodplain/wetlands in the area. Thus, the construction of the rail line would most likely require compliance with Executive Order 11988 and 11990.

Ridesharing. Ridesharing is the use of one vehicle by two or more individuals for a particular trip purpose and is mostly used for work trips. There are two basic types of ridesharing: carpooling and vanpooling. Ridesharing eliminates the need for every individual to drive his or her own car and thus reduces the traffic volume. Ridesharing can be organized in two ways. In one method the driver picks up other passengers at their doors and delivers them to the work site. Another method is for ridesharers to arrive at a common site and then drive in one vehicle to the work site. Carpooling employees use the first method most often, while vanpooling predominantly uses the second method.

Ridesharing is an attractive mitigation alternative for a number of reasons. First, the limited number of roads and accesses to the plant site dictates the extensive use of U.S. 60. Second, the distance workers will have to travel to the plant site encourages shared driving responsibilities. Third, the cost of commuting decreases with ridesharing. Fourth, the locations of two urban centers east and west of the plant site are good collector points for workers to share rides.

Carpooling and vanpooling are distinct forms of ridesharing. Each type has its own characteristics, requirements, and costs that are discussed as separate subalternatives.

Estimated costs for the vanpool alternative are based on two basic assumptions. The first is that the maximum number of employees that could be expected to participate in the vanpooling program would be 50%, or 1750 to 2500 persons, based on the experience of the TVA at Hartsville. For a peak work force of 3500, this translates into 175 ten-person vans. For a peak work force of 5000, the number of vans required is 250. The second assumption is that the average cost for a ten-person van is in the vicinity of $9000. Based on these assumptions, the cost of purchasing the equipment would be approximately $1,575,000 to $2,250,000. All administrative costs including operation, insurance, and maintenance of equipment would be defrayed by employee riders.

The complete expense of the carpool alternative would be borne by the program commuters.

The potential reduction in the additional traffic volumes produced by ridesharing of all kinds (car pooling, van pooling, and bus pooling) is shown in Table 4.42. Note that under this maximum ride sharing scenario, 42% of all workers are expected to carpool, 30% are expected to vanpool, 11% to buspool, and 17% to drive alone.

Table 4.42. Estimated SRC-I plant worker vehicles at anticipated construction peak (1983) for ridesharing and park-and-ride alternatives

Assumption	Peak work force of 3500 traveling to and from			Peak work force of 5000 traveling to and from		
	Henderson	Owensboro	Total	Henderson	Owensboro	Total
Maximum vehicles (1 worker per vehicle)	1470	2030	3500	2100	2900	5000
Baseline assumption (1.9 per vehicle)[a]	774	1068	1842	1105	1526	2631
Estimated maximum ridesharing[b]						
47% Voluntary						
42% Carpool (3 people)	206	284	490	294	406	700
5% Vanpool (10 people)	8	10	18	10	15	25
36% Sponsored program						
25% Vanpool (10 people)	37	51	88	53	72	125
11% Buspool (35 people)	5	7	12	7	9	16
17% Drive alone (1 person)	250	345	595	357	493	850
Total with rideshare	506	697	1203	721	995	1716
Estimated maximum bus service						
90% Bus riders (44 people)	30	42	72	43	59	102
10% Drive alone (1 person)[c]	147	203	350	210	290	500
Total with buses	177	245	422	253	349	602
Estimated maximum rail service						
90% Rail riders	0	0	0	0	0	0
10% Drive alone[c]	147	203	350	210	290	500

[a] National average, approximates 75% Carpooling with three persons per vehicle and 25% driving alone.

[b] From *Ridesharing at Construction Sites—a TVA Experience*, by Stokey, Wegmann, Menendex, Whitney, updated.

[c] TERA estimate of minimum.

Source: TERA, Inc.

Under the maximum ridesharing scenario, added traffic volumes would be reduced from approximately 770 to 1100 vehicles (baseline assumption) near Henderson to roughly 510 to 720 vehicles. In the vicinity of Owensboro, the added number of vehicles would drop from between 1070 and 1530 to between 700 and 1000.

Three basic benefits arise from the use of the ridesharing alternative: reduced traffic volume, energy savings, and reduced plant costs.

The last benefit would be directed to the site operator. Ridesharing reduces the vehicles needed to deliver workers to the plant site. The reduced vehicles require a reduced number of parking spots. The cost and land savings provided from a limited parking area would accrue to the operator.

Nonstructural alternatives. To reduce the amount of travel by plant construction workers and/or reduce the peak amount of such travel, ICRC has identified two nonstructural mitigation alternatives considered feasible. These nonstructural alternatives include:

- staggered daily work schedules and
- off-site fabrication of plant components.

Staggered daily work schedules would not change total employment but would increase total manhours. Craftsmen would be assigned different starting/finishing times according to plant location wherever possible (not by craft). Staff overtime would be required for supporting services to be available from earliest start to last finish — likely a minimum of 1 h overtime for 173 to 247 individuals. Maximum effectiveness of staggered work schedules for minimum additional cost (1 h staff overtime) would reduce peak hour travel almost 50%. Specifically, from a peak of 3500 to 5000 workers and 1850 to 2630 vehicles at 1.9 riders per vehicle, to 1750 to 2500 workers and 974 to 1316 vehicles at the highest of two AM and PM peak flows.

The effectiveness of staggered or overlapping work schedules would be limited by the number of work locations that make this procedure feasible. A 25% reduction via staggered shifts may be the effective maximum. Adding to the number of staggered shifts would not significantly increase effectiveness but would add to staff overtime. Having construction workers work completely separate shifts as in industrial plants is not considered a feasible alternative because this would double or triple staff requirements and still produce travel peaks at shift changes, and night construction work would be less efficient.

Offsite fabrication will be used as much as possible because of the efficiencies of shop fabrication. The use of this mitigation alternative is limited by union-employer contractual agreements that may specify what equipment must be field assembled.

Only nonstructural alternative 1 imposes an identifiable cost. Assuming a $10/h base rate plus 25% insurance and other payroll cost and $1.50/h fringe costs as an overall average, 1 h of staff overtime would cost between $2.7 and $3.9 million (173 to 247 staff, 36 months).

In summary, the vehicle impact reduction via nonstructural alternative 1 is as follows:

	Maximum VPH		
	Base	Alternative	Reduction
50/50 shift stagger	1850/2630	974/1316	776/1184
25/75 shift stagger	1850/2630	1387/3506	463/876

The staggered work shifts are not expected to change worker efficiency. No other impact on the area or area residents other than reduction of road congestion can be identified.

Summary. Increased traffic on U.S. 60 could produce a major adverse impact if no mitigation measures are carried out. Increased delays to traffic between Henderson, Kentucky, and the SRC-I site during peak use periods could be expected to average 1-1/4 to 2 h and to reach 4 h in extreme cases. Delays to traffic between Owensboro and the SRC-I site could be expected to average 40 min to 1.5 h and to go as high as 3 h.

Mitigation measures have been studied, and there are a variety of such measures that can reduce the potentially adverse impact of increased traffic on U.S. 60 (Sect. 4.2.4.1). A number of the available measures have been combined into a unified traffic mitigation plan that should ensure that acceptable levels of service will not be exceeded on U.S. 60.

The project sponsors will: (1) construct an intersection with signals and turn lanes at the SRC-I plant entrance on U.S. 60; (2) encourage voluntary ridesharing, vanpooling, and bus riding; (3) utilize staggered workshifts, or establish a second shift to reduce peak period traffic; and (4) establish a company-sponsored bus riding program if the preceding measures fail to ensure acceptable traffic conditions on U.S. 60.

In addition to the above actions, Federal, State, and local governments are studying the feasibility of the following mitigation measures to increase the effectiveness of those measures described above: (1) realignment of curves and improvement of railroad crossings on U.S. 60 at Stanley and Reed; (2) construction of a temporary ramp from the Audobon Parkway to KY-1554 to accommodate traffic to and from the areas west of the SRC-I plant site; and (3) upgrading Sauer Lane from KY-1554 to the plant site (a rear entrance will be constructed to allow access from Sauer Lane). If these measures are not undertaken, an increased degree of effectiveness will be required of the four project-sponsored measures described above. Specifically, a substantially larger number of company-sponsored buses is likely to be required and worker participation in the bus-riding program will have to be correspondingly greater.

Section 4.6.2.2 of this document presents additional information on the above mitigation measures. Before construction begins, a detailed traffic mitigation plan would be issued by the project sponsors in cooperation with KYDOT and the Green River Area Development District (GRADD), describing the exact costs of the measures to be taken and the institutional arrangements that would be necessary for their implementation.

Without an effective mitigation effort like that described above, project-induced traffic would result in unacceptable social impacts on the communities in the vicinity of the proposed site. Because of the lengthy traffic delays, increased safety risks, and accelerated road deterioration projected to occur on U.S. 60 between Owensboro and Henderson, construction workers traveling to the Newman site will face extremely adverse conditions daily. The multi-hour, one-way work trip that will be the norm during the 5000-worker peak construction period will have a substantially greater impact than the 90 min trip that is generally considered to be the upper limit for construction workers; many workers would find even this 90 min trip intolerable. The excessive time that will be required for the daily work trip is likely to elicit the same kind of response from SRC-I construction workers that accompanies seriously degraded living conditions in classic boomtown cases. Under such circumstances, worker turnover and absenteeism is frequently high, morale is low, and productivity suffers accordingly, resulting in delays of project completion and/or the need to expand the construction work force. In addition to the obvious implications for the project workers and sponsors, such a situation would directly affect the communities of the region by introducing a work force to the area that is more transient than normal for construction projects of this kind, by extending the time period during which impacts will be experienced, and, possibly, by increasing the number of workers that will have to travel to the site.

Many current area residents will be severely affected by SRC-I-induced traffic in the vicinity of the proposed site. In addition to the 1600 people residing in the seven small communities located along U.S. 60 between Owensboro and Henderson, another 8000 individuals are distributed throughout the rural areas between the two major cities who depend on U.S. 60 as a major access route. Many of the nearly 80,000 residents of Owensboro and Henderson will also be significantly affected by project-induced traffic tie-ups along U.S. 60, which passes through both these urban centers. U.S. 60 will be seriously degraded in terms of the standard measures of accessibility, travel time, safety, and comfort. The impacts will be especially severe for the numerous rural residents for whom U.S. 60 is the primary link to work, school, and shopping and who will be forced to deal with the massive traffic congestion and increased safety risk daily. Property values in the vicinity of the proposed site could also be adversely affected by project-induced traffic problems. In summary, project-induced traffic would result in extremely severe hardships and disruptions for many thousands of current residents if appropriate mitigation measures are not taken and would constitute an unacceptable social impact for the communities in the vicinity of the proposed site.

Railroad transportation

There will be no direct impacts on the rail system during construction of the demonstration plant except possibly for occasional material shipment to the site. This is expected to have a negligible impact on the rail system. A possible park-and-ride rail program to transport construction workers to the site is discussed above.

Barge transportation

As presented in Appendix Y, three possible barge scenarios exist: (1) delivery of demonstration plant construction machinery and process equipment, (2) delivery of coal for the demonstration plant in addition to scenario 1, and (3) delivery of coal for the commercial plant. The Green River has sufficient excess capacity to easily accommodate increased barge traffic during the demonstration.

Aesthetics

Residents south of the railroad along Sauer Land and Murphy Road will have relatively unobstructed views of the site during construction. Residents of Newman and other nearby small communities will notice a significant increase in traffic. Boaters on the Green River will also be aware of construction activity.

Archaeological, historical, and paleontological impacts

There are no sites potentially eligible for inclusion in the National Register at the Newman site (see Sect. 3.2.4 and Appendix U). The SRC-I project will have no significant impact on archaeological, historical, or paleontological sites.

4.2.4.2 Operations phase impact

Most of the socioeconomic effects during operation of the proposed SRC-I plant will be reductions in the impacts that were created during the construction period but will still represent a net change over baseline conditions.

Employment

The first operations employees are expected to commence training and/or work at the proposed SRC-I demonstration facility in late 1983 or early 1984 when approximately 100 workers and plant supervisory personnel begin work on the site. Full employment will be reached in early 1985 when an estimated 725 personnel will be on site. This number is roughly double that used in the DES and reflects updated projections by the applicant. Analysis of facility staffing requirements indicates that approximately 90 of these personnel will be supervisory, administrative, or technical employees who are likely to be transferred from other plants. The remaining 635 employees are expected to be hired locally. Of the 725 total personnel, it is projected that approximately 545 will reside in Owensboro and 180 will reside in Henderson. It is possible that a small number of operations employees will commute from outside these communities, but this number is expected to be insignificant.

At the end of construction, the construction-induced jobs will no longer be supported by construction wages. However, the start-up of facility operation will provide continuing support for approximately 1540 of the service-sector jobs in the three-county area. By comparison to the secondary employment during the construction phase (between 1490 and 2100 jobs in the three county area), the above estimate of 1540 service-sector jobs represents a net decline of up to 560 jobs.

Population

The 90 operations employees expected to relocate to the three-county area are expected to bring households averaging 3.2 persons in size (the 1970 persons-per-household average for Kentucky and Indiana). Thus, the population of the area is expected to increase by about 160 persons, or by approximately 0.1% of the projected 1985 population of the three-county area. Instead of this increase, a decrease may actually occur at that time if relocated construction workers move out of the area; such out-migration, however, seems unlikely in view of the proposed synthetic fuel plant development in the area and the number of construction jobs this will create.

Income

Annual wages paid to operation employees at the proposed SRC-I facility are estimated at $20,310,000 per year, based on an average annual salary of $28,500 for operating labor and

$30,000 for supervisory personnel (1980 dollars). Approximately $11,170,000 (55%) of the total is estimated as locally disposable income. Applying an aggregate three-county personal consumption-expenditures multiplier of 2.00 (Table 3.17) produces an estimate of $22,341,000 in additional income.

The facility is expected to receive approximately 6000 tpsd of high-sulfur coal at peak capacity. At an anticipated price of $1.30 per million Btu and an average Btu content of 5870 Btu/kg (12,940 Btu/lb) for Kentucky No. 9 coal or its equivalent, the value of coal purchases is expected to total approximately $73.7 million per year. These purchases represent a significant economic benefit to the local areas that will supply coal for the facility.

Housing

The 90 employees estimated to be transferred from other plants to work at the proposed SRC-I facility are expected to rent or purchase housing within the communities of Owensboro and Henderson. Considering the withdrawal of plant construction workers from the project area, the demand for 90 units should be easily satisfied.

Transportation

The primary impact of plant operation on road traffic is expected to consist of continued use of U.S. 60, which will provide local access to the proposed SRC-I facility. The adverse impact of such use is expected to be small in comparison with peak construction traffic in 1983. Assuming 1.9 persons per car, an estimated 380 commuter trips to and from the site will be made daily. It is estimated that approximately 220 trips will originate from Ownesboro and that 160 trips will originate from Henderson.

Since operating personnel will be divided among three work shifts, impacts on area roads (including U.S. 60) will be minor.

Railroad transportation. Coal will be transported to the demonstration plant in trains up to 80 cars. Each car will hold approximately 100 tons of coal. On the average, there will be one trip per day, six days per week. The existing L&N Railroad tracks are more than adequate to supply the demonstration plant's coal needs.

As assumed in the methodology presented in the spill analysis in Appendix DD, a 75-tank-car train would have a twice-weekly trip to haul the light liquid product, and a 60-tank-car train would have a once-a-month trip to haul the heavy products.

The train used to haul coal to the site will cross U.S. 60, probably at Stanley. The SRC-I plant includes a curved entrance track designed to allow the unit-train to maintain 10 mph speeds at the plant entrance. It is considered likely that the train would still be traveling at 30 mph while crossing U.S. 60 at Stanley before slowing to enter the plant. Trains leaving the plant should also be able to accelerate to 30 mph speeds before reaching U.S. 60 crossings. Because the train is approximately 3906 ft long and would block traffic on U.S. 60 for approximately 4.4 min if traveling at 10 mph, there should be no problem in complying with Kentucky Regulation KRS 277.200, which allows a maximum obstruction time of 5 min for a highway, street, or navigable stream.

There is flexibility in scheduling train arrival and departure times, so schedules will be arranged to avoid the peak vehicle travel times on U.S. 60.

Barge transportation. A barge docking facility (see Appendix Y) will be constructed to move materials to the plant site during construction of the SRC-I plant. In the event that the coal is purchased from a mine that does not have nearby rail access, coal will be barged to the demonstration plant. In either case, the Green River has sufficient excess capacity to easily meet the demonstration plant's needs for barge transportation.

Public services and facilities

No significant direct impacts are anticipated on public services and facilities in the impact region. Reduction of the size of the SRC-I labor force should ease most of the impacts induced by the construction phase. Approximately 75 students enrolled in the schools of Daviess and

Henderson counties in 1983 would be attributable to the proposed SRC-I facility operation. No adverse impacts on the capacities of the two counties' school systems are anticipated. Assuming an average cost of education per student of approximately $1300, the annual education expense for the 75 students will be about $97,500.

Taxes

Since the Federal government retains title during demonstration phase operation, the facility will be exempt from paying taxes. However, the Federal funds for areas designated as impacted by energy development projects may be available. The magnitude of potential revenues and the need for alternative compensation systems will be evaluated.

In the 21-county impact area, revenues attributable to the operations of the SRC-I facility would be relatively insignificant, since employment is expected to drop to 725 employees by 1985 from a construction employment peak of 3500 to 5000 in 1983. Assuming the operations employees would be permanent residents of the tri-county impact region, any fiscal impacts would be concentrated in Henderson, Daviess, and Vanderburgh counties. Fiscal effects in the region would, however, be minor, when the 21-county region of influence reverted back to steady state economic levels.

Aesthetics

The transportation corridor along the western boundary of the site and accompanying activity will be quite visible, especially to residents just west of the site. The physical structures visible beyond the immediate site area will be the 56.4-m (185-ft) coke silo, a 61-m (200-ft) flue, and some smoke stacks. See Sect. 4.2.3.1 for a discussion of cooling-tower impacts.

4.2.4.3 Impacts related to commercialization at an expanded capacity

Introduction

At present the unavailability of sufficiently reliable information regarding construction and operations in the commercialization phase precludes an analysis as detailed as that developed for the demonstration phase. More specifically, projected 1987 baseline estimates for the commercial SRC-I site, realistic construction schedule and labor requirements, and operations data are unavailable. Nevertheless, a preliminary set of estimates is presented below that attempts to assist in understanding the general level of the consequences of commercialization. The primary assumption on which the following estimates rest is that the socioeconomic infrastructure existing during the demonstration phase would continue to exist essentially unaltered during the commercialization phase.

Construction

An estimated total of approximately 5000 to 10,000 construction workers at peak would be needed over an eight-year period to construct the commercial plant. This total is in addition to the projected 725 people who would continue to operate and maintain the demonstration plant.

It is important to emphasize that all estimates are contingent upon the size and time of peak construction activity and that no reliable information is available in these respects. Neither do these estimates take into consideration any cumulative impacts potentially resulting from the concurrent construction/operation of any other synthetic fuel production facility. These cumulative impacts of multi-project origin are treated in Sect. 4.2.5.

Construction worker relocation

In the 116-km (70-mile) zone around the SRC-I site, it is estimated that of the 5000-to-10,000 person peak construction labor force, about 3250 to 5000 will be local hires who commute daily to the job site; some 1300 to 3700 construction workers are likely to be distance movers or travellers, relocating within the 116-km (70-mile) zone. Comparable estimates for the primary impact counties of Daviess, Henderson, and Vanderburgh indicate about 1900 to 2900 local com-

muters and 1000 to 2800 in-movers, this time counting both distance *and* local movers/travelers for the reasons discussed in the demographics subsection of Sect. 4.2.4.1. All of these estimates are related to peak construction activity.

Because of the expectation that demonstration-phase construction will result in considerable shortages of construction craft workers, it is readily inferred that the larger scale of the commercialization-phase construction will further overburden craft labor markets in the region. Because of this regional competition for labor, particularly in light of the other proposed synfuel plants in the area, careful planning would be necessary to ensure the availability of an adequate labor force.

Indirect employment

Demonstration-phase analysis translated to the size of commercialization-phase peak labor force leads to an estimated 3370 to 6740 indirect (secondary) jobs created at peak construction activity in the 116-km (70-mile) zone and approximately 2100 to 4200 in the three-county area.

The number of construction workers moving to the area during construction of the commerical plant would be larger than the number during construction of the demonstration facility. However, because this in-migration would occur over a longer period of time, the local infrastructure is more likely to be able to keep pace with the rate of population increase. Also, experience gained by the local area in accommodating demonstration plant construction should help in planning for growth during commerical plant construction.

Demographics

Total in-migration to the 21-county area (116-km, or 70-mile, zone) by workers and dependents responding to both primary and indirect (secondary) jobs is estimated at 3800 to 10,400 persons at peak construction, including some 800 to 2200 school age children. For the three-county primary impact area, a total in-migration of about 3000 to 8000 persons is likely, including about 630 to 1700 school age children.

The estimate of 3000 to 8000 new residents in the three-county area represents between 1% and 2.7% of the area's projected 1985 population, and thus is not likely to result in significant adjustment problems for the socioeconomic infrastructure of the area as a whole. This, of course, does not deny the possibility of specific or highly localized significant impacts, nor does this conclusion stem from any consideration of any of the other proposed synthetic fuel plants in the vicinity of SRC-I.

Incomes

Estimated construction payroll for the 12 months surrounding the peak construction employment is about $160 to $320 million in 1980 dollars. Given the relationship established for the demonstration-phase analysis, this payroll implies additional indirect (secondary) incomes of about $150 to $300 million in the 116-km (70-mile) zone for the above time frame, including some $100 to $200 million (1980 dollars) received by persons located in the tri-county area of Daviess, Henderson, and Vanderburgh counties.

Housing

The longer construction period for the commerical plant would likely result in greater proportional demand for permanent housing and less proportional demand for rental houses and apartments. As indicated in Sect. 3.2.4.3, the available supply appears adequate to handle demonstration phase in-migration; because commercialization phase in-migration would occur over a longer period of time, the local infrastructure should be able to accommodate the population increase. More specifically, the above in-migration estimates and the demonstration-phase analysis suggest that the demand for housing in the three-county area would likely be as follows:

	Total housing	Single homes	Mobile homes	Other[a]
Daviess, Henderson, and Vanderburgh counties	1210-3220	610-1620	290-780	310-820

[a]Apartments, sleeping rooms, campers, and dormitories.

Public services and finance

Commercialization would provide a significant economic benefit to Daviess County in the form of a large increase to the local tax base, because ownership of the facility would be transferred from the Federal government to private industry at the end of the demonstration phase.

Current and planned water and sewer overall capacities should be generally adequate for the population increase; however, certain service areas may have to be expanded to support the increased housing needs necessitated by the in-migrant workers.

Demands on police and fire protection should be absorbed by local communities without effects on overall service or adequacy levels, although some increase in manpower would be needed.

Tax revenue to the county and the State will be large and should be more than adequate to pay those jurisdictions receiving it for increased public services needed during the construction period. Should full ownership pass to the private sector, as is currently planned, Daviess County and the State of Kentucky would commence to collect taxes on SRC-I. The assessed value of the demonstration facility is expected to be roughly $1.4 billion. Given this value and current tax rates (see Table 3.23), SRC-I would be liable for about $5.4 million in county and school district property taxes and about $3.9 million in State property taxes. The actual value of the expanded commercial plant should be considerably larger.

None of the above mentioned revenues will go directly to the cities of Henderson and Owensboro, and this could create short-term fiscal imbalances requiring mitigation measures. In any case, the population in-migration into the Henderson County area could result in negative financial impacts because the area might experience a need for increased public services while not receiving tax payments directly associated with the construction and operation of the SRC-I facility.

The surrounding county areas in Kentucky, Indiana, and Illinois will experience a moderate level of growth. At present, significant fiscal impacts are not expected. However, to the extent that expenses are incurred by Henderson County or the cities of Henderson or Owensboro as a result of workers' migration to these areas, there could be negative financial impacts, because these jurisdictions would not receive direct tax payments from the plant.

Transportation

By 1986 (when construction on the expanded commercial plant is scheduled to begin), it is assumed that mitigation strategies will have been taken to improve the physical access to the facility at levels of traffic commensurate with the needs of the construction labor force for the demonstration plant. These strategies could include improvement of U.S. 60 and construction of an interchange on the Audubon Parkway. For the commercial phase, these improvements to the road system will be necessary and must be supplemented by a park-and-ride bus and/or park-and-ride rail program if the projected 5000 to 10,000 construction work force is to be accommodated. If structural improvements such as those mentioned above are not made, the existing road system could not accomodate the traffic generated by the commercial construction labor force unless park-and-ride programs are 100% effective.

Railroad transportation. It is expected that all coal for the commercial plant will be transported by barge. It is anticipated that all commercial plant products will be shipped by rail. This is estimated to result in ten 75-tank-car train trips per week for the light product and five 60-car train trips per month for the heavy product. This is an overall average of less than two train trips per day.

The existing L&N Railroad track is more than adequate to supply the commercial plant product shipment needs.

As during the demonstration phase (see Sect. 4.2.4.2), Kentucky Regulation KRS 277.200 — which allows a maximum of 5 min for obstructing a highway, street, or navigable stream — will easily be met.

There is flexibility in scheduling train arrival and departure times, so schedules would be arranged to avoid the peak vehicle travel time on U.S. 60.

Barge transportation. Coal shipments to the commercial plant are expected to be primarily by barge. Increased traffic along the Green River due to the SRC-I commercial plant in conjunction with other plants could cause delays at locks unless lock capacity is increased in the meantime (Sect. 4.2.5).

Commercial operations

Operation of the commercial plant would result in the employment of approximately an additional 1475 people, or a total of 2200 personnel. Operation of the commercial facility would roughly triple the magnitude of the impacts associated with the operation of the demonstration facility, but the operations impacts will nevertheless represent a substantial decline from the impacts stemming from the construction of the commercial facility.

4.2.4.4 Impacts of decommissioning and mothballing

Since the land and facility would remain under DOE ownership, anticipated tax revenues would not be collected for use of the site. The mothballed facility would provide no economic benefits and would also preclude other industrial development capable of providing tax revenue. As a result of either decommissioning or mothballing, the majority of the operational labor force would be laid off, with the probable loss of many secondary support jobs as well. Should DOE elect to decommission the facility, it could be sold by the General Services Administration for private use and would become taxable.

4.2.5 Cumulative impacts

4.2.5.1 Introduction

The proposed SRC-I facility is one of nine energy projects currently under construction or proposed for construction in the vicinity of the Newman site. These projects are identified in Table 4.43, and their relative locations are indicated in Fig. 4.9. A construction and operation schedule for the projects is presented in Fig. 4.10.

Although the impacts of SRC-I must be assessed by themselves, it is important to identify and evaluate synergistic effects that may result as a consequence of construction and operation of SRC-I in concert with the other energy projects in the affected region. Even if each individual energy project, including SRC-I, were projected to cause no significant impact on its particular environment, it is possible that, acting together, significant impacts could occur in the region or in particular subregions as a consequence of multiple sitings. Alternatively, if problems are projected to result from construction and/or operation of SRC-I or any of the other individual projects, these problems may be exacerbated by the construction and/or operation of the other projects. This section assesses the degree of interaction that can be expected as a result of the SRC-I plant's construction within the context of multiple sitings and the degree to which cumulative impacts impinge on existing resources in the relevant natural and human environments.

This discussion is constrained by the limited availability of data and by the considerable uncertainty that surrounds the project design and construction schedules of the synfuel and electrical generating facilities listed in Table 4.43. Thus, this analysis only suggests the types and magnitudes of cumulative impacts with which the SRC-I project could be associated.

Considerable environmental data have been collected and evaluated for the proposed SRC-I demonstration plant through site-monitoring programs and conceptual design studies. Three other synthetic fuel facilities are in the feasibility phase of design, and specific data for a reliable quantitative assessment of cumulative impacts are not available. Also, because some project information is considered proprietary, detailed project plans have not been released by DOE or the Kentucky Department of Energy for analysis or publication. The Kentucky Department of Energy is also studying potential cumulative impacts from the proposed synfuel plants and

Table 4.43. Synfuel facilities and electricity-generating plants proposed or under construction in the Newman, Kentucky area

Name/location	Operator	Approximate coal input (tons/d)	Product			Schedule	
			Type	bbl/d equivalent	Capacity (MW)	Construction begins	Operation begins
Synfuel facilities							
1. SRC-I (demonstration) Newman, Ky.		6,000	Solid, liquid, and gaseous hydrocarbons	20,000		1982[a]	1985[a]
SRC-I (commercial)		30,000				1988[a]	1996[a]
2. W. R. Grace[b] Baskett, Ky.		30,000	Liquid hydrocarbons	100,000		1983[a]	1988[a]
3. Tri-State Synthetic Fuels (SASOL) Project Geneva, Ky.		20,000	Liquid hydrocarbons	50,000		1983[a]	1988[a]
4. H-Coal Project[b] Cloverport, Ky.		23,000	Liquid hydrocarbons	50,000		1984[a]	1988[a]
Electricity-generating plants							
5. Rockport I and II Rockport, Ind. (Spencer Co.)	Indiana Michigan Electric Co.				1,300/1,300	c/c	1986/1987
6. D. B. Wilson Plant Matanzas, Ky. (Ohio Co.)	Big Rivers Electrical Coop.				395/395	1981/1981	1984/1986
7. Gibson Plant Princeton, Ind. (Gibson Co.)	Public Service of Indiana				650	c	1984/1986
8. Hancock Plant Cannelton Dam, Ky.	Kentucky Utilities				650/650	1982/1982	1979/1994
9. A. B. Brown Plant West Franklin, Ind.	Southern Indiana Gas and Electric				250/500	c	1984/1988

[a]Tentative schedule.
[b]Currently limited to process design.
[c]Under construction.

has released three reports: An Assessment of Environmental and Health Issues (February 1981), A Basis for Planning and Assessment (March 1981), and A Coal Conversion Project Summary (April 1981). SRC-I is the first of the synfuel projects in the area to reach this stage in the permitting and NEPA process. Furthermore, SRC-I is a demonstration plant intended to test the economic and environmental feasibility of the processes involved. Hence, much of the information on impacts associated with SRC-I will be available only after the plant is in operation. This information could, in turn, be used to modify design features of future plants. Where data on environmental impacts are lacking, it will be incumbent on planners of the later projects to assess more fully than is currently possible the cumulative impacts that may result from implementation. Because specific design information for facilities other than SRC-I is not available, best-available estimates of design capacity and resource requirements along with conservative estimates of impacts have been used throughout this section.

To provide a conservative evaluation of cumulative impacts, the region is defined as an area of western Kentucky and southern Indiana in which four synfuel plants have been proposed and five electrical generating plants are either proposed or under construction (see Table 4.43). All plants occur within a commuting distance of 116 km by road (70 road miles)* of the SRC-I site. The primary criteria for delimiting a region for evaluation of cumulative impacts involve labor migration patterns and other socioeconomic impacts, likely direct spatial interactions, impingement on common resources such as water quantity and quality and air quality, and joint use of existing or proposed transportation networks. In this case, cumulative socioeconomic impacts

*For purposes of this analysis, it was assumed that 40 air miles is roughly equivalent to 70 road miles.

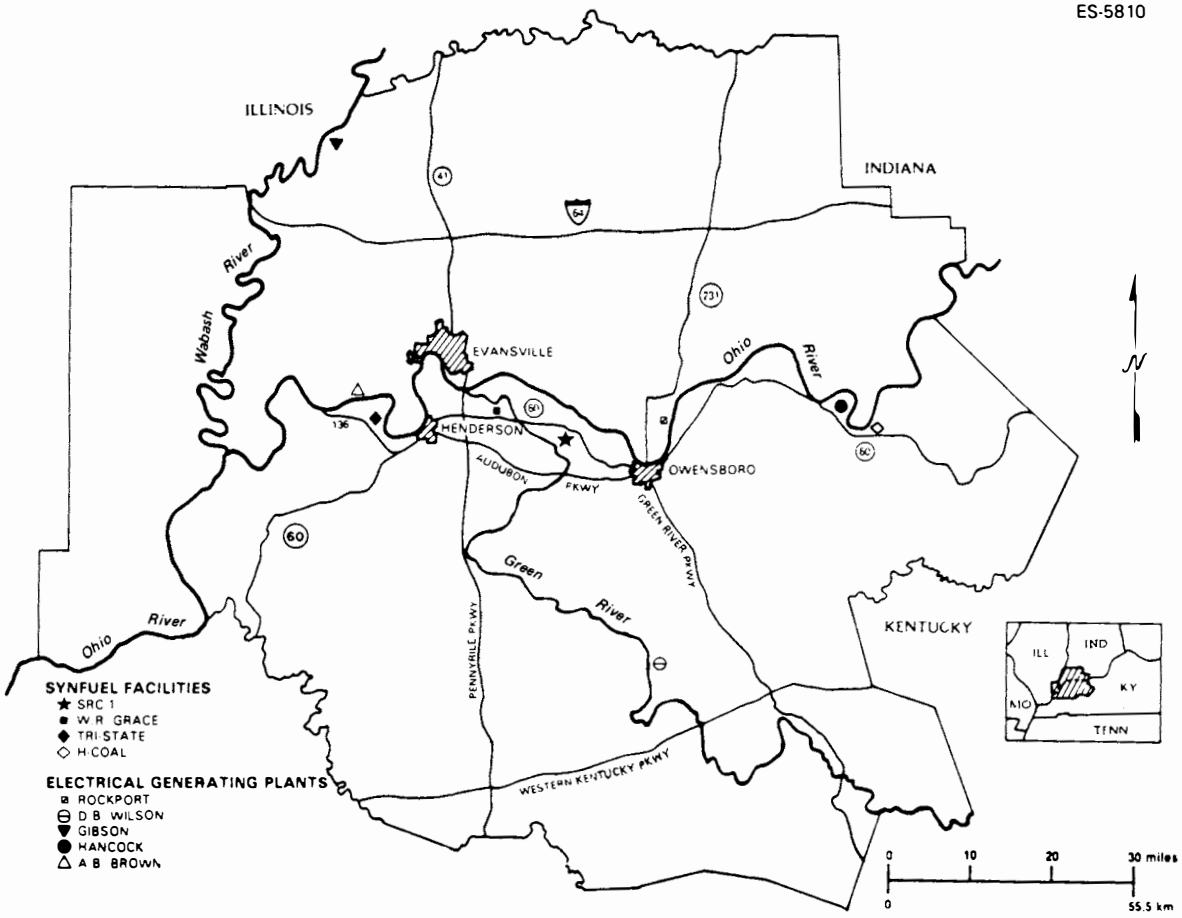
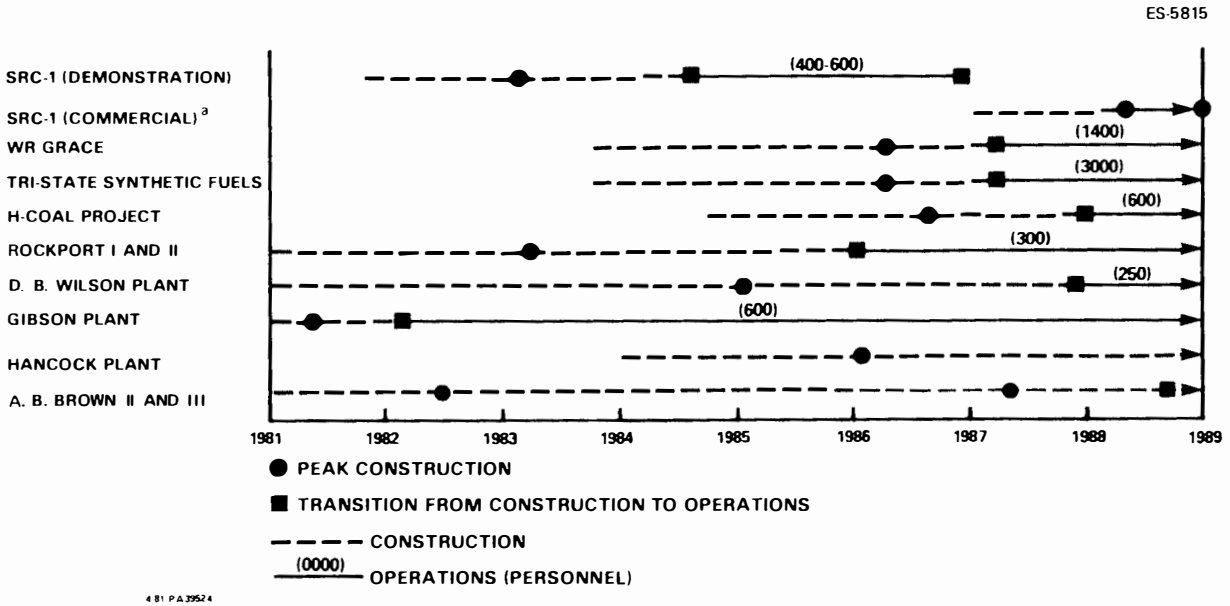


Fig. 4.9. Energy project locations in the vicinity of the SRC-I site.



[a]IF COMMERCIALIZATION PROVES FEASIBLE, SRC I OPERATIONS WOULD OCCUR AFTER 1989, WITH AN OPERATIONAL MANPOWER LEVEL OF 2200.

Fig. 4.10. Projected cumulative construction and operation schedule for nine energy projects in the vicinity of the Newman site.

are expected to be extremely important. Eight of the nine energy-related projects identified in the region are featured in this analysis (one of the fossil-fuel plants, Gibson 5, will be completed before SRC-I construction is expected to begin). No other projects were identified during the scoping process that elicited inputs from the public and other local, State, and Federal agencies.

The primary features that could experience cumulative impacts include (1) social, economic, and cultural resources; (2) drainage networks; (3) regional air masses; (4) urban centers; (5) coal resources; and (6) highway, rail, and water transportation routes. Based on an assessment of the location of the competing plants and resources, specific plants having potential for significant cumulative effects with the SRC-I plant are identified for each regional feature (see Table 4.44).

Table 4.44. Anticipated degrees of spatial interaction with SRC-I[a]

	Drainage networks	Regional air masses	Urban centers	Coal reserves	Transportation routes
Grace	H	M	H	H	H
Tri-State	L	L	H	H	H
H-Coal	L	L	M	H	M
Rockport	L	L	M	H	M
D. B. Wilson	H	L	M	H	M
Gibson	L	L	M	H	L
Hancock	L	L	M	H	M
A. B. Brown	L	L	M	H	M

[a]Conservative assumptions used in determining categories low (L), medium (M), high (H).

4.2.5.2 Land

It is anticipated that effects on land use, geology, soils, and terrestrial ecology as a result of SRC-I and other energy developments will for the most part be site specific and localized and will not result in cumulative impacts. However, as is stated in Sect. 4.2.1.1, the SRC-I project, as well as the other energy projects, will result in a reduction of prime farmland.

Because the percentage of local agricultural land to be affected is low (0.3% at the county level for the SRC-I facility), it is unlikely that the plants themselves will contribute significantly to this problem. At the same time, it is probable that indirect impacts such as residential and commercial development will cause some withdrawal of agricultural land on the margins of existing urban areas.

Both the direct and indirect impacts of the four synfuels plants and the five electrical generating plants proposed, planned, or under construction will accumulate within the region. The Kentucky Department of Energy Study of March 1981 noted that each of the four synfuel plants will require from 1000 to 2000 acres of land for the facility. However, the phase-zero deliverables for the H-Coal plant describe an 8500-acre site. Therefore, the amount of acreage required could be much higher. Most of this acreage would be farmland, much of which may be prime farmland. Additional land may in some cases be needed for waste disposal. For the four synfuels plants this would amount to roughly 23 ha (56 acres) per year, which could be returned to productive use.

About 1619 ha (4000 acres) of land might be disturbed annually by surface mining of coal for the four plants. Some of this coal would be under agricultural lands, although surface mining laws require that any farmland disturbed be returned to its original productivity.

Population growth resulting from the new plants will result in an additional loss of land to urban sprawl. It has been estimated that the maximum additional urban areas needed from 1990 to 1992 are 1335 to 2023 ha (3300 to 5000 acres) for plant operation and 1538 to 3076 ha (3800 to 7600 acres) for coal mining. It is not feasible to estimate what fraction of these acreages would be farmland, although the fraction could be high.

Land acreage lost to power line and transportation corridors would be much less, and the impact of this loss would be relatively minor. Agricultural activities would probably be allowed to continue underneath power lines.

The sites are sufficiently dispersed and separated by local relief so that no direct cumulative impacts to the land are anticipated. None occur on direct downslope drainage courses of the others except along major drainage channels. The sites are sufficiently dispersed that they should have no direct cumulative effect on terrestrial animal habitats. It is likely, however, that recreational activity and land use will increase in the area, thus increasing man-induced stresses on local animal populations. Secondary land use impacts, such as residential, commercial, institutional, and industrial development resulting from increased regional population pressure, will lead to direct encroachment on terrestrial habitats. Air pollution also may degrade terrestrial habitats, but cumulative air quality effects for SRC-I are expected to be limited to problems associated with the W. R. Grace project. No endangered terrestrial species occur in the area, with the exception of the Indiana bat, whose habitat extends throughout the area during the summer months. The facilities occupy an insignificant portion of the species range, although reduction of riverine habitat and air pollution may have some impact on the species. The plants will have no cumulative effect on the winter habitat considered critical to the species' survival (see Appendix K, Sect. K.1.6.1).

4.2.5.3 Water

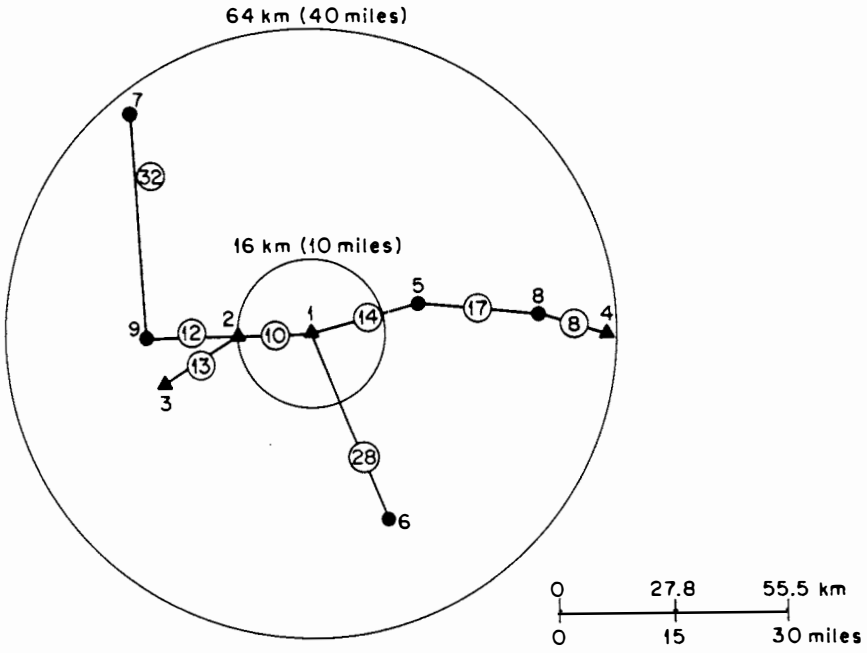
All nine energy facilities are located in the drainage basin of the Ohio River (Fig. 4.11). Five of them (A. B. Brown, Tri-State, Rockport, Hancock, and H-Coal) are located on the main stem of the Ohio. Three (W. R. Grace, SRC-I, and D. B. Wilson) are on the Green; and one (Gibson) is on the Wabash. W. R. Grace is located near the mouth of the Green River, however, and is situated far enough downstream to be within the backwater navigation pool of the Ohio. Consumptive withdrawals this close to the confluence are likely to be more significant to the Ohio River than to the Green River. Impacts to the Green and Wabash rivers are assumed to be limited to plants located on those tributaries, but water quantity and quality impacts of all nine plants could have a cumulative impact on the Ohio downstream of points of confluence. The greater volume of flow in the Ohio reduces the level of impacts resulting from cumulative effects but extends the ultimate consideration of cumulative impacts to the entire Ohio River basin.

Cumulative impacts to the Green River associated with the SRC-I facility and other energy developments in the area on surface hydrology, surface water quality, and aquatic ecology are primarily related to the extent to which consumptive water will be required and to the volume and quality of effluent discharge during the operation phases of the various plants. Because of the design features of the projects, no cumulative effects are anticipated to occur for groundwater quality. It is possible, however, that unforeseen problems may occur, such as breaks in the waste containment system, which may go undetected for a period, thus facilitating infiltration of contaminants into aquifers. These types of problems can be dealth with case by case through a continual environmental monitoring program such as those included in the design of the SRC facilities.

Water quantity

Projected water consumption could generate significant cumulative impacts on surface hydrology. The SRC-I demonstration plant is expected to consume approximately 159 liters/s (2520 gpm), which is less than 2% of the 7-d, 10-year low flow of the Green River (11,160 liters/s). Estimated water use during commercial operation of SRC-I is estimated to be 747 liters/s or 6.7% of the 7-d, 10-year low flow of the Green River. If the commercial-scale water requirements from the Green River for SRC-I are combined with other projects (W. R. Grace, D. B. Wilson, and the existing Paradise Steam Plant upstream of D. B. Wilson) in full operation, water available to downstream users could be significantly reduced. If water use attributable to W. R. Grace is of the same general magnitude as that of SRC-I (1000 liters/s), the combined water use demands of

ES-5629AR



▲ SYNFUEL FACILITIES
1. SRC-I
2. W. R. GRACE
3. TRI-STATE
4. H-COAL

● ELECTRICAL GENERATING PLANTS
5. ROCKPORT
6. D. B. WILSON
7. GIBSON
8. HANCOCK
9. A. B. BROWN

CIRCLED NUMBERS CONNOTE
APPROXIMATE DISTANCE IN MILES

Fig. 4.11. Relative locations of the nine energy projects located in the drainage basin of the Ohio River.

the W. R. Grace and SRC-I facilities in commercial operation would result in a consumptive use of more than 15% of the estimated 7-d, 10-year low flow of the Green River. Additional consumption by the 880-MW D. B. Wilson plant would use around 550 liters/s,[49] not to mentional the upstream consumption of about 1133 liters/s by TVA's Paradise Steam Plant in Muhlenberg County, Kentucky.[50] Potential total consumption by energy facilities alone would be about 3450 liters/s representing 25 to 30% of the 7-d, 10-year low flow.

In a previous study of water availability for energy development in the Ohio River Basin, conducted for DOE at the request of the Ohio River Basin Commission (ORBC), the availability of 10% of the 7-d, 10-year low flow for energy was specified by the ORBC as the guideline criterion for identifying potential negative impacts.[50,51] The possibility of over 30% cumulative consumption by energy facilities from the Green, as estimated above, clearly exceeds this 10% guideline. The 10% value is not an absolute threshold, however, and the location of the SRC-I plant, and particularly the W. R. Grace plant, so near to the confluence with the Ohio may reduce the actual impacts to the Green River system to less severe levels than the percentage values alone might indicate. Some of the impacts of consumption may however be transferred to

the Ohio mainstem where their importance will depend on cumulative upstream consumption in the Ohio Basin. In this case, serverity of impacts to the Ohio and lower Green will further depend on the coincident severity of low-flow conditions throughout the region. Agglomeration of plants in the area could have potentially significant cumulative impacts on water quantity, particularly when competing domestic, industrial, and other project-related consumption is considered. No detailed projections of the water demands by nonenergy competing use sectors are available, but during times of drought emergency, the Division of Water of the Kentucky Department of Natural Resources may temporarily allocate or restrict consumptive water use. Although domestic uses would definitely take precedence, no definite plans or priorities have been established to deal with such activities. A study to assess the severity of impacts due to cumulative water consumption should be performed prior to commercialization.

Water quality and aquatic ecology

Water quality problems are associated primarily with the operation phase of the commercial plant. In assessing the cumulative impacts on water quality, it is assumed that all the coal conversion facilities operate predominantly in a zero-wastewater discharge mode except when wastewater recycling systems are nonoperative. Therefore, impacts to water will result from occasional wastewater discharge and from infrequent spill events. Because pollutant releases will be relatively small, any direct cumulative effects will be infrequent and minor. During low-flow periods, the consumptive water use of the facilities in the region will indirectly affect water quality by reducing the river's capacity to dilute incoming contaminants downstream. For instance, if the Grace plant were discharging wastewater during a 7-d, 10-year low-flow period, the consumptive water use by upstream facilities, including the SRC-I commercial plant, would cause roughly 30% higher concentrations of chemicals in the Green River resulting from Grace's discharge. However, this situation would affect only a small area because the Grace plant is located less than 2 km from the Green River's confluence with the Ohio. Cumulative consumptive water use on the Green River may have a small impact on water quality in the Ohio River due to reduced dilution of the Ohio by the Green River's flow. This problem would be accentuated by the consumptive use of projects (Tri-State, H-Coal, and Rockport) along the Ohio.

The primary concern to aquatic ecology resulting from multiple facilities is the increased release of heavy metals and polynuclear aromatic hydrocarbons (PNAs) and subsequent accumulation of these chemicals into river sediment and organisms. Aquatic biota in the rivers (especially sediment- and suspension-feeding animals) may experience chronic, low-level effects. These impacts would occur in proportion to the quantity of contaminants released by occasional wastewater discharge or infrequent spills. Continual monitoring during each project's operational phase will provide information necessary for accurate assessment of such effects (Sect. 4.5).

4.2.5.4 Air

Cumulative air quality problems are associated primarily with the commercial operation phase. It is assumed that all air quality impacts in the region occur on common regional air masses because no major landforms that occur locally disrupt air flow from site to site and because the cumulative impact study area is supplied by air masses from common source regions. This statement is true for most of the Midwest, however, and it is therefore necessary to define more narrowly the area of cumulative air quality impacts. The area was narrowed to the distance within which a plant would have a significant impact, as significance is defined under PSD regulations and guidelines. According to this definition, analysis of the impact of a source beyond the distance at which the ambient concentration becomes insignificant is unnecessary. The threshold of significant impact is defined as an ambient concentration of 1 $\mu g/m^3$ for an annual average and 5 $\mu g/m^3$ for a 24-h average for SO_2 and TSP and 25 $\mu g/m^3$ for a 3-h average for SO_2.

The maximum impact resulting from the SRC-I plant at 10 km is less than 1 $\mu g/m^3$; consequently, the effect becomes insignificant at distances greater than 10 km. The distance from the SRC-I plant to the nearest proposed synfuel plant is 16 km (Fig. 4.11), well beyond any significant impact of SRC-I.

Only one of the sites, the W. R. Grace project, is in sufficient proximity that its emission plume could overlap the SRC-I plume under certain wind conditions that occasionally occur in the region (Fig. 4.9). It is considered unlikely that emissions from the other plants will reach the Newman site in sufficient concentrations to affect attainment of air quality standards. All the plants are located with in 64 air km (40 air miles) of the Newman site. No plant is within 15 km (9 miles) of the Newman site, and all the plants are at least 11 km (7 miles) apart.

A preliminary assessment indicates that, because of the distance from SRC-I to the competing sites, cumulative impacts to the air at SRC-I are insignificant except for a small impact from the proposed W. R. Grace plant. The Grace facility, 16 km (10 miles) away, is the closest proposed plant to the SRC-I site and is also the largest of the other plants. In the absence of sufficient data on exact plant locations, pollutant emission rates, physical stack parameters, and other data necessary for dispersion modeling, simplifying assumptions were required for assessment of probable cumulative impacts on air quality. The SRC-I demonstration plant emissions data were prorated to production levels of the other proposed coal conversion plants in commercial operation to conservatively estimate their emissions. This approach should overestimate maximum ambient concentrations. All additional emissions are assumed to occur at the same release height as the SRC-I plant. In reality, emissions are likely to occur over a larger area than assumed, thus causing atmospheric concentrations lower than estimated.

Because specific data is unavailable on the other proposed plants, general dispersion models, PTMAX and PTDIS were used to estimate the likelihood of significant impact from them. These are EPA-approved screening models and, consequently, are quite conservative; they, however, lend themselves well to the problem. More specific models would require input of more specific data. Using PTMAX and PTDIS, it was found that if the W. R. Grace plant emitted 10 times the emissions of the SRC-I plant, its impacts would still be insignificant at the distance to the SRC-I plant, the nearest synfuel plant. The rest of the synfuel plants are still further apart than W. R. Grace and SRC-I.

Other nonsynfuel plants were also modeled and found not to have significant cumulative impacts. A. B. Brown (No. 9, Fig. 4.11) and other major proposed plants were also found to pose probable insignificant impacts on other facilities. Existing plants were not modeled because area monitoring will give a more accurate assessment of their impacts.

Consumption of prevention of significant deterioration (PSD) increments, especially short-term (3-h and 24-h) increments, is extremely local. It is highly unlikely that the short-term maxima of any two plants will occur in the same general location unless they are extremely close. Long-term averages experience the greatest effect, and these become minimal at distances greater than 15 km (9 miles).

This diminished effect with distance also applies to predicted impacts on nonattainment areas. The cities of Owensboro and Henderson are designated as nonattainment areas for total suspended particulates (TSP). Cumulative impacts are expected to be minor, but they will add slightly to problems of nonattainment of TSP standards in the cities.

If various proposed facilities demonstrate the ability to meet the air quality standards required for a PSD permit, which must be obtained prior to commercial-scale construction, the cumulative effect of the other proposed plants will be addressed in the permit applications and cannot exceed those standards.

There is some concern over the cumulative impacts of the various proposed plants within the 64-km (40-mile) radius of SRC-I. National Ambient Air Quality Standards address this concern and limit cumulative impacts to levels acceptable to health and welfare. As the various plants apply for permits to construct, their environmental analyses will have to show that the cumulative effects of the existing plants and those currently under construction, along with the anticipated emissions from their own plant, will not violate air quality regulations.

4.2.5.5 Noise

No direct cumulative noise impacts caused by agglomeration are anticipated to occur because of the distance between sites. However, urban areas and transportation routes will experience increased noise levels. These increases will be proportional to the cumulative impacts that are anticipated to result from increased traffic and development.

4.2.5.6 Economic, social, and cultural

Socioeconomic problems are associated primarily with construction phases of the demonstration and commercial facilities. The potential economic, social, and cultural impacts of the proposed SRC-I facility are addressed in Sect. 4.2.4.1. The following discussion will focus only on those jurisdictions (Daviess, Henderson, and Vanderburgh counties) identified in that earlier analysis as composing the primary impact area for the SRC-I project. The impacts to the

tri-county region of all the major construction projects identified in Table 4.43 will be treated below. This discussion is not intended to be an analysis that produces definitive projections regarding impacts of multiple facilities. Rather, its purpose is to determine, with the limited data available, whether significant adverse socioeconomic impacts could occur. The SRC-I impacts must be appreciated within this framework of potential impacts from multiple projects.

The key factor in determining the magnitude of socioeconomic impacts is the construction work force. Of particular importance are in-migrant workers and their dependents who relocate to the impact region for employment at the facility. These individuals create an array of demands for new services and, under particularly high levels of in-migration, may contribute to breakdowns in the existing social and political fabric. Careful coordination of scheduling of all synthetic fuel projects in the area will help avoid concurrent work-force peaks, thereby reducing project-induced cumulative impacts.

Labor

Table 4.43 lists the coal-fired steam plants and synthetic fuel plants, either planned or under construction, in the 21-county region from which the SRC-I facility will draw most of its workers. Not all of these construction efforts are scheduled to reach their peak level of activity at the same time, but the overlapping of their schedules and, consequently, their competing demands for available workers suggest that potentially substantial impacts to local communities could result. The cumulative man-power demands of these facilities are depicted in Fig. 4.12, and the estimated labor demands for each facility are set forth in Table 4.45 (the estimates are based on current construction schedules). Though a range of 3500 to 5000 construction workers for the SRC-I demonstration phase peak has been used throughout the preceding sections, the upper figure of 5000 is used in the following discussion to provide a worst-case analysis. A work force of 10,000 is assumed for the commercial phase construction peak.

The power plant and synfuels-related demand for construction workers in the cumulative impact region after 1981 may reach as high as 24,700, in addition to the 3,000 power plant construction workers who will be employed in the region prior to SRC-I startup. The total number of in-migrant workers can be calculated using the following assumptions: (1) the relatively small supply of labor remaining available in the region during the peak period will require the importation of approximately 75% of the cumulative work force and (2) two-thirds of these workers will bring families of an average size of 3.2 people. The resultant peak in-migrant population for the entire region comes to approximately 45,500 (approximately 18,500 construction workers and 27,000 dependents). Additional population associated with indirect economic expansion could bring this total to nearly 55,000 (Table 4.46). Therefore, in the worst-case analysis, the 21-county SRC-I impact area could experience an increase equal to 8% of its current population of 679,000 by 1986, the year in which the regional labor demands will peak.

Population

Most definitions of boomtowns establish an 8 to 10% annual population growth as the point at which local public and private infrastructures begin to break down. Accordingly, peak period in-migration can be expected to be significant but should not create a boomtown situation for the entire 21-county region. For particular communities within this larger region, however, the rate of growth can be expected to be much higher than the 8% average mentioned above, resulting in the generation of much more severe socioeconomic impacts.

To gain a more realistic picture of what this population growth will mean for the various communities in the impact region, accurate projections must be made concerning where in-migrating workers and their dependents will settle within the 21-county area. A gravity model was used to allocate in-migrants to specific counties, based on their population and distance from the construction projects listed in Table 4.43. The model was run for each of three significant years: (1) 1983, the projected peak labor-force year for SRC-I; (2) 1986, the projected peak year for the region for all major construction projects; and (3) 1989, the projected peak year of the SRC-I commercial construction phase. From these calculations, those counties that will be most heavily affected by the cumulative influx of population were identified (Table 4.47). Counties are defined as being greatly affected if they are projected to receive over 5% of the cumulative in-migrant population or will experience over a 5% increase in their 1989 populations. The number of in-migrants shown in Table 4.47 represents a worst-case analysis and could be somewhat high, particularly for 1983, when the cumulative work force will almost certainly not be large enough to necessitate 75% in-migration.

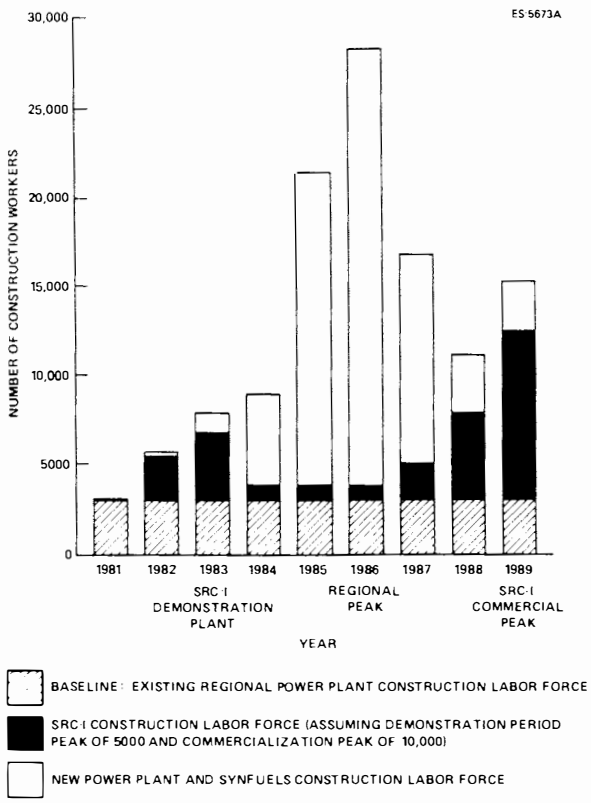


Fig. 4.12. Projected cumulative construction labor demand according to present schedules. The numbers are annual averages and differ from those given in the Draft Environmental Impact Statement in that they show only power plant and synfuels employment — not construction employment of all types.

Housing, services, and infrastructure

The three counties of primary concern in this document will receive a significant proportion of cumulative growth in all three peak years. In 1983, project-induced in-migration is expected to raise the population of Daviess, Henderson, and Vanderburgh counties by 3.6, 2.8, and 1.5% respectively (Table 4.47). All three counties are expected to be able to accommodate this relatively moderate growth, but problems may occur in some areas. The following discussion will focus on impacts to housing, water and sewerage services, schools, and transportation as being representative of the nature and magnitude of the impacts likely to occur.

In Daviess County, the demand for housing could exceed the supply, but there should be excess stock available in Henderson and Vanderburgh counties. Sufficient excess capacity exists in area schools to easily accommodate projected population growth. Similarly, anticipated water and sewerage demand can be met by existing systems in the three host counties. As is indicated in Sect. 4.2.4.1, impacts on area transportation systems will be extremely significant from the SRC-I project alone. In 1983, these impacts are likely to increase slightly as a result of other construction projects in the region, especially with the start of construction on the W. R. Grace and Tri-State synfuel facilities in the latter half of that year.

More severe cumulative impacts can be anticipated in 1986, the regional peak construction-labor-force year. As is shown in Table 4.47, Henderson County is expected to receive an additional 18,440 residents, a number equal to nearly half its 1980 population. The primary cause of this growth is the simultaneous peaking of the labor forces at the W. R. Grace and Tri-State synfuels plants, both located in Henderson County. The work force at the SRC-I plant will be minimal during this time and should not contribute significantly to regional impacts. Still, because of the Grace and Tri-State projects, Henderson County's growth rate will be many times that projected for 1983 to result from SRC-I construction (Table 4.48) and, consequently, the accompanying

Table4.45. Preliminary worst-case estimates of direct construction craft labor demand by project within 110 km of the SRC-I site

	Year	Quarter	Synthetic fuel plants					Electric generating plants					Total employment Based on annual averages
			SRC-I		W. R. Grace	Tri-State Synfuel	H-Coal	Rockport[a] I and II	Big Rivers[b] D. B. Wilson I and II	KU[c] Hancock I and II	SIG & E[d] A. B. Brown II and III	PSI[e] Gibson V	
			Low	High									
	1981	1						1,240			425	700	3,080
		2						1,410			500	900	
		3	0	0				1,590			560	1,200[f]	
		4	150	210				1,770	300		620	900	
	1982	1	390	560				1,950	300		680	(600)	5,620
		2	1,180	1,690				2,120	300		735[f]		
		3	2,120	3,030				2,300	300		680		
		4	3,020	4,320				2,480	400		620		
SRC-I Demonstration peak	1983	1	3,500[f]	5,000[f]				2,740	400		560		7,733
		2	3,160	4,520	0	0		3,100[f]	500		500		
		3	2,230	3,190	260	620		2,830	600		400		
		4	1,240	1,170	260	620		2,560	800		300		
	1984	1	460	660	740	1,680		2,300	900	0	200		8,767
		2	10	20	740	1,680	0	2,030	1,100	110	100		
		3	420	600	2,200	5,070	210	1,770	1,200[f]	220	90		
		4	420	600	2,200	5,070	560	1,500	1,200[f]	220	90		
	1985	1	420	600	3,920	9,050	1,130	1,240	1,200[f]	330	90		20,819
		2	420	600	3,920	9,050	1,690	970	900	330	250		
		3	420	600	5,610	12,950	2,360	700	900	440	350		
		4	420	600	5,610	12,950	3,020	440	800	550	450		
Regional peak	1986	1	420	600	6,080	15,000[f]	4,320	350	800	660	550		27,715
		2	420	600	6,500[f]	15,000[f]	5,000[f]	260	800	770	650		
		3	420	600	5,860	13,530	5,000[f]	260	700	880	700		
		4	420	600	4,140	13,530	4,510	260	600	1,000[f]	750		
	1987	1	420	600	4,140	9,560	3,850	260	500	1,000[f]	800		16,293
		2	1,220	1,830	2,300	9,560	3,190	260	400	1,000[f]	868[f]		
		3	1,220	1,830	2,300	5,310	1,770	260	300	880	720		
		4	1,920	2,880	860	5,310	660	260	250	880	580		
	1988	1	1,920	2,880	860	1,980	600	260	250	770	440		10,643
		2	1,920	2,880	1,420	3,000	600	260	250	660	300		
		3	4,180	8,270	1,420	3,000	600	260	250	660	150		
		4	4,180	6,270	1,420	3,000	600	260	250	660	90		
SRC-I Commerical peak	1989	1	4,180	6,270	1,420	3,000	600	260	250	550	90		14,741
		2	4,750	9,500	1,420	3,000	600	260	250	220	90		
		3	4,750	9,500	1,420	3,000	600	260	250	220	90		
		4	5,000[f]	10,000[f]	1,420	3,000	600	260	250	220	90		

[a] Rockport facilities of Indiana and Michigan Power Company, Units I and II.
[b] D. B. Wilson facility of Big Rivers Electric Company, Units I and II.
[c] Hancock facility of Kentucky Utilities Company, Units I and II.
[d] A. B. Brown facility of Southern Indiana Gas and Electric Company, Units II and III.
[e] Gibson facility of Public Service of Indiana, Unit V.
[f] Construction peak.

Table 4.46. Project-induced in-migration during peak cumulative construction period, 1986

	Total workers	In-moving workers	In-moving dependents	Total in-movers
Direct employment	24,700[a]	18,500[b]	27,000[c]	45,500
Indirect employment	18,500[d]	3,700	5,500[e]	9,200
Total employment (Direct and indirect)	42,200	22,200	32,500	54,700

[a] This number does not include 3,030 construction workers already employed prior to SRC-I start-up (1981).
[b] Assuming 75% in-migration.
[c] Assuming 20% in-migration.
[d] Indirect employment calculated from RIMS multipliers (Table 3.17).
[e] Assuming two-thirds of workers will bring families with an average size of 3.2.

Table 4.47. Counties most heavily impacted by worker in-migration resulting from cumulative regional labor demands

County	1980 population	Number of in-migrant workers[b]	Total number of in-migrants[c]	Total in-migration as percentage of 1980 population	Total in-migration as percentage of in-migration for entire region
1983					
Daviess, Ky.[a]	85,702	1,260	3,110	3.6	29.7
Henderson, Ky.[a]	40,797	470	1,160	2.8	11.1
Vanderburgh, Ind.[a]	166,723	980	2,420	1.5	23.1
Spencer, Ind.	19,395	610	1,510	7.8	14.4
Other Counties		920	2,270		21.7
Total		4,240	10,470		100.0
1986					
Daviess, Ky.[a]	85,702	1,820	4,480	5.2	8.2
Henderson, Ky.[a]	40,797	7,470	18,440	45.2	33.7
Vanderburgh, Ind.[a]	166,723	6,420	15,840	9.5	29.0
Perry, Ind.	19,211	880	2,170	11.3	4.0
Breckenridge, Ky.	16,862	610	1,500	8.9	2.8
Union, Ky.	17,807	440	1,090	6.1	2.0
Hancock, Ky.	7,710	170	410	5.3	0.8
Other Counties		4,370	10,770		19.5
Total		22,180	54,700		100.0
1989					
Daviess, Ky.[a]	85,702	2,960	7,310	8.5	28.1
Henderson, Ky.[a]	40,797	2,220	5,480	13.4	21.0
Vanderburgh, Ind.[a]	166,723	2,890	7,140	4.3	27.4
Other Counties		2,480	6,130		23.5
Total		10,550	26,060		100.0

[a] SRC-I impact counties for Newman, Ky., site.
[b] Direct plus indirect employees, assuming 5,000 SRC-I workers as worst case.
[c] Workers plus dependents, assuming 67% of workers bring families with an average size of 3.2.

Table 4.48. A comparison of project-induced in-migration for SRC-I alone and all large construction projects in cumulative impact region

	Total in-migration for SRC-I alone, peak year (1983)[a,b]	Total in-migration for all large construction projects in region,[c] peak year (1986)
Daviess Co., Ky.	1,440	4,480
Henderson Co., Ky.	550	18,440
Vanderburgh Co., Ind.	800	15,840

[a] Local movers/travellers plus distance movers/travellers.
[b] Assuming SRC-I will be the only large construction project in the region at this time.
[c] Assuming all currently planned projects are built.

socioeconomic impacts will be much more severe than those discussed in Sect. 4.2.4.1. Because the majority of in-movers to the county are expected to settle in the city of Henderson, demands for housing and public services could seriously overload that municipality's ability to accommodate growth during the regional peak year unless extensive mitigation measures are taken. The number of housing units required (assuming the one unit per worker shown in Table 4.47) will equal about 10 times the number currently available, and the city water supply (Sect. 3.2.4.4) will also be greatly overtaxed. Despite the large number of regional vacancies, the Henderson County schools will also be inadequate to deal with the projected influx of school-age children. On the other hand, sewerage capacity in Henderson could be adequate even for the phenomenal amount of growth projected.

Vanderburgh County will receive almost as large a share of the 1986 peak labor force as will Henderson. However, because Vanderburgh is larger, this influx will amount to slightly less than 10% of its 1980 population. Most of these in-movers are expected to settle in and around Evansville. Socioeconomic impacts in this area will be significant but not as severe as in Henderson. The demand for housing (again assuming the one unit per worker shown in Table 4.47) will be more than double that currently available, and the need for the classroom space will approach current capacity. Existing water and sewerage services (Sect. 3.2.4.4) should be more than adequate, however, to handle even this peak-period growth.

Daviess County will experience far less growth during this regional peak period than either of the other two counties, because the heaviest construction activity will be occurring at the W. R. Grace and Tri-State synfuel facilities, both located in Henderson County. Still, with nearly 4500 in-movers expected (Table 4.47), Daviess County will not completely escape project-induced impacts. The demand for housing in this peak construction period will be roughly double the number of currently available units, but the need for classroom facilities and city water should be adequately met by existing capacities. Sewerage services should also be more than adequate to meet in-migrant needs during periods of average flow, but the problems already experienced at peak periods, when wastewater flow is more than double the design capacity of Owensboro's sewage treatment plant, will be exacerbated. Extremely severe traffic problems will occur in all the counties discussed here, particularly Daviess and Henderson, as a result of cumulative construction activities. A more detailed transportation analysis is found in Sect. 4.2.5.7.

These project-induced public service demands will require public expenditures that could strain the fiscal capabilities of the host counties. In Henderson County, where the impacts are expected to be most severe, local revenues should be significantly increased when the Grace and Tri-State synthetic fuel facilities go on the tax rolls. Though substantial, these revenues are not expected to accrue to the county government until after construction is completed and the peak demand for public services is past. Since the municipality of Henderson and the surrounding counties will not be empowered to tax these facilities, they will not receive direct compensation for any project-induced expenditures. The rapid growth and boomtown impacts on the community public service infrastructure could also be accompanied by significant changes in the pace and quality of life, particularly in Henderson County. In addition, construction of the large number of power plants and synthetic fuel facilities planned for the area could result in changes in the local economic character, leading to a greater emphasis on industry and a correspondingly lesser empahsis on agriculture.

The peak-period impacts will result almost entirely from the labor demands of power plants and synfuels facilities other than SRC-I, which will have only a minimal work force on site in 1986 (Table 4.45). If, however, the SRC-I schedule slips by two or three years, causing its peak work force to coincide with the regional peak, the socioeconomic impacts projected above for Daviess, Henderson, and Vanderburgh counties could be magnified. The addition of an extra 3500 to 5000 workers is, numerically, relatively small compared to the 27,700 construction workers already scheduled to be employed in the region, but the extra demands of SRC-I in-migrants would be likely to further tax severely burdened service delivery systems. In any case, carefully designed and implemented mitigation measures will be essential to successfully manage peak-period impacts.

In the event that the SRC-I plant continues successfully into the commercialization phase, another construction peak can be expected to occur in 1989, but the total number of construction jobs will be roughly only half those existing in 1986 (Fig. 4.12). The likely effect of this will be a net loss of construction-related population for the impact region as a whole, but the impacts will be very unevenly distributed. In Henderson and Vanderburgh counties, there will be fewer project-induced residents in 1989 than during the cumulative construction peak three years earlier (Table 4.47). Though this still represents a significant increase in population over

1980 levels, particularly for Henderson County, additions to the local housing stock and service capacities created to deal with regional peak in-migration in 1986 should be more than adequate to deal with the smaller number of in-migrants coming to the area (or remaining from the earlier influx) in 1989. In fact, the major impacts experienced in these two counties, particularly in Henderson, may be due to the rapid out-migration of previously employed construction workers in contrast to the regional peak year of 1986 when in-migration will be the driving force behind area impacts.

In Daviess County, however, the number of project-induced in-migrants will increase dramatically over 1986 levels. The 4480 project-related workers and dependents who will move to Daviess County in 1986 will be joined by at least an additional 2830 new residents in 1989, representing a total increase to the 1980 population of 7310, or 8.5% (Table 4.47). The latest wave of in-migrants will experience a renewed housing shortage and possible problems with the Ownesboro waste treatment plant if necessary improvements have not been made prior to that time. The proposed SRC-I commercialization work force of 5000 to 10,000 should cause extremely severe traffic problems in all the impact counties, unless significant improvements to local transportation systems have already been made.

The preceding discussion suggests that the cumulative impacts from a substantial number of major construction projects will create some serious socioeconomic burdens in the 21-county region. From the tentative data available, it appears that the overall region will not experience boomtown impacts but that specific communities will incur levels of in-migration great enough to seriously impair the delivery of local services. The magnitude of cumulative impacts is also sensitive to scheduling changes. A joint mitigation plan should be developed and implemented by the major area developers (particularly SRC-I, W. R. Grace, and Tri-State) in cooperation with local and regional governments. All relevant project data would be made available on a quarterly basis to assist in the preparation of the plan and to identify any modifications that may become necessary over time. Such a regional mitigation plan resulting from these efforts would guide the timely provision of those services and accommodations necessary to handle project-induced growth without any serious disruptions to local infrastructure. Contingency plans should also be made to deal with any worsening of projected impacts which may arise as a result of delayed construction schedules. In the event of construction delays, the potential for SRC-I contributing significantly to severe cumulative socioeconomic impacts would exist without the coordinated scheduling and cooperative mitigation planning described above.

4.2.5.7 Traffic

In the three impact counties under consideration, the traffic impacts associated with cumulative construction in 1983 (the SRC-I peak year) will be only slightly greater than those predicted for SRC-I alone. During the regional peak construction year of 1986, however, transportation impacts in Daviess, Henderson, and Vanderburgh counties will be significantly worse. Though the construction work force still employed at SRC-I will be minimal, both the W. R. Grace and Tri-State synfuels plants will be at peak, averaging about 5600 and 14,300 workers on site, respectively, throughout the year. Most routes between the main population centers of Owensboro, Henderson, and Evansville will be heavily taxed, with extreme congestion on U.S. 60 between Owensboro and Henderson and on State Route 136 west from Henderson to Geneva (the site of the Tri-State plant). Should there be a delay of two or three years in the SRC-I construction schedule, causing it to coincide with peak or near-peak activity at the Grace and Tri-State facilities, traffic congestion in the area will be worsened substantially. The importance of project timing in determining the severity of area traffic problems suggests that one general impact management strategy that could be taken would be to coordinate the scheduling of all synfuels projects planned for the area to minimize concurrent construction. Even without this overlap, however, carefully designed and implemented mitigation measures will be necessary to avoid serious dislocations to the area transportation network (see Sect. 4.2.4.1 for mitigation strategies proposed for SRC-I alone).

In 1989, area transportation impacts will also be severe, particularly on U.S. 60, as SRC-I commercial plant construction peaks with a work force of 5000 to 10,000. W. R. Grace and Tri-State construction activities are scheduled to decline prior to that time, but should delays occur, causing SRC-I commercial plant construction to coincide with the efforts at Grace and Tri-State, the impacts on area roads will be exacerbated. Finally, grade-level rail crossings on major area highways could cause delays or local traffic jams because of the increase in

train movements expected to result from coal and product shipments. There is likely to be sufficient flexibility, however, to allow scheduling to avoid peak travel times on U.S. 60 (Sect. 4.2.4.1).

Without effective mitigation, project-induced traffic would entail an unacceptable social impact to the communities in the vicinity of the proposed site.

4.2.5.8 Coal reserves

Impacts on coal reserves are associated primarily with the commercial-operation phase of SRC-I. Coal reserves in Kentucky, especially in Hopkins and Muhlenberg counties, are likely to experience heavy demand as a result of the many new coal conversion facilities and power plants. This demand should result in increased coal-mining activity and decreased unemployment within the impact region. Other reserves occur in nearby areas in Indiana and Illinois. Although demand may initially be concentrated in particular subregions, barge transport along the Ohio system and rail transport in the area are sufficiently integrated so that economic incentives tend to distribute impacts among coal reserves throughout the entire coal mining region. Cumulative impacts on coal reserves will thus be distributed throughout the region and, for the most part, will be independent on the precise location of coal users in the area.

4.2.5.9 Transport of coal and products

Rail transport

Rail transport problems are associated primarily with the commercial-operation phase. All nine facilities are located on or near major rail lines (Fig. 4.13). In two cases a single rail line supplies access to two or more facilities. The Grace and SRC-I facilities are located on the Owensboro to Henderson line, and Tri-State is located just west of Henderson, with Henderson as its closest point of rail access. Gibson, A. B. Brown, Tri-State, W. R. Grace, SRC-I, Hancock, and H-Coal all occur on various legs of the general east-west line from Louisville to Evansville and points west. Rockport and D. B. Wilson are located on a common north-south line. Impacts will depend on decisions regarding sources of raw materials, modes of transport, and market destinations.

Coal transport by rail is likely to occur particularly for local transport from mines to plants or from mines to barge loading facilities. Although locally heavy demands for rail transport may occur, these needs will be proportional to mining operations. Particularly heavy rail traffic could occur because of the particular sitings along the Henderson to Owensboro corridor, depending on the location of coal reserves, modes of transport, and market destinations. The greatest volume of regional rail transport is expected to be product shipments because of diverse market locations rather than coal movements. Increased rail traffic is likely to be viewed as a positive impact by rail companies. Appropriate mitigation measures are likely to be economically justified by increased revenues.

Water transport

Water transport problems are associated primarily with the commercial operation phase. Water transport along navigable streams in the region is unlikely to be constrained by capacity limitations in open stream courses. Locks, however, may constrict movements in some instances. The Green River is expected to experience cumulative impacts because of increased coal transport through critical locks (See Fig. 4.13). Lock 1 is located downstream of SRC-I. This places it between SRC-I and W. R. Grace and between SRC-I and the mainstem of the Ohio. Lock 2 is located between SRC-I and D. B. Wilson. Because much of the coal is assumed to be transported on the Green from Muhlenberg County, Kentucky, barged coal destined from a number of the plants may be routed through one or both locks. One lock is located on the Ohio just upstream of confluence with the Green, and another occurs between the Hancock and H-Coal facilities. Water transport problems are expected to be minimal along the Wabash and the main stem of the Ohio because of the high capacity of these waterways compared to anticipated increases in barge traffic attributable to the nine facilities.

Cumulative effects on barge traffic on the Green River that could occur in response to meeting coal demands of the SRC-I (commercial), W. R. Grace, Tri-State Synthetic Fuel, and H-Coal projects will be primarily determined by (1) the amount of coal required by each project and

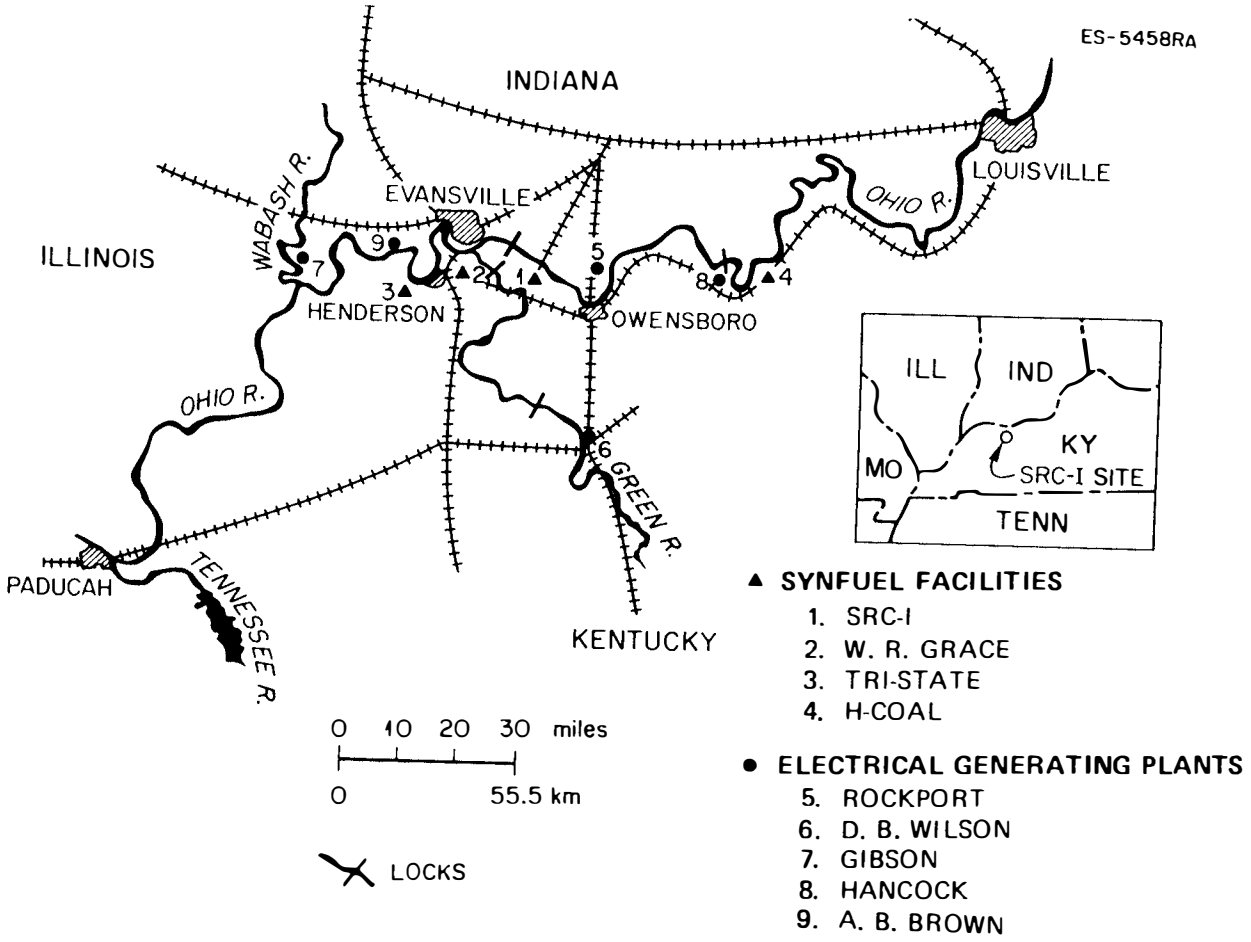


Fig. 4.13. Rail lines and waterways near the SRC-I site.

(2) the origin of the transported coal. Information regarding the latter is currently unavailable. Therefore, the following cumulative impact scenario is based on the following assumptions: (1) more than half (55%) of the coal required for these projects will originate in Hopkins and Muhlenberg counties in Western Kentucky; (2) coal mined in this area will be delivered to these projects via barge along the Green River; and (3) remaining coal requirements will be mined outside this two-county area and will not require delivery by barge via the Green River.

Available data indicate that Locks 1 and 2 along the Green River are capable of accommodating a maximum 27.8 million tons of barge traffic annually without improvements to the locks. This figure increases to more than 50 million tons annually when improvements are also considered. It is estimated that when the SRC-I (commercial), W. R. Grace, Tri-State, and H-Coal projects are all fully operational (1994), the cumulative annual requirement for coal will be approximately 41 million tons. Of this total, it is assumed that approximately 23 million tons will be delivered via barge along the Green River. Current use of the river approaches 17 million tons annually. The unimproved capacity of Locks 1 and 2 along the Green River will be exceeded, thereby resulting in delivery delays. This problem would be further accentuated if more coal than is assumed in this analysis were transported along the Green River.

4.3 ALTERNATIVE SITE — EQUALITY, KENTUCKY

This section identifies the impact issues that could arise should the Equality site be the location of the proposed SRC-I demonstration plant. This evaluation was performed to determine whether the Equality alternative site offered potential for appreciably reduced impacts. Impacts on the Equality site are based on general site characteristics without a plant layout or detailed monitoring data

4.3.1 Land

4.3.1.1 Land use and development

Construction

Over three-fourths of the 405-ha (1000-acre) Equality site consists of prime farmland; some of it is currently being used for corn production, and some is wooded. This area of Green River bottomland could be severely impacted by construction of the proposed SRC-I plant. Losses of farm soils could occur through development on portions of the prime acreage, reduced soil productivity resulting from compaction, grading, and erosion. Considerable earth moving and forest clearing can be expected on the remaining portions of the Equality site. The ten residences located in the hilly portion of the site are likely to be destroyed or seriously impacted as a result of construction-period activities.

Additional land use changes can be expected through the increased urbanization of Ohio, Daviess, McLean, and Muhlenberg counties resulting from the influx of plant employees and their families. Considerable amounts of housing and commercial construction will be required to support this increase in population. Some agricultural and forest acreage will be converted to residential and commercial uses in this accommodation process.

Operation

In the areas of maximum air pollutant concentration, slightly reduced productivities of certain sensitive species such as soybeans and pasture grasses may result from plant operation. Corn, which is resistant to air pollutants, should experience minor effects, if any. The residential and commercial expansion that occurred during the construction period will leave a certain percentage of former farm acreage unarable. There is a possibility that some additional surrounding lands may be cleared and developed in the event that complementary industrial or commercial facilities move to the Equality area.

4.3.1.2 Geology and soils

Construction impacts

Soils at the Equality site are of variable texture, ranging from sandy alluvium to silty clay on upland slopes. Depending on the site design, the volume of soil lost by erosion during

construction may be the same as or less than that at the proposed site. Sediment eroded during construction could be retained on the site in retention ponds to minimize sedimentation of local streams and the Green River. Soil erosion may be mitigated by limiting exposed areas and stabilizing the cut slopes with vegetation, bulkheads, or asphalt-sprayed hay. It may be necessary to import fill from off site or another area within the site should the upland loess soils prove unstable near foundations and embankments.

Operational impacts

Like the proposed site, the geology and soils in the Equality, Kentucky, area are prone to earthquakes and liquefaction. Liquefaction is the changing of soil to a liquid state because of high water content and the application of stress to the soils. Preloading of the site soils or extension of foundations to bedrock would be required if the loess capping the hillsides is extensive. In excavated areas of the site requiring fill, additional material would have to be imported because of the unsuitability of the loess soils. Because of the lack of subsurface investigations and testing, it is impossible to define potential foundation problems at the site.

The Equality site is located near the border of seismic risk zones 2 and 3. Designation of the site as zone 3 would necessitate more careful construction techniques and would imply increased risk of disruption of solid and liquid waste storage areas or process pipelines. Also, potential for soil liquefaction may increase risk if the loess soils are extensive.

4.3.1.3 Terrestrial ecology

Construction on the Equality site would destroy a mixture of upland, floodplain, and swamp hardwood forests, cornfields, and active and abandoned pasture. This mixture of plant communities creates high-quality habitat for a large variety of wildlife, including deer, grey and fox squirrel, woodcock, quail and woodduck. Filling the swamps and marshy floodplain forests for plant construction would destroy potential habitat for six animal species (see Sect. 3) that are rare in Kentucky.

Construction of the plant in the hilly portion of the site would require large volumes of earth to be moved. Siltation from this activity could seriously damage the adjoining floodplain/wetlands. Also, some forest or cropland on the floodplain would be destroyed by construction of a coal line, water lines, and a road to the barge landings.

The Equality site is a significantly more varied wildlife habitat when compared to the proposed site because of abundant forest cover, the presence of a flood-retreat habitat for swamp species, the division of the cropland into small parcels by hedgerows, and the generally low level of human activity in the area. No endangered species are known to occur on this site, although the Indiana bat may be present (Sect. 3.2.1.3).

Construction and operation of the SRC-I facility at the Equality site would not appear to have less impact on terrestrial ecology than at the proposed site.

4.3.2 Water

4.3.2.1 Surface water hydrology

Construction impacts

Grading and excavation during construction at the Equality site would remove protective vegetative ground cover, reduce percolation rates, and increase rainfall runoff and the amount of topsoil removed. Such runoff, high in suspended solids, may accelerate channel scouring in small streams on the site. Use of sedimentation basins would reduce the impact on the streams below the basin.

If construction occurs at the lower elevations, erosion and increased suspended solids during flooding could occur. The impact can be reduced by scheduling floodplain construction during periods of low rainfall probability and by using temporary dikes to protect the structures while they are being built.

Operational impacts

Depending upon the final location of the facility at the Equality site, a significant percentage of the onsite stream drainage areas may be graded or paved. Such alteration of the drainage may reduce the flow in the streams by diverting runoff into a drainage collection system. Siting of plant facilities at the lower elevations of the Equality site would significantly increase the risk of flood damage and of possible release of toxic process material or wastes into the Green River. Mitigation measures include erecting dikes; increasing the elevation of the land surface; and relocating critical structures in uplands above the probable maximum flood elevation.

4.3.2.2 Groundwater

Construction impacts

It is not anticipated that groundwater flow or quality would be significantly affected if construction were to occur on this site. However, onsite impacts caused by changes in infiltration rates during soil compaction, spills of small quantities of fuel oils or other liquids, removal of vegetation, or grading operations may occur.

Operational impacts

Groundwater quality at the Equality site could be affected by leachates from solid waste storage or spills or process liquids. The chemical and physical soil properties, the depth of the soils, and the nature of the aquifers and cap rocks below the site influence the probability and magnitude of the leachate impact.

An alluvial aquifer containing water of acceptable drinking water quality exists along the floodplain of the Green River. Bedrock aquifers may also occur in the area, but the nature of the cap rock, flow direction, and water quality is unknown. Generally, in this area of Kentucky, the bedrock aquifers have low yields and variable water quality with salinity increasing with depth. Even though the yields may be low, these aquifers may be the sole source of drinking water for rural residences. Adverse impact on drinking water aquifers may occur; however, because of the absence of site specific information the potential cannot be quantified.

Percolation and infiltration rates to bedrock aquifers are relatively slow at the Equality site because the soils contain a layer of dense, compacted material. These layers may also act to form perched water tables. If leachate containment systems fail, accumulated waste leachate could eventually drain through springs into the Green River. Concentrations of iron and manganese hydrous oxides may increase the ability of the soil to absorb trace elements from leachates or spills. Control measures proposed in the original plant design could be used to reduce the potential impact (see Sect. 4.2.2.2). Recharge level reductions caused by soil compaction and paving may occur in the immediate area of the facilities, but the effect is not likely to exceed beyond the plant boundaries.

4.3.2.3 Surface water quality and aquatic ecology

Construction impacts

Potential impacts on surface water quality and aquatic ecology from construction of the proposed SRC-I facility at the Equality site include: (1) effects of constructing the water intake, barge facilities, and/or pipelines; (2) site runoff into the Green River (and smaller streams including Williams Creek and tributary and the small onsite pond); (3) disturbance and/or destruction of the various drainage basins; and (4) shoreline disturbance of the Green River during site preparation. Destruction or degradation of onsite streams and sloughs during construction will reduce the local aquatic habitat. Sampling data in Sect. 3.3.3.3 indicate that these hydrologic features serve as spawning, nursing, and refuge areas in the Green River ecological system. Additional sediment loading of the Green River would aggravate the current water quality problems (Sect. 3.3.3.3). The extent of construction impacts would depend on the amount of site preparation required, mitigation measures employed, and the exact location of facilities on the Equality site.

Operational impacts

Operational impacts of an SRC-I plant, if constructed at the Equality site, would include water withdrawal intake, leachate containment system failure, discharge of contaminated runoff from storms exceeding the ten-year, 24-h precipitation event, wastewater discharge, and possibly barge traffic. Many of the impacts for the Equality site are very similar to those for the proposed site at Newman, Kentucky.

To estimate the potential for water quality degradation and consequent biotic effects from the discharge of wastewater into the Green River, the dilution of water quality constituents was calculated (Table 4.49). It was assumed that the ambient concentration of each constitutent would be the maximum recorded, that wastewater concentration and flow would be at their maxima, and that the effluent would be completely mixed in the 7-d, ten-year low flow of the Green River (Sect. 3.3.3.3). Although based on several worst-case assumptions, these calculations do provide an approximation of potential effects. However, if the zero discharge alternative is adopted, no impacts from wastewater discharge are expected to occur during normal plant operation. The analysis indicates that discharge from an SRC-I facility sited at Equality or Newman would cause some degradation of water quality because of the discharge of cadmium, chlorine, cyanide, phenol, and perhaps selenium. Impacts to aquatic biota would be very similar to those projected for the proposed site (Sect. 4.2.2.2).

Table 4.49. Mixing of SRC-I effluent with seven-day, ten-year low flow of Green River (9500 liters/s) Equality site [a]

Constituent	Water quality standard (mg/liter)	Maximum ambient concentration[b] (mg/liter)	Fully mixed concentration (mg/liter)	Compliance with standard (mg/liter)
Arsenic	0.05	<0.01[c]	<0.004	Yes
Cadmium	0.0012 in hard water	0.004	0.008	No[d]
Chlorine, residual	0.01	Assume 0	0.026	No[e]
Chromium	0.05	0.001	0.03	Yes
Copper	1.0	0.014	0.04	Yes
Cyanide	0.005	Assume 0	0.011	No[e]
Iron	0.3	3.72	3.72	No[d]
Lead	0.05	0.075	0.08	No[d]
Manganese	0.05	0.475	0.48	No[d]
Mercury	0.00005	0.0002	0.0002	No[d]
Phenol	0.001	Assume 0	0.008	No[d]
Selenium	0.01	0.001	0.01	Borderline[e]
Silver	0.05	<0.03[b]	<0.03	Yes
Total suspended solids		230	228	
Zinc	5.0	0.06	0.08	Yes

[a] See Table 4.6 Sect. 4.2.2.3, for mixing formulae and maximum effluent concentrations.

[b] From Table 3.3.1, Sect. 3.3.3.3.

[c] Where values were reported as "less than" some concentration, it was assumed that the concentration was equal to that value.

[d] Maximum ambient concentrations of these constituents exceeded the standard.

[e] Maximum ambient concentrations did not exceed standards; significant water quality degradation attributable to SRC-I discharge.

An SRC-I demonstration facility would require a withdrawal of about 217 liters/s (3445 gpm) from the Green River. This represents 2.3% of the 7-d, ten-year low flow of 9500 liters/s. Assuming uniform distribution of planktonic organisms, the maximum impact would be destruction of 2.3% of the ichthyoplankton or other plankton. Although this impact might be measurable, it would be unlikely to cause significant adverse impact. For flow regimes of nondrought periods, it is doubtful that removing water for the SRC-I process would produce any measurable impacts. Impacts resulting from excess runoff are uncertain for all sites, but significant degradation of the water quality seems unlikely because of dilution in a large volume of water.

4.3.3 Air quality

4.3.3.1 Construction impacts

The hilly terrain in rural Ohio County, Kentucky would tend to inhibit the dilution of pollutants emitted by the proposed facility. The area is currently in compliance with applicable air quality regulations except total suspended particulates (TSP). Sources of fugitive dust have caused ambient TSP secondary standards to be exceeded for both short-term and annual average time periods.

The Paradise steam plant of the Tennessee Valley Authority located near the Equality, Kentucky, site has sulfur dioxide (SO_2) monitors to the north of its plant which show SO_2 concentrations to also be in compliance. Monitoring site No. 23 of Paradise steam plant recorded an annual average of 23 $\mu g/m^3$, a second highest 3-h reading of 950 $\mu g/m^3$, and second highest of the 24-h recorded at 275 $\mu g/m^3$. While these presently do not violate National Ambient Air Quality Standards, there are higher levels at the Equality site as compared with the proposed site at Newman, Kentucky.[52]

The Equality site would likely require extensive earth-moving activity, similar to the proposed site. Fugitive emissions during this activity would exacerbate the particulate problem measured in the area. Even though the wind and precipitation regimes are similar to the Newman site, impacts of fugitive dust generation from construction would be somewhat greater at the Equality site.

4.3.3.2 Operational impacts

Routine emissions would result in approximately the same ground-level concentrations as those predicted at the proposed site. The Equality site will have a lesser regional impact than the proposed action because Equality is further removed from other major sources. The fugitive emissions from the coal storage areas would be similar at both sites.

Impacts of pollutants released during accidents would be approximately the same at both the Equality and Newman sites. Small settlements near the two sites could be exposed to toxic materials during accidental releases, and the total number of people exposed to significant concentrations would be similar. The proximity of the proposed site to other major emission sources makes the impacts of operational emissions somewhat greater at the Newman site.

4.3.4 Economic, social, and cultural

4.3.4.1 Population

Construction

A relatively large increase in the populations of Ohio, Daviess, McLean, and Muhlenberg counties can be anticipated during the construction phase of the SRC-I facility. Peak construction is to be reached roughly 18 months after construction begins, with project completion expected approximately 18 months after that date. Approximately 3500 to 5000 workers are projected to be required during the peak construction period.

A worker relocation projection model from the recent (post-1976) experiences with TVA nuclear power plant construction workers was used to analyze the spatial distribution of this anticipated work force. The model, which is discussed in more detail in Sect. 4.2.4.1, is used to predict the number of construction workers that will come from the existing labor force for each county within 116 km (70 miles) of the site and the number of workers who will migrate to each of these same counties. In-migrants are classified as either local or distance movers/travellers (Sect. 4.2.4.1), and current area residents are referred to as *commuters*.

Estimates of the total number of employees in each of these categories anticipated during the peak construction phase of the SRC-I facility are presented in Table 4.50. Differences between these findings and those presented in the DES are explained in the "Construction labor force in-migration" subsection of Sect. 4.2.4.1.

It can be noted that from 420 to 620 workers, or approximately 12% of the anticipated labor force, will come from the existing population in the four-county Equality impact area. Within

Table 4.50. Distribution of direct workers for major impact counties, Equality, Ky. site – SRC-I demonstration, peak employment (1983)

County, state	Peak work force of 3500					Peak work force of 5000				
	Local commuters[a]	Local movers/ Travellers[b]	Distance movers/ Travellers[c]	Total	Total as percentage of all direct employment	Local commuters[a]	Local movers/ travellers[b]	Distance movers/ travellers[c]	Total	Total as percentage of all direct employment
Daviess, Ky.	171	17	190	378	10.8	227	24	279	530	10.6
McLean, Ky.	41	12	95	148	4.2	55	18	140	213	4.3
Muhlenberg, Ky.	102	18	175	295	8.4	136	26	257	419	8.4
Ohio, Ky.	148	44	468	660	18.9	197	63	688	948	19.0
Outside four-county area	896	126	997	1889	54.0	1032	186	1468	2686	53.7
Total	1228 (35.1%)	217 (6.2%)	1925 (55.0%)	3370[d] (96.3%)	96.3[d]	1647 (32.9%)	317 (6.3%)	2832 (56.6%)	4796[e] (96.0%)	96.0[e]

[a] Local commuters are residents of county prior to SRC-I employment who drive to and from the project site daily.

[b] Local movers/travellers are prior residents of the area within 90 min of the site who move from one county within the 90-min zone to another as a result of SRC-I employment. Movers will change their residence permanently; travellers maintain their original permanent address and travel home on weekends or less frequently.

[c] Distance movers/travellers relocate in the vicinity of the SRC-I site from outside the 90-min zone. Movers will change their residence permanently; travellers maintain a permanent address outside the areas to which they travel on weekends or less frequently.

[d] Total differs from 3500 and/or 100% because "distance commuters," those workers residing outside the 90-min zone and commuting to work on a daily basis are not included.

[e] Total differs from 5000 and/or 100% because "distance commuters" are not included.

the first two years of project construction, this same area will have to absorb from 1020 to 1500 movers and travellers. These numbers include both distance and local movers/travellers to the four-county area on the assumption that most of these local movers will come from those counties farther away from the site and will not be prior residents of the four counties immediately surrounding the plant. The TVA worker relocation experiences show that approximately 67% of the movers will bring families averaging 3.2 persons in family size. For the four-county impact area, this brings the in-migrant population to a total of approximately 2520 to 3700.

In addition to the anticipated population increase resulting from direct plant employment, a certain amount of indirect employment increase can be anticipated during the construction period. Table 4.51 lists the estimates derived from the relocation model.

Table 4.51. Projected indirect employment during peak construction period (1983), Equality, Ky. site

County, state	Peak work force of 3500,	Peak work force of 5000,
Daviess, Ky.	262	367
McLean, Ky.	95	137
Muhlenberg, Ky.	195	277
Ohio, Ky.	405	581

Source: Based on a TVA worker relocation study.

These figures represent jobs in the support and service industries that will be generated by the influx of population associated with plant construction. Past experience with projects of similar size indicates that approximately 10% of these employees will be in-movers. Calculation of the total number of in-movers, using the same assumptions about the proportion of workers with families and average family size that were used for direct movers, shows that another 240 to 340 people will be added to the population of the impact region because of indirect employment. When added to the in-movers and travelers anticipated from direct plant employment, the total potential population increase for the four-county area comes to between 2760 and 4040.

Table 4.52 presents a breakdown of the estimated in-migrants for each county in the Equality impact area.

It can be seen that Ohio County is estimated to receive a substantial increase in its population over approximately an 18-month period from the beginning of plant construction to the anticipated peak. Other counties in the impact area can expect noticeable, but much less substantial, population influxes (Table 4.52).

It would be reasonable to assume that a large portion of these in-migrants will congregate in the more urbanized areas of the counties because of the greater availability of services. In Ohio County, the two most populous towns are Beaver Dam, with 3185 population, and Hartford, with 3752. If all the in-migrants to Ohio County settled in these two areas in numbers proportional to their current populations, Beaver Dam would experience an increase of 630 to 920 people or 20 to 30% of its population, and Hartford would gain roughly 740 to 1080 people or, again, 20 to 30% of its current numbers. Over an 18-month period, this influx would create numerous problems for the impacted towns in terms of housing, services, transportation, and other socioeconomic issues. In most cases, measures would have to be taken in advance in order to mitigate potentially damaging impacts. Discussion of these possible measures will be included in the following sections where appropriate.

Operation

The operational period of the SRC-I facility is expected to begin roughly two years after the onset of construction, when about 100 employees will be required to support early plant activities. After the facility is completed, approximately 725 personnel will be required for full plant operation, representing no more than 20% of peak construction employment. The net change in population of the Equality impact area during the operational phase, therefore, is likely to be a negative one. It can be anticipated that some supportive and/or service industry jobs will remain beyond the construction phase, especially if other complementary industries develop in the immediate area. Other members of the construction population may decide to remain in the area and become absorbed into other sectors of the local economy. Still, the primary effect to be expected during the operational phase is that of a scaling down of the employment and population levels reached during the plant construction phase. A relatively sizeable amount of disposable income may disappear from the impact area upon completion of the SRC-I facility, and an economic downswing could result unless anticipatory steps are taken to counteract the loss of employment in the area.

4.3.4.2 Housing

Construction

The unavailability of housing in the rural counties of the Equality impact area (McLean, Muhlenberg, and Ohio) presents a major obstacle to the area's ability to support the projected in-moving population, and can be contrasted to the situation at the proposed site where the housing stock is expected to be adequate. As described in Sect. 3.3.4.2, the housing stock in the three rural counties is already falling short of demand. Overcrowding and generally poor housing conditions exist in at least 10% of the housing in the area. Planning authorities indicate that the area is lacking in an adequate construction labor force to handle current growth.

The TVA's observations of construction-worker relocation behavior indicate that the following housing mix might be required by project-induced in-migrants (Table 4.53).

Of the approximately 1120 to 1630 households (as opposed to total population) expected to relocate in the impact region, 560 to 820 are expected to purchase or rent single family homes, about 270 to 400 projected to move into mobile homes, and about 280 to 410 will live in apartments or other rented living quarters. Because a certain lag time can be expected to elapse before new units become available, temporary housing is likely to be needed to accommodate the initial influx of population. Mobile home and camper villages may be set up, and overcrowding in available units could occur. Workers may have to resign themselves to more distant locations in the event that the housing demand cannot be met.

Table 4.52. Projected in-migration to Equality, Ky., impact area, peak of SRC-I demonstration phase construction (1983)

County	1980 Population	Peak construction work force of 3500				Peak construction work force of 5000			
		In-moving direct workers[a]	In-moving indirect workers[a]	Total in-migrants[b]	Total in-migrants as a percentage of 1980 population	In-moving direct workers[a]	In-moving indirect workers[a]	Total in-migrants[b]	Total in-migrants as a percentage of 1980 population
Daviess	85,702	207	26	576	0.7	303	37	840	1.0
McLean	11,058	107	10	289	2.6	158	14	425	3.8
Muhlenberg	32,315	193	20	526	1.6	283	28	768	2.4
Ohio	21,845	512	41	1,366	6.3	751	58	1,998	9.1
Total	150,920	1,019	97	2,757	1.8%	1,495	137	4,031	2.7%

[a] In-moving workers includes distance movers (travellers and local movers/travellers.

[b] Total in-migrants include direct and indirect in-moving workers and their dependents; it is assumed that 2/3 of all in-moving workers bring families with an average size of 3.2.

Source: Based on a TVA worker relocation study.

Table 4.53. Percentage of total in-migrants (movers and travellers) demanding various housing types

Housing type	Percentage
Single-family homes	50.3
Mobile homes	24.3
Apartments, sleeping rooms, campers, and other	25.4

Source: Based on a TVA worker relocation study.

Operation

The reduction in population to a net increase of 725 workers (some with families) over the pre-SRC-I population may have the opposite effect on the housing market than did the construction period population influx. A possibility of construction period overbuilding exists in which an effective flooding of the impact area housing market may occur. This could produce negative effects on the area economy.

4.3.4.3 Public services

Construction

Impacts in the public services area could feasibly be as severe as those expected in the housing market. Current system capacities are close to being met in all three areas of public services discussed in the profile section for much of the impact region (Sect. 3.3.4.3). With the exception of that of Daviess County, water supplies in the area are about fully utilized, and the majority of the area's sewerage systems are approaching design capacity. Major expansion projects would have to be undertaken in order to accomodate the demand on these systems that is expected to accompany project-induced in-migration, particularly in Ohio County. Again, these projected impacts exceed those expected at the proposed site, where public service shortfalls are not anticipated.

The school systems throughout the impact area, with the exception of those in Daviess County, are similarly operating near capacity, but there are several expansion projects under way or under consideration by local officials. The TVA observations predict that 49% of in-movers' children will be primary school age, with 14% seeking space in the high schools. This influx of students would most likely require larger expansion projects than currently under consideration. Another far less expensive and less permanent solution for meeting the incoming student needs would be to set up temporary schools in areas of highest demand for the duration of the construction phase.

Operation

The potential problem of overbuilding, mentioned earlier in the context of housing, could also apply to expansions of the water and sewerage systems in the Equality impact area. Should population decline following the completion of project construction, local residents may be left with a large bill for underutilized service facilities. One possible mitigation measure may be for the site area to seek Federal aid for at least partial funding of the minimum expansions required of water and sewer systems.

If the county school systems accommodated construction-period students with minor expansions and temporary school set-ups, then the operations period could be adjusted to relatively easily. Temporary schools could be closed, and any minor expansions made might be effectively utilized by operational-phase children and unrelated plant growth in the area. If this approach is not followed, the same problems of overbuilding discussed above could result.

4.3.4.4 Transportation

Construction

The major adverse impact to the Equality site area will result from the increased number of vehicles using the local road system. These roads currently do not experience heavy use, and their estimated capacities indicate that they could not support the traffic expected during the peak construction period. Major adverse traffic impacts are also expected at the proposed site; there, no single section of roadway will have to serve as many vehicles as will the Equality road, but a much higher number of current users will be impacted. Table 4.54 lists the estimated number of vehicle round trips to be expected on the various sections of road described in Sect. 3.3.4.4.

Table 4.54. Construction-induced traffic and road capacities for the Equality site

Road section	Current peak hourly count	Project-induced vehicles at peak hours	Total	Level of service "E," hourly capacities
(A) Equality Road	50	1850–2630	1900–2680	1070
(B) Kentucky 85 (Centertown to U.S. 62)	210	825–1200	1035–1410	1070
(C) U.S. 62 (Central City to Kentucky 85)	330	825–1200	1155–1530	1600
(D) Kentucky 69 (Centertown to Hartford)	250	1000–1450	1250–1700	1150
(E) Kentucky 69 (Hartford to Green River Parkway)	440	700–1000	1140–1440	1600

Source: David Docter, Green River Area Development District, Dec. 2, 1980.

The hourly capacities are given for each section of road for the E level of service. These capacities represent the maximum number of vehicles traveling in both directions that can be accommodated by a given section of road. At the E level of service, the flow of traffic is subject to breakdown resulting from the minimum spacing of vehicles. This is not a desirable level of design because it leaves little room for error. All of the roads are without shoulders and run over rolling hills, leaving little room for passing.

Examination of Table 4.54 shows that all but one of the sections of two-lane highway could not accommodate the predicted volume of traffic at reasonable levels of service. The Equality road, State Route 69 between Centertown and Hartford, and State Route 85 all have projected volumes that exceed their "E" capacities in the "best" as well as the "worst case." U.S. Route 62 shows traffic projected at capacity under worst-case conditions, and State Route 69 between Hartford and the Green River Parkway has an estimated traffic volume that approaches its design limit in the worst case. It is obvious from these figures that peak traffic volumes can not feasibly be accommodated by the existing road system. If material deliveries are made by truck, the road problem will be aggravated. Current truck use of the road sections listed in Table 4.54 is 6% of all traffic (see Sect. 3.3.4.4).

Figure 4.14 illustrates the impact area's anticipated commuter traffic. The number of vehicles using selected sections of the highway system surrounding the proposed site are given in order to present a picture of expected commuting patterns. These figures were calculated by taking the peak work force numbers of 3500 and 5000 (current plans are for a single shift for all workers); dividing by 1.9, the projected number of workers per vehicle; and placing these 1840 to 2630 vehicle round trips on area roads according to the projected place of worker residence (Table 4.51). The accuracy of this analysis is closely tied to the accuracy of the worker relocation model discussed earlier, which establishes the county of origin for all work trips. Counties are indicated in uppercase lettering, with the relevant towns indicated in lower case. The lettered road sections nearest to the Equality site (represented by a star) refer to the

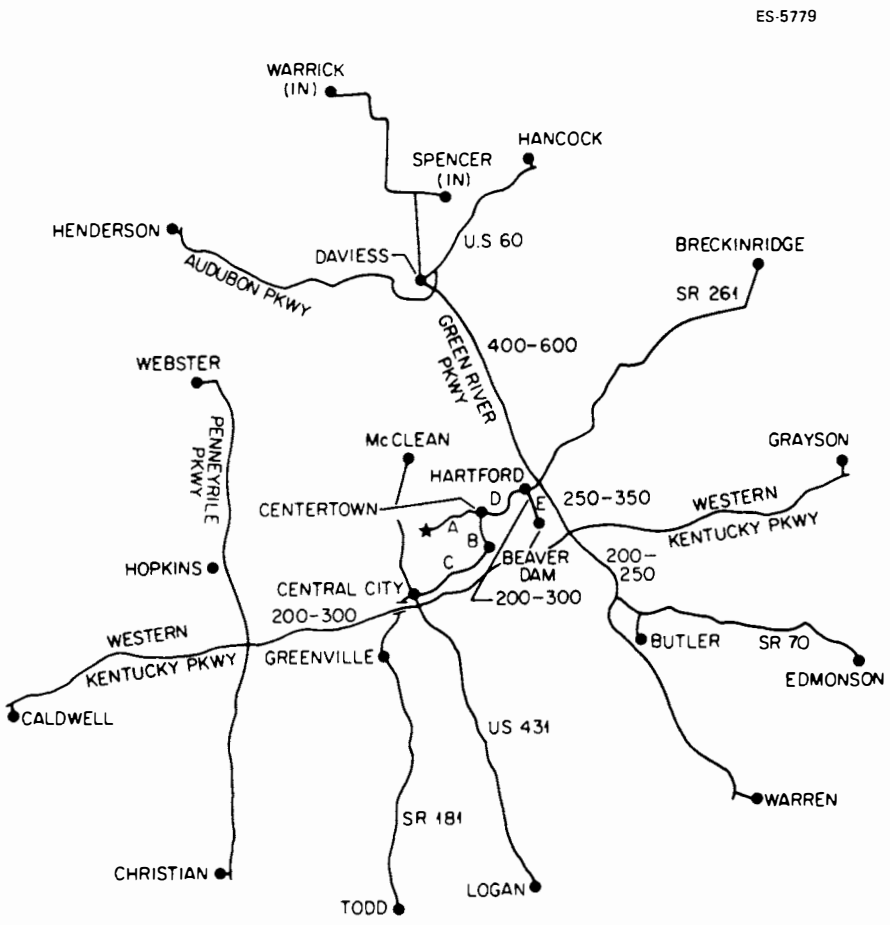


Fig. 4.14. Estimated number of commuter vehicle round trips on selected road sections, Equality impact region.

sections listed in Table 4.54. As vehicles from the outlying areas converge on the roads leading to the Equality site, capacities begin to be exceeded.

Mitigation measures will have to be taken in order to avoid damage to the road systems and to accommodate the predicted traffic. Truck traffic from construction equipment deliveries could be reduced by transporting materials to the site by rail or barge. Rail lines may need to be improved in order to support this activity, while the Green River system should be able to handle the traffic. Staggering working hours on the single shift that is currently envisioned by project planners could provide some reduction in traffic congestion, but is not likely to eliminate the serious overcrowding expected. Other mitigation measures that may be more effective in reducing or accomodating project-induced traffic include the institution of bus service, the encouragement of car- or vanpooling, and the funding of road expansions and improvements for the most heavily impacted sections of road near the site. Implementation of the above programs, particularly the road improvements, could be expensive, thus creating a problem for the responsible local and state governments, especially since no property tax will be paid during the entire demonstration phase.

Operation

An increase in truck traffic for coal or other material deliveries to the facility during the operational period may result in increased wear on the highway system. If rail and barge lines are used for the majority of these deliveries, this problem could be lessened. Also, if substantial improvements were made to the road systems during the construction phase, the handling of truck traffic would most likely not be a problem. The peak commuter traffic count projected for the 725 employee operation period is not likely to seriously impact area roads.

4.3.4.5 Economic base

Construction

An increased level of activity in the service and supportive industries will develop in response to demand for the construction labor population (Sect. 4.3.2.1). Spending on local goods and services by construction employees will provide increased revenues to local businesses. It is expected that the vast majority of indirect jobs will be filled by workers residing in the counties prior to SRC-I. These workers will come from the unemployed sector or will transfer from other occupations. A drop-off in agricultural activity or a switch to part-time farming may result. Thus, the economic base may shift to some degree from that of a primarily agricultural/mining base to more of an industrial (direct plant employment) and service (indirect employment) base.

A possible negative impact that may result from project employment during the construction phase is that of project-induced inflation in the immediate impact area. Construction worker wages are likely to be significantly higher than those of the existing labor force in all types of employment. This situation could put pressure on employers to raise their wage rates in order to maintain their labor forces. Also, the rapidly increased demand for housing, goods, and services will most likely have an inflationary effect on the local economies. This inflation could severely impact residents on fixed incomes. Because the proposed site is located in a more metropolitan area where prices for goods and services are established in regional markets, local inflation and the resulting adverse effects are expected to be minimal there.

Operation

A certain number of service jobs created during the construction phase will likely remain as a significant part of the area economy. These positions will be needed to serve demands of operation period employees and the normal growth experienced by the impact area over the construction period. Some workers may return to their previous occupations, resulting in some reversion from part-time farming and working in a commercial establishment back to full-time farming. The industrial sector, however, could remain a significant part of the area economy beyond the operational phase in the event that complementary industries relocate to the impact area. Planning agencies in the broader Green River area maintain policies favorable to increased industrial growth in the region.

4.3.4.6 Labor and income

Construction

It can be anticipated that the unemployment rate will decrease in the impact area during the construction period as many direct and indirect jobs will be filled by area residents. The TVA relocation analysis of direct plant employment presented in Sect. 4.3.2.1 estimated that approximately 13% of the required labor during the peak construction period would come from the immediate four-county area. A much higher percentage of the approximately 960 to 1360 indirect jobs created in the four-county area can be expected to be filled by this same labor force.

Spending of primary income by the construction labor force (construction payroll) will result in the generation of secondary incomes received by local businesses in the respective counties. Total secondary incomes generated are listed below in Table 4.55.

Table 4.55. Secondary incomes received by impact counties as a result of construction employment spending, 1983

County	Peak construction work force of 3500, (1980 dollars)	Peak construction work force of 5000, (1980 dollars)
Daviess	12,309,000	17,259,000
McLean	4,387,000	6,314,000
Muhlenberg	9,122,000	12,957,000
Ohio	18,735,000	26,911,000
Total (4 county area)	44,553,000	63,441,000

Source: Based on a TVA worker relocation model.

Operation

A sizeable portion of the workers employed during the construction period of the SRC-I facility will most likely leave the area upon plant completion. Among those remaining, a certain increase in unemployment may result at least temporarily; this impact is not expected to be as pronounced in the more urbanized region of the proposed site. If complementary industries enter the Equality area, this effect could be minimized.

4.3.4.7 Local government taxation and spending

Construction

The local governments of the four-county Equality impact area will experience some increases in property tax revenues resulting from the expansion in the residential and commercial sectors that is expected to accompany project-induced population growth. These property tax revenues, however, will not be sufficient to cover the local expenditures that will be required for the expansion of public services during the construction phase. Since the SRC-I plant will be held in title by the Federal government, the project will be exempt from property taxation. While there are both state sales and income taxes in Kentucky, these revenues are not returned to the locales in which they are collected. The net fiscal impact to the local governments resulting from the need to make capital intensive public service expansions and the minor increases in revenues available to balance this could be severe.

Operation

Federal ownership is expected to continue during the demonstration phase, thus maintaining the tax exempt status of the plant. New residential and commercial properties added to the local tax roles during the construction period will continue to contribute to local revenues, but there could be some loss of revenues here if mobile homes are removed from the area or if property abandonment results from overbuilding during the construction era. Because of the local government expenditures required during the construction phase, any loss of tax dollars could exacerbate the problem of recovering those capital investments.

4.3.4.8 Historical and archaeological resources

Construction

No known historical sites will be impacted by construction of the SRC-I facility but several archaeologically significant sites may be affected. At least two sites in the Ohio County area are being considered for inclusion in the National Register and it is estimated by state archaeologists that up to 30 other sites of major significance may exist in the Ohio County portions of the Green River bottomlands (Sect. 3.3.4.8). In the event that these or other sites of importance would be irreparably disturbed by plant construction, excavation of the sites prior to construction would be considered. Impacts on local archaeological resources are expected to be substantially less in the proposed site area, where existing resources are not as rich.

Operation

No further impacts on historical or archaeologically significant sites are anticipated during the operational phase of the plant.

4.3.4.9 Impacts of commercialization, decommissioning, or mothballing

Commercialization of the SRC-I plant after the completion of the demonstration phase will require an eight-year construction period with a peak work force of approximately 5000 to 10,000. It is anticipated that the impacts occurring in the four-county region during that period will be much the same as those outlined above but at a larger scale. The capacities of local housing, public service, and transportation systems would be increasingly strained by commercialization, and the previously discussed fiscal impacts stemming from the need to make significant public service expenditures without a corresponding increase in tax revenues would be magnified. Ohio County alone would receive substantial tax revenues from the facility if ownership is transferred to the private sector at the onset of commercial operations. All other impact area jurisdictions, including the Ohio County municipalities of Hartford and Beaver Dam, will not be empowered to tax the facility and will receive no direct tax revenues from the facility itself.

If the plant were decommissioned or mothballed after the demonstration period elapsed, a temporary period of unemployment and economic adjustment, possibly accompanied by some out-migration, would most likely result.

4.3.5 Cumulative impacts

A number of other construction projects planned for the area within roughly 116 km (70 miles) of the proposed Equality site could combine with the construction of the SRC-I facility to produce significant cumulative impacts in the impact region. These planned or projected power plants and synthetic fuel facilities are the same as those identified in Sect. 4.2.5 for the Newman site, with the exception of the Gibson plant in Gibson County, Indiana, and the A. B. Brown plant in Posey County, Indiana, which are too far from the Equality site to be included in this analysis. The overlapping construction schedules of these plants and the SRC-I plant result in three significant peak work force years: 1983, the peak year for SRC-I demonstration; 1986, the peak year for the cumulative regional work force; and 1989, the peak year for SRC-I commercialization. Given the tentative nature of the construction schedules and work force requirements of the various projects, the following analysis should not be viewed as producing definitive projections, but rather as suggestive of the nature of the possible impacts.

It is expected that about 75% of the required work force will be in-migrants. It is further assumed that two-thirds of the in-migrating construction workers will bring families, with an average family size of 3.2. To simplify the following analysis, only the 5000-worker case for SRC-I construction was used, representing the worst-case scenario.

A gravity model analysis was conducted for the Equality site for each of the three major peaks using work force estimates for SRC-I and the other competing construction projects. Table 4.56 lists the counties most heavily impacted by worker in-migration resulting from cumulative regional labor demands during the three peak work force years. For the purpose of discussion, the focus will be placed on the four-county impact region of Daviess, McLean, Muhlenberg, and Ohio. The impact analysis will be concerned with only the effects on housing, water and sewerage, schools, and transportation because these are representative of the nature and size of the impacts likely to be incurred.

In 1983, the peak regional in-migrating labor force will be about 5100 workers, with a total in-migrating population (workers plus dependents) of about 12,700. About 22% of these in-migrants will settle in Daviess County. For Ohio County, this will represent a 13% increase in population over the 1980 level. The unavailability of housing presents a major obstacle to the impact area's ability to support the projected in-moving population. As described in Sect. 3.3.4.2, the housing stock in the four-county impact area, with the exception of Daviess County, is currently in short supply. Moreover, no adequate residential construction labor force exists to handle current growth. Because current water and sewerage system capacities are close to being met in the four-county area (with the exception of Daviess County), these population increases, especially in Ohio County, will place severe strain on these systems. Major expansion projects would have to be undertaken to accommodate the likely increase in demand. Similarly the school systems in all but Daviess County are presently operating near capacity. While there are some

Table 4.56. Counties most heavily impacted by worker in-migration resulting from cumulative regional labor demands, Equality, Ky., site

County	1980 population	Number of in-migrant workers[a]	Total in-migrants[b]	Total in-migration as percentage of 1980 population	Total in-migration as percentage of in-migration for entire region
			1983		
Daviess, Ky.[c]	85,702	665	1,644	1.9%	12.9%
Henderson, Ky.	40,797	290	717	1.8	5.6
McLean, Ky.[c]	10,056	126	313	3.1	2.5
Muhlenberg, Ky.[c]	32,234	378	936	2.9	7.4
Ohio, Ky.[c]	21,877	1,146	2,836	13.0	22.3
Spencer, Ind.	19,395	872	2,156	11.1	16.9
Vanderburgh, Ind.	166,723	309	765	0.5	6.0
Other counties		1,358	3,357		26.4
Total		5,144	12,724		100.0
			1986		
Breckenridge, Ky.	16,862	635	1,569	9.3%	2.8%
Daviess, Ky.[c]	85,702	1,748	4,318	5.0	7.6
Hancock, Ky.	7,710	175	431	5.6	0.8
Henderson, Ky.	40,797	7,673	18,953	46.5	33.5
McLean, Ky.[c]	10,056	133	327	3.3	0.6
Muhlenberg, Ky.[c]	32,234	264	652	2.0	1.2
Ohio, Ky.[c]	21,877	479	1,182	5.4	2.1
Union, Ky.	17,807	452	1,117	6.3	2.0
Perry, Ind.	19,211	913	2,254	11.7	4.0
Vanderburgh, Ind.	166,723	6,502	16,060	9.6	28.4
Other counties		3,940	9,733		17.0
Total		22,914	56,596		100.0
			1989		
Daviess, Ky.[c]	85,702	1,499	3,701	4.3	12.8
Henderson, Ky.	40,797	1,783	4,404	10.8	15.3
McLean, Ky.[c]	10,056	265	653	6.5	2.3
Muhlenberg, Ky.[c]	32,234	766	1,893	5.9	6.6
Ohio, Ky.[c]	21,877	2,424	5,986	27.4	20.8
Vanderburgh, Ind.	166,723	1,372	3,388	2.0	11.8
Other counties		3,566	8,808		30.4
Total		11,675	28,833		100.0

[a] Direct plus Indirect Employees, assuming 5,000 SRC I Workers as Worst Case.

[b] Workers plus Dependents, assuming 67% of workers bring families with an average size of 3.2.

[c] SRC I Impact Counties for Equality, Ky. Site.

expansion projects planned or under way, these projects are probably insufficient to accommodate the influx of school children likely to accompany in-migrating construction workers. The major adverse impact to the Equality site area will result from the increased number of vehicles using the local road system. Currently lightly used, the existing roads are structurally inadequate to serve the anticipated traffic volume and weight. Because of its distance from the other projects, this increase is likely to be generated solely from construction of the SRC-I facility but will still be extremely significant.

By 1986, the regional demand for new (post-1981) labor is projected to grow to include about 23,000 in-migrating workers, with a total in-migrating population of about 56,500. However,

because construction of SRC-I will have been completed and because of the distance of the Equality site from the other projects, three of the four counties in the primary impact region will likely include about the same or fewer in-migrants than in 1983. The exception is Daviess County, where the 1986 increase in population represents a 5% increase over the 1980 population, as opposed to a 1.9% increase for 1983. Ohio County, on the other hand, will experience a net decrease in population from 1983: 1182 in-migrants in 1986 from 2836 in 1983. For Daviess County, the demand for housing will be roughly double the number of currently available units, but the need for classroom facilities and city water should be adequately met by existing capacities. Sewerage services should also be more than adequate to meet in-mover needs during periods of average flow, but the problems already experienced at peak periods, when wastewater flow is more than double the design capacity of Owensboro's sewage treatment plant, will be exacerbated. For the other three counties in the primary impact region, unless public service capacities and housing availability are increased to meet the 1983 peak period, these areas will still be strained. The extent to which the housing market and public services are expanded to meet the earlier demand will determine the extent of this stress in 1986. The burden on the transportation system in and around the Equality site is likely to be lessened with completion of SRC-I construction.

In 1989, while the regional demand for labor will decline, the labor demand for commercialization of SRC-I will likely increase in the Equality site area. Except for Daviess, the counties of the primary impact region will likely experience significant population increases from 1986 levels. The largest increase will occur in Ohio County, with an approximate 27% jump over 1980 population levels. Even if these counties had developed the capacities in public services and housing to meet the 1983 peak demand, this new increase in demands would probably severely strain these increased capacities. The effect on Daviess County, on the other hand, will be a slight lessening of the impacts from 1986 levels. The transportation system in the immediate vicinity of the plant will experience a significantly greater burden over all previous years. If mitigative action is taken in previous peak years, especially in 1983, this action should result in reduced strain on the system in 1989.

In general, the four Equality site impact counties will experience severe stress on at least some sectors of the community infrastructure because of the construction of SRC-I and competing facilities. Given the distance from the other projects, most of the impacts will occur during SRC-I construction peaks.

4.4 ALTERNATIVE SITE — RAVENSWOOD, WEST VIRGINIA

This section identifies the impact issues that could arise should the Ravenswood site be the location of the proposed SRC-I demonstration plant. This evaluation was conducted to determine whether the Ravenswood alternative site offered the potential for appreciably reduced impacts. Impacts on the Ravenswood site are based on general site characteristics without a plant layout or detailed monitoring data.

4.4.1 Land

4.4.1.1 Land use and development

Construction

The agricultural, forest, and recreational uses to which the site is currently subject (Sect. 3.4.1.2) are likely to be displaced by plant construction. Specifically, this means that a sizable parcel of prime farmland and the locally utilized Keraland will both probably be lost to use. The proposed facility may also adversely affect the nearby Kera Lakes area and the neighboring residential community of Ripley Landing because of the noise, additional traffic, and heightened industrial character which are likely to result in the vicinity of the site. In addition, air pollution resulting from plant operations could have some effect on sensitive agricultural plants, such as soybeans and pasture grasses, in the vicinity of the site. The maximum effect would likely be slightly reduced agricultural productivity in areas of maximum air pollutant concentration.

In the larger socioeconomic impact region, conflicts between new and existing land uses could also occur. The influx of project workers and their families that is expected to result from construction of the proposed facility (Sect. 4.4.4.1) is likely to be accompanied by expansion of the residential and commercial sectors that could compete with agricultural uses for available

land. It is also possible that, in the upcoming period of rapid growth, residential and commercial uses could be hastily placed in areas in which they are not appropriate. However, because of recent trends in the impact area toward expansion of the residential and commercial sectors (Sect. 3.4.1.2), it is not expected that any land use conflicts resulting from this project will be completely unprecedented or unanticipated.

Operation

Impacts on land use during this period will be largely the same as those outlined above. While there will be no new surge of population growth during this period, indicating a basic stability in the residential and commercial land-use sectors and while the facility itself will have already been built, the changes engendered during the construction period will remain. In addition, however, it is possible that, even in the absence of generalized new growth, those land-use conflicts caused by the expanding residential and commercial sectors may continue to cause land conversion in specific areas where sensitive land uses are impacted by their neighbors on an ongoing basis.

4.4.1.2 Geology and soils

Construction impacts

Erosion of topsoil during construction activities could result in permanent loss of soils. Although some soil loss is unavoidable, the magnitude of this impact can be reduced by maintaining vegetation on areas not necessary for construction. Also, the use of sediment retention structures during construction and maintaining cover over stockpiled soils will reduce soil losses. Because of similar soil texture and site topography, the quantity of soil lost during construction would probably be similar at both sites. Construction in the areas of sandy and gravelly loams would probably result in less erosion and transport than in areas of silty deposits.

Operational impacts

Operational effects related to geology are (1) unavailability of mineral resources of the site, (2) possible foundation settlement, and (3) reduction in soil productivity.

During the time the SRC-I facility would operate, sand and gravel deposits would not be available for production. Gravel pits are in operation in other local areas, and large reserves of this commodity are in the region. Development of gas or oil reserves beneath the site, should they exist, would be complicated by the existence of an industrial facility on the site.

Foundation conditions on the site are unknown. If poorly consolidated or clayey sediment underlie the site, prevention of foundation settlement may require preconsolidation. Potential effects on soils are not greatly different from those at the Newman site.

Grading and compaction of soils, which will reduce permeability and destroy soil structure, are expected to limit productivity of the soils for future agricultural use. This impact is unavoidable in preparation of the site for construction. Should the facility be decommissioned and removed, soils would take years to redevelop to existing productivity levels.

4.4.1.3 Terrestrial ecology

Construction at the Ravenswood site would displace cultivation of prime farmland. In addition, both the forest along Spring Creek and the Keraland Recreation Area, which receive recreational use by Kaiser employees, might be destroyed. The Spring Creek forest appears to be an important ecological resource because this forest type is rare. If construction could be largely limited to the farmlands, the botanical value of the forest and its value to most wildlife would be preserved. The ecological values of this site are greater than those of the proposed Newman site.

Although emissions of air pollutants would be identical at all sites, the potential for ecological effects of air pollution appears to be greater at the Ravenswood site. Forested hills that

rise up to 100 m (328 ft) above the site immediately to the east and west could have relatively frequent contact with plumes. The significance of this impact cannot be completely characterized because the characteristics of these emissions are not completely defined.

No endangered species are known to occur on this site, although the Indiana bat may be present in riparian forests on the site.

Construction and operation of the SRC-I facility at the Ravenswood site would not appear to have less impact on terrestrial ecology than at the proposed site.

4.4.2 Water

4.4.2.1 Surface water hydrology

Construction impacts

Potential construction impacts on hydrology at the Ravenswood site are increased runoff and siltation in Spring Creek and alteration of site drainage affecting flows in Spring Creek. If a substantial fraction of the Spring Creek watershed is disturbed during construction, runoff from the site may be substantially increased. If controls are not effectively employed, this runoff could result in increased local flooding and greater erosion and sediment loads. Clearing of vegetation on the site -- soil disturbance and compaction -- will tend to increase surface runoff. Much of the site is drained by Spring Creek, which would receive increased flows. Erosion of soils from the site could result in siltation of the Spring Creek watershed and the embayment. This impact can be minimized by maintaining a buffer zone of undisturbed vegetation using settling basins to reduce suspended sediment load and maintaining grass cover.

Operational impacts

Compaction of soils and paving at the Ravenswood site will reduce infiltration of precipitation and increase runoff. Generally, plant design requires collection and treatment of runoff from storms of a frequency of ten years (24-h storm duration) or less. After treatment, the runoff water may be routed to the Ohio River or used within the plant. These options would result in lower flows in Spring Creek, particularly during storm events.

Site elevations are generally above the 100-year frequency flood event, as estimated by the U.S. Army Corps of Engineers. However, some flood damage may occur to loading or pipeline facilities if these are located near the river.

4.4.2.2 Groundwater

Construction impacts

Location of plant facilities near the Ohio River could require extensive dewatering during construction of foundations. Such dewatering would lower groundwater levels in the alluvial aquifer and could affect well yields in neighboring areas. Unless extensive compaction of the soil or alluvium occurs, water levels would probably return to normal levels after construction ceases. Little impact on groundwater quality is likely to occur during construction.

Operational impacts

At the Ravenswood site the Ohio River alluvium contains a valuable aquifer that is widely developed for municipal and industrial water supplies. Sources of groundwater contamination are similar to those discussed in Sect. 4.2.2.2. The impacts of spills of leachate penetration are likely to be greater at the Ravenswood site than at the proposed site because (1) the soils are coarser in texture, reducing the amount of contaminant absorption and increasing the infiltration rate, and (2) the flow in the alluvial aquifer may carry the contaminants toward the groundwater users. Faster groundwater flow rates in the alluvium facilitate dilution of contaminants but could also decrease the cleanup operation time frame should contamination occur. Site-specific groundwater flow studies are required to determine more precisely the nature of the impact.

Ohio River alluvium yields large volumes of water to wells in the area, and yields to individual radial collector wells utilizing induced filtration may range from 4543 to 7192 liters/min (1200 to 1900 gpm). Use of the alluvial aquifer as a source of process water may cause serious drawdowns unless wells are located near the river and are equipped for induced filtration. Reduced infiltration of rainfall caused by paving or soil compaction may lower local groundwater levels. However, such decreases would probably be of small magnitude and only noticeable directly below buildings.

4.4.2.3 Surface water quality and aquatic ecology

Construction impacts

Potential construction impacts on surface water quality and aquatic ecology at the Ravenswood site include effects of constructing water intake and discharge structure and barge facilities, site runoff into the Ohio River (and the Spring Creek drainage if it remains intact once construction has commenced), disturbance and/or destruction of the Spring Creek Basin, and shoreline disturbance of the Ohio River during site preparation.

Although Spring Creek appeared moderately sedimented on site (Sect. 3.4.3.3), the slough on site may serve as a spawning habitat, nursery, or refuge for Ohio River biota. The creek and slough are also of importance from the standpoint of terrestrial ecology (Sect. 3.4.1.3). The extent of construction impacts would depend on the amount of site preparation required and the exact location of facilities on the site. Site runoff during construction would represent a small incremental source of sediments and dissolved solids added to the already turbid Ohio River.

Operational impacts

Operational impacts of an SRC-I facility, at the Ravenswood site, could result from raw-water intake (impingement and entrainment of aquatic biota), uncontrolled leachate from solid waste disposal, and discharge of runoff from storms greater than the ten-year, 24-h precipitation event.

Impacts resulting from wastewater discharge to the Ohio River are analyzed in Table 4.57 (structure of analysis and assumptions are similar to analysis in Sect. 4.3.2.2). Because of the large dilution capacity available in the Ohio River, the SRC-I discharge would appear to have no significant impact on water quality. When the effluent is fully mixed, the only water quality constituents not in compliance are those for which ambient water quality exceeded the recommended level.

The water supply requirements of an SRC-I plant at the Ravenswood site [217 liters/s (3445 gpm)] would constitute 0.1% of the Ohio River's 7-d, ten-year low flow. No significant impacts would be anticipated from this withdrawal.

Because the location of the landfill disposal area is unknown, specific impacts on surface water resulting from uncontrolled leaching or runoff from large storms are uncertain. However, any leachate escaping a plant site or landfill would enter the alluvial aquifer and could subsequently enter the Ohio River because of the large dilution capacity of the Ohio River. Contaminants released from runoff caused by storms larger than the ten-year, 24-h event would probably not affect water quality.

4.4.3 Air quality

4.4.3.1 Construction impacts

When compared to the proposed site, the Ravenswood site is in an area of superior air quality and is not as close to major nonattainment areas. However, the hilly terrain in rural Jackson County would tend to inhibit the dispersion of pollutants from the proposed plant. Also, the proximity to the Kaiser facility could produce significant air quality impacts on the currently undeveloped areas.

Impacts of fugitive emissions during construction would likely be approximately equal to those predicted at the proposed site because the Ravenswood site would require similar earth-moving

Table 4.57. Mixing of SRC-I effluent with seven-day, ten-year low flow of Ohio River, Ravenswood site (194,000 liters/s)[a]

Constituent	Water quality standard (mg/liter)	Maximum ambient concentration[b] (mg/liter)	Fully mixed concentration (mg/liter)	Compliance with standard (mg/liter)
Arsenic	0.05	<0.01[c]	<0.01	Yes
Cadmium	0.0012 in hard water	0.007	0.007	No[d]
Chlorine, residual	0.01	Assume 0	0.001	Yes
Chromium	0.05	0.016	0.017	Yes
Copper	1.0	0.06	0.06	Yes
Cyanide	0.005	Assume 0	0.0006	Yes
Iron	0.3	9.0	9.0	No
Lead	0.05	0.05	0.05	Borderline[d]
Manganese	0.05	0.62	0.62	No[d]
Mercury	0.00005	0.0008	0.0008	No[d]
Phenol	0.001	Assume 0	0.0003	Yes
Selenium	0.01	<0.005[c]	0.005	Yes
Silver	0.05	<0.001[c]	<0.001	Yes
Total suspended solids		306	306	Yes
Zinc	5.0	0.19	0.19	Yes

[a] See Table 4.7, Sect. 4.2.2.3, for mixing formulae and maximum effluent concentrations.
[b] From Table 3.38, Sect. 3.4.3.3.
[c] Where values were reported as "less than" some concentration, it was assumed that the concentration was equal to that value.
[d] Maximum ambient concentrations of these constituents exceeded the standard.

activity. However, the Ravenswood site is expected to generate less fugitive dust because of lower wind speeds at the site.

4.4.3.2 Operational impacts

Impacts of pollutant releases during accidents could be greater at the Ravenswood site because of the proximity to the Kaiser facility. Were the winds to carry the accidentally released pollutants to the Kaiser facility, the impacts from toxic gases under worst-case conditions could pose a health threat. If winds blow in any other direction, the impact from an accident would be less at the Ravenswood site than at the proposed Newman site.

4.4.4 Economic, social, and cultural impacts

As mentioned in Sect. 3.4.1.2, the primary share of the socioeconomic impacts generated by the SRC-I facility will be experienced in the largely rural counties of Jackson and Mason, West Virginia, and Gallia and Meigs, Ohio. The following discussion, therefore, will focus on these four jurisdictions.

4.4.4.1 Population

Construction

Using a computerized work-force relocation model, discussed in more detail in the labor force and employment section (4.2.4.1), the number of workers who will move into the area within 116 km (70 miles) of the facility was calculated for a peak construction force ranging from a low of 3500 workers to a high of 5000. These projections are shown in Table 4.58.

Table 4.58. Distribution of direct workers for major impact counties, Ravenswood, W. Va. site, SRC-I demonstration peak employment (1983)

County, state	Peak work force of 3500					Peak work force of 5000				
	Local commuters[a]	Local movers/ travelers[b]	Distance movers travelers[c]	Total	Total as percentage of direct employment	Local commuters[a]	Local movers/ travelers[b]	Distance movers travelers[c]	Total	Total as percentage of direct employment
Jackson, W. Va.	694	50	327	1071	30.6	805	96	643	1544	30.9
Mason, W. Va.	197	23	102	322	9.2	228	44	201	473	9.5
Gallia, O.	146	17	68	231	6.6	169	33	133	335	6.7
Meigs, O.	92	13	45	150	4.3	106	25	89	220	4.4
Outside 4 county area	1095	116	384	1595	45.6	1268	225	768	2261	45.2
Total	2224 (63.5%)	219 (6.3%)	926 (26.5%)	3369[d] (96.3%)	96.3[d]	2576 (51.6%)	423 (8.4%)	1834 (36.6%)	4833[e] (96.7%)	96.7[e]

[a] Local commuters are residents of county prior to SRC-I employment who drive to and from the project site daily.

[b] Local movers/travelers are prior residents of the area within 90 min of the site who move from one county within the 90-min zone to another as a result of SRC-I employment. Movers will change their residence permanently; travelers maintain their original permanent address and travel home on weekends or less frequently.

[c] Distance movers/travelers relocate on the vicinity of the SRC-I site from outside the 90-min zone. Movers will change their residence permanently; travelers maintain a permanent address outside the areas to which they travel on weekends or less frequently.

[d] Total differs from 3500 and/or 100% because "distance commuters," those workers residing outside the 90-min zone and commuting to work on a daily basis are not included.

[e] Total differs from 5000 and/or 100% because "distance commuters" are not included.

With a peak construction work force of 3500, about 63.5% of the total number (2224 workers) is expected to be local commuters (prior area residents) who travel to the site on a daily basis from the 22 counties surrounding the Ravenswood site (Table 4.58). Some 219 workers (6.3%) already living in the region are expected to establish residence elsewhere in the area (presumably closer to the site), and 926 workers (26.5%) are expected to move into the area from outside the region either permanently (movers) or on a temporary basis (travelers). The last two groups (local movers/travelers and distance movers/travelers), combined and termed in-movers, total some 1145 workers, or 32.8% of the SRC-I peak construction labor force. While all these workers will change their place of residence as a result of SRC-I, only the 926 distance movers/travelers represent an actual net increase to the population of the 22 county commuting zone. Four counties — Jackson and Mason in West Virginia, and Gallia and Meigs in Ohio — account for nearly 60% of all in-movers.

Comparable figures for the 5000 peak employment case are also shown in Table 4.58. The number of in-movers has been adjusted upward from those actually predicted by the TVA model because the model's predictions are based on past experience with construction projects located within commuting distance of a large metropolitan area, resulting in a larger indigenous work force than is the case here. As shown in Table 4.58, 51.6% (2576) of peak construction manpower is expected to be local commuters. Some 423 workers (8.4%) already living in the region are expected to seek accommodations in the area (local movers/travelers), and 1834 (36.6%) are expected to move into the area from outside the region. The expected number of in-movers, therefore, totals 2257, or about 45% of the total SRC-I peak construction labor force requirements. The four county area (Jackson, Mason, Gallia, and Meigs) accounts for 1264 (56%) of these in-movers.

Population in the impact region will increase not only just by the number of direct construction employees moving in but also by those dependents that accompany workers to the area. In addition, construction activity will stimulate approximately 2600 to 3750 indirect jobs in the service and support sectors of the economy, roughly 10% of which will be filled by in-movers. These 260-375 in-movers will also be accompanied by a certain number of dependents. Based on data gathered at 13 TVA power plant projects in the last four years, it is assumed that 67% of movers will be accompanied by families, with an average size of 3.2 persons. For the purpose of this analysis, it is also assumed that the same proportion of in-moving indirect workers will be accompanied by families of the same average size.

Table 4.59 shows the total (direct and indirect) in-migration expected in the primary impact region by county during the peak construction period for the low and high labor estimates. As can be seen there, the proportion of in-migrants to current residents ranges from a low of 0.7% in Meigs County, Ohio, to a high of 4.4% in Jackson County, West Virginia, for the best case. For the worst case, the comparable figures are 1.4% in Meigs County and 8.2% in Jackson County. Comparing these in-mover figures with the existing population of the major urban centers in the

Table 4.59. Projected in-migration to Ravenswood, W. Va. impact area, peak of SRC-I demonstration phase construction (1983)

County	1980 population	Peak construction work force of 3500				Peak construction work force of 5000			
		In-moving direct workers[a]	In-moving indirect workers[a]	Total in-migrants[b]	Total in-migrants as percentage of 1980 population	In-moving direct workers[a]	In-moving indirect workers[a]	Total in-migrants[b]	Total in-migrants as percentage of 1980 population
Jackson, W. Va.	25,547	377	79	1126	4.4	739	113	2104	8.2
Mason, W. Va.	26,673	125	25	371	1.4	245	37	697	2.6
Gallia, O.	30,152	85	22	264	0.9	166	32	489	1.6
Meigs, O.	23,641	58	13	175	0.7	114	19	329	1.4
Total	84,733	645	139	1936	2.3	1264	201	3619	4.3

[a] In-moving workers include distance movers/travelers and local movers/travelers.

[b] Total in-migrants includes direct and indirect in-moving workers and their dependents; it is assumed that 2/3 of all in-moving workers bring families with an average size of 3.2.

Source: Based on a TVA worker relocation study.

impact region, however, where the majority of new residents are likely to settle, the magnitude of the influx becomes more substantial. In Jackson County, projected in-migration is equal to 15% of the current combined population of the municipalities of Ripley and Ravenswood for the low labor force figure and 28% for the high figure. In Mason County, in-migration will amount to 6.6% of Point Pleasant's existing population at the low end of the range and 12.3% at the high end. In Gallia County, Gallipolis's current size would increase by 4.7% with a 3500 worker peak and 8.7% with 5000 workers if all in-movers settled there. Finally, in Meigs County, the total projected in-migration equals 3.1% of the combined populations of Pomeroy and Middleport at the 3500 figure and 5.8% at the 5000 figure. In the major municipalities of all four counties, therefore, and particularly in Jackson and Mason Counties, project-induced population growth is likely to be sudden and substantial. The specific impacts to community systems which are expected to accompany this growth will be addressed in the following sections.

Operation

While the total construction labor force will range from 3500 to 5000 at peak, operations-period direct employment will amount to only 725 workers. The major population impacts engendered during this period, therefore, will be associated with population stabilization, and possibly even decline, rather than with rapid growth as in the construction period. A fair number of those indirect jobs created during the construction period may remain in the area, and the development of new commerce and industry may take up some of the slack in employment left by completion of SRC-I. Nevertheless, the operations period is likely to be characterized by a scaling down of employment and population from the heights of the construction period.

4.4.4.2 Housing

Construction

Within the four-county impact region, it is projected that in-moving workers (direct and indirect) will require around 780 to 1470 dwelling units (this figure is derived by taking the total number of distance movers/travelers and local movers/travelers and assuming that each one, single or with family, requires one unit of housing). In the same four counties, roughly 1200 to 1600 dwelling units are currently vacant (Table 4.60). However, despite this potential area-wide surplus of housing, there are still likely to be noticeable housing shortages in some local areas. This should be contrasted to the situation at the proposed site, where current housing stock throughout the area is adjudged as adequate.

The explanation for the potential localized housing shortages mentioned above is twofold. First, the demand for housing is not uniform for all housing types. Based on the observed demand of TVA construction workers at more than a dozen recent projects, it is expected that the 780-1470 unit total housing demand will break down into a need for 390-730 single family homes, 200-370 mobile homes, and 200-370 apartments and sleeping rooms. It is probable that the required number of housing units by type will not be uniformly available in all four impact counties; providing the required apartments and sleeping rooms may prove a particularly

Table 4.60. Housing supply and project-induced demand in Ravenswood, W. Va., Impact Area, peak construction year (1983)

County, state	Vacancies, 1980	Work force of 3500			Work force of 5000		
		Project-induced demand	Surplus	Deficit	Project-induced demand	Surplus	Deficit
Jackson, W. Va.	280–470	460	Up to 10	Up to 180	850		380–570
Mason, W. Va.	>500	150	>350		280	>220	
Gallia, O.	340–580	110	230–470		200	140–380	
Meigs, O.	<90	70	<20		130		>40

difficult problem. Also, the number of vacant units of all types are not spread uniformly throughout the impact region. In Jackson County, where 460-850 housing units will be required, only 280-470 will be available. If the lowest figure for supply and the highest for demand are used, the shortage would be especially significant, forcing workers to live in other areas, in nonpreferred housing types, or in crowded or substandard conditions. The actual shortage could be even greater than indicated here, since the habitability of vacant units is unknown. Rapid, unplanned housing growth and an inflated local housing market could result from a strong local demand for housing that outruns supply. This pressure is likely to be eased to some degree, however, by housing surpluses in neighboring Mason and Gallia Counties. The current existence of a healthy and active residential construction sector in Jackson County may also mitigate some of these potential impacts. In addition to the situation discussed above, Table 4.60 also shows a probable housing shortage in Meigs County.

Operation

Because of the stabilization and possible decline of population levels in the impact region during the operations period, the housing stock in existence at that time should be more than adequate to accommodate demand. On the other hand, if the housing stock grows too rapidly during the construction period, a surplus could result during the operations period with negative effects on the local housing market. This kind of overbuilding is also a danger in the public service and transportation sectors as well, where expensive facilities may become underutilized as local population steadies or contracts after the rapid growth of the construction era. If the demonstration phase is followed by commercialization and the expanded construction work force that this will entail, any additions and improvements to the local infrastructure made prior to that time are certain to receive continued use. Underutilization could still occur, however, after this newest stimulus to local growth is removed.

4.4.4.3 Public services

Construction

The approximately 1900-3600 new residents that are expected to settle in the four-county impact region as a result of SRC-I construction will add to existing demands on public services, many of which are already seriously strained (Sect. 3.4.4.3). Again, this is in contrast to the situation at the proposed site, where adequate capacity exists to absorb project-induced growth. In Jackson County, West Virginia, where in-migration will be heaviest, the Ravenswood water system and the Ripley sewer system are currently operating at or over design capacity (Table 3.41). The addition of a significant project-induced demand will greatly exacerbate the situation, unless those improvements currently being contemplated are actually made before the start of peak construction. In Mason County, West Virginia, the major sewer system is also near capacity and is expected to be similarly strained by project-induced population growth unless planned improvements are made in a timely fashion.

Gallia and Meigs Counties, Ohio, are also likely to experience some degree of stress as a result of adding new demand to currently overloaded service systems. As described in Sect. 3.4.4.3, Gallia County's sewage treatment system, while nominally able to handle more demand, has frequent pump station failures and is generally obsolete. County schools are also at or near capacity, but approval of an upcoming school bond could change this. In Meigs County, existing

sewer and water systems will not accommodate new growth without difficulty, necessitating improvements if project-induced demand is to be accommodated. Improvements are also likely to be required in several of the county's schools if new students are to be accommodated in a reasonable manner.

Operation

As in the housing market, no significant new demand for public services is expected as a result of operations period activities.

4.4.4.4 Transportation

Construction

Project-induced automobile traffic could strain the capacities of several critical sections of roadway in the Ravenswood impact area. For the 3500 peak estimate, such strains will be apparent on portions of West Virginia Highway 2 between Ravenswood and Mount Alto (Sect. B). Other roads should, however, be able to handle the increased traffic loads. Under conditions of the 5000-worker peak, portions of Sect. B and Sect. C will exceed E capacity (see Table 4.61). While serious, these impacts are generally not as pronounced as those at the proposed site. Level of service E represents the peak number of vehicles traveling in both directions which can be accommodated by a given section of road. At this level of service, the smooth flow of traffic is subject to breakdown because vehicles are at minimum spacing. When this level is exceeded, the traffic flow is certain to break down, and substantial delays are likely to occur. Three figures are listed for Sect. B because projections were made for three separate subsections of this route. It should be remembered that the E-level capacities shown in Table 4.61 are for two-way flow. Serious problems are likely to occur when even 70-75% of this peak number of vehicles are all traveling in the same direction. Accordingly, the entire length of Sect. B plus Sects. C and F are likely to be problem areas under the worst-case scenario.

Table 4.61. Construction-induced traffic and road-capacities for the Ravenswood site

Road section[a]	Current peak[b] hourly count	Project-induced vehicles at peak hours	Total construction period traffic	Level of service "E",[c] hourly capacities
(A) West Virginia 2 (I-77 to Ravenswood)	NA	250–350	NA	NA
(B) West Virginia 2 (Ravenswood to Mt. Alto)	600	550–800, 1200–1800, 700–1000	1150–1400, 1800–2400, 1300–1600	1800
(C) U.S. 33 (Ripley to Ripley Landing)	700	550–750	1250–1450	1440
(D) U.S. 33 (Mt. Alto to New Haven)	380	250–350	650–750	1800
(E) U.S. 33 (New Haven to Mason)	380	250–350	650–750	1600
(F) West Virginia 2 (Mt. Alto to Pt. Pleasant)	650	450–650	1100–1300	1340

[a] Road sections are shown graphically in Figure 3 *b*.

[b] 1979–80 actual traffic counts; the peak hour for Sect. B is 3:00–4:00 PM, and, for all other sections, 4:00–5:00 PM.

[c] Level of service "E" represents the peak number of vehicles traveling in both directions that can be accommodated by a given section of road.

Source: See Table 3.

Figure 4.15 graphically illustrates the location of all the communities mentioned above and the number of project-induced commuter vehicles that will be using area roads during the peak construction period. These figures were calculated by the same method used for the Equality impact area (Sect. 4.3.2.4).

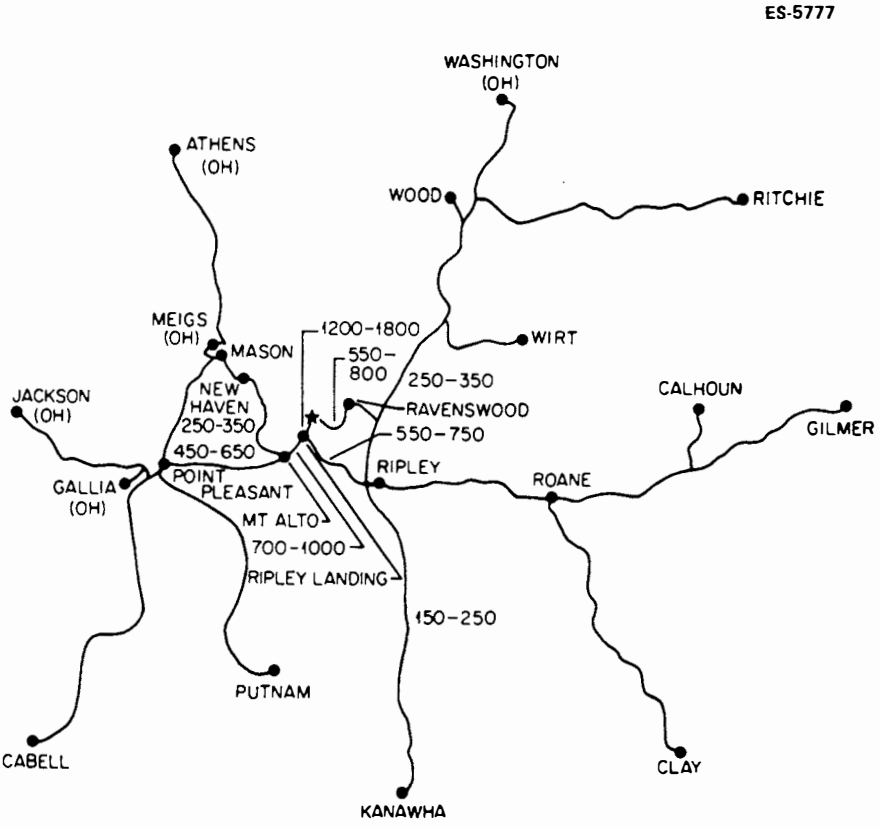


Fig. 4.15. Estimated number of commuter vehicle round trips on selected road sections, Ravenswood Impact region.

In addition to the automobile traffic discussed above, trucks carrying heavy equipment and building supplies are expected to add to the congestion in the area. To mitigate the expected traffic problems (automobile and truck), staggered working hours should be considered as should the options of widening and improving existing roads, instituting a commuter bus service, encouraging car and van pooling, and making deliveries of equipment and materials during off-peak hours.

Some of the additional strain to area roads caused by truck traffic could be reduced by using rail and barge service to transport heavy equipment and building materials to the site. Barge facilities are adequate to handle this load, while rail facilities are available but may require some improvements.

Operation

Automobile traffic will be dramatically reduced at the end of the construction period, eliminating much of the stress to area roads identified above. While there may be some increase in truck traffic because of the need to deliver some materials and equipment to the plant, this

should not be of major importance since the facility's major transport need — the delivery of raw coal and the removal of finished products — will be served by rail and barge lines. Should coal deliveries be, in fact, made by truck, as may be the case if significant tonnage is obtained from neighboring counties, the adverse effect on area roads could be significant.

4.4.4.5 Economic base

Construction

The economic character of the socioeconomic impact region will change somewhat during the construction period as project-induced direct and indirect employment cause the construction and service sectors of the economy to expand. This will be particularly pronounced in Jackson County, where from 1070 to 1540 new construction jobs and 800 to 1100 service and support jobs will be created, and in Mason County, where 320 to 470 new construction jobs and 250 to 370 service and support jobs are expected. In addition, retail trade in the entire four-county region is expected to increase with the influx of sizable numbers of highly paid construction workers.

Operation

While construction employment will drop dramatically after project completion and the number of service jobs may also decline, the operations period is still expected to produce a somewhat different economic character than existed prior to construction. The presence of the SRC-I facility in Jackson County will add to the industrialization of the area, and the demand for coal is likely to strengthen the importance of mining in this region, particularly in the counties of Gallia and Meigs. Retail trade volumes, while remaining higher than during the preconstruction period, are not expected to grow beyond construction-period levels as a result of operations activities.

4.4.4.6 Labor and income

Construction

Unemployment rates in the entire four-county region are expected to decline significantly during the SRC-I construction period. Roughly 1130 to 1300 construction jobs and 1250 to 1800 service and support jobs will be filled by current residents of the impact area. In Jackson County, where the unemployment rate of 7.2% is substantially higher than in the other three counties (Table 3.44), the decline in joblessness should be especially dramatic. Between 690 and 800 construction jobs and 710 to 1020 service and support jobs will go to current Jackson County residents. Concurrent with the decline in unemployment, area incomes should rise with the addition of large numbers of high-paying construction jobs. The attractiveness of these wages could in turn bid up the wages paid by existing employers as they compete for workers. Another result of rapidly rising incomes could be the onset of local inflation in the prices of property, rents, and consumer goods, which would be particularly damaging to the poor and those on fixed incomes. This situation is expected to be more pronounced here than at the proposed site.

Operation

With the completion of the SRC-I facility, the large number of high-paying construction jobs described above will disappear, as may some portion of the newly created service and support jobs. The most likely operations-period impact, therefore, is that of a sharp jump in local unemployment, at least until adjustments can be made in the local labor market. Again, this is expected to be more pronounced here than at the proposed site. At the same time, income levels may decline, as may any local inflation that accompanied construction. By advance recruitment of new commercial and industrial enterprises to the area, local governments may avoid the most serious economic disruptions that could result in the early years of the transition period from construction to operations.

4.4.4.7 Local government, taxation, and spending

Construction

The SRC-I facility represents a very large potential source of income to Jackson County, the jurisdiction in which the facility is to be located. The facility is *not* expected to be taxable during the demonstration phase, however, since it will be under Federal ownership. Still, all four impact counties will receive some additional property taxes from new residential and commercial construction that is expected to accompany population growth. While there is a state sales tax, no revenues from this source are returned directly to local governments based on the amount paid in. The same is true of the State income tax. All four impact area counties could be eligible for Federal energy impact assistance funds and State aid for education.

On the other side of the ledger, there are significant public expenditures that will be required for all four counties plus their municipalities for the public service improvements that will be necessary to accommodate growth. Without property tax payments from the facility itself, project-induced expenditures are expected to outstrip any available revenues. Even if the facility eventually does become taxable, it will become taxable long after construction-period public investments have been made and the revenues will go only to the rural districts of Jackson County, not to the surrounding counties and municipalities that will share the project-induced impacts. To mitigate this situation, careful consideration would be given by DOE to all available options for providing assistance to impacted jurisdictions to help provide, in advance, needed public service and transportation improvements.

Operation

During the operations period of the demonstration phase, there will still be no property taxes collected from the facility, but some Federal energy impact assistance or in-lieu payments may become available. At the same time, new residential and commercial properties added to the area during construction will still be paying taxes, although there could be some revenue loss here if overbuilding and abandonment occurs or if construction-period mobile homes are removed from the area.

On the expenditures side, there should be no pronounced demand for new public services, but local governments will still be paying for any construction-period public service improvements. At this stage, possible mitigation measures include assistance in obtaining Federal energy-impact assistance and the transfer of facility title to private ownership, so that property taxes can be paid. If this latter step is taken, revenue-sharing arrangements could be encouraged between Jackson County and all impacted jurisdictions, and the State's seven-year tax exemption for demonstration facilities would have to be carefully examined to see if it applies to local property taxes.

4.4.4.8 Historic and archaeological impacts

Construction

As described in Sect. 3.4.4.8, the Ravenswood site area is very rich in archaeological sites, in contrast to the situation at the proposed site. Accordingly, excavation and construction in the Ravenswood area may unearth additional archaeological finds that could be damaged or destroyed if proper care is not taken. To prevent this eventuality, a thorough archaeological survey should be undertaken, and any significant sites that are discovered should be catalogued and excavated prior to construction. It will, however, be more difficult to protect any archaeological sites that may be disturbed by project-induced growth and development outside the site boundaries in the larger impact region. As far as historic sites go, none are located on the site itself, but those located in the larger impact area could likewise be disturbed by development in the four-county region.

Operation

Because the rapid growth expected to accompany the construction period is not expected to continue past the completion of the SRC-I facility, any project-induced disturbances to historic and archaeological resources in the impact area should, for the most part, also end at this

time. Where land conversion does continue, however (Sect. 4.4.1.1), the possibility of adverse impacts to historic and archaeological resources will continue as well.

4.4.4.9 Impacts of commercialization, decommissioning, or mothballing

Should the SRC-I facility successfully complete operations as a demonstration project, conversion to a full-scale commercial plant may occur. In this eventuality, the impacts that will occur in the socioeconomic impact region will be much the same as those outlined above, but the scale will be larger. Instead of lasting three years with a peak work force of 3500 to 5000, commercialization will require an eight-year construction period with a peak work force of approximately 5000 to 10,000. It is expected, therefore, that there will be a corresponding jump in in-migration to the area, although the county-by-county distribution of in-movers is likely to remain similar. Land-use conflicts are expected to be more intense than those projected earlier, as pressure increases for residential and commercial growth in the impact region. Housing and public service demands will also be much greater than during the demonstration phase, and traffic congestion, predicted to be significant with a work force of 3500 to 5000, could be much more intense. The severity of these impacts could be reduced, however, if significant improvements to the local infrastructure are made during the demonstration period. At the same time, the danger of over-building (Sect. 4.4.2.2) is heightened. Changes in the economic base are likely to be more pronounced, as will be construction-period inflation and the consequent disruption following project completion. Impacts to historic and archaeological resources are also likely to be more serious during the commercialization phase.

A major difference in kind between the demonstration and commercialization phases will occur in the area of government taxation and spending. Expenditures will be greater during commercial plant construction, due to the greater level of impacts, but property tax could also be paid on the commercial facility. Should full ownership pass to the private sector at this point, as is currently planned, Jackson County would commence to collect taxes on SRC-I. The assessed value of the demonstration facility is expected to be roughly $467 million (assuming a market value of approximately $1.4 billion), compared to a current total assessed value of $211 million for all property in Jackson County. The assessed value of the commercial plant could be considerably higher. Based on current tax rates (Sect. 3.4.4.7) and assuming the value of the commercial facility will not exceed the $1.4 billion figure given above, the SRC-I plant would be liable for $11.8 million annually, compared to a 1979 total of $2.68 million in tax revenues for all Jackson County rural districts. Because of an absence of revenue-sharing arrangements, all these funds would stay in Jackson County's rural districts, with none going to the municipalities of Ravenswood and Ripley or to any surrounding counties. Unless some form of area wide revenue-sharing is instituted, therefore, any adverse fiscal impacts experienced by those nontaxing jurisdictions will not be relieved when the plant goes on the tax rolls.

If, instead of going into commercial operations, the plant is decommissioned or mothballed at the end of the demonstration phase, a loss of jobs (both direct and indirect) is likely to occur, possibly followed by some degree of population out-migration from the impact area. As long as the plant site remains in Federal ownership, this land will be lost for the purpose of further development and eventual contribution to the local tax base.

4.4.5 Cumulative impacts

In the DEIS, four other large construction projects were found to be in the planning stages for location within 116 km (70 miles) of the Ravenswood site. As of this writing, only one of these projects, the most distant of the four [110 km (68 miles)], is still planned for construction. The Gas Centrifuge Enrichment Plant in Pike County, Ohio, is projected to have a peak work force of 3500 in 1984. The other three plants, all conversion facilities, have discontinued plans for various reasons (D. Lewis, U.S. Department of Energy, personal communication, March, 1981).

Little competition for labor between the Pike County and Ravenswood projects is expected, both because of the considerable distance between them and because of the availability of construction labor from other sources within commuting distance of the Pike County site, most notably from the Columbus, Ohio, metropolitan area. Accordingly, significant numbers of local construction workers should not be bid away from the Ravenswood site, and the magnitude of in-migration predicted in Sect. 4.2.4.1 should not be significantly increased. As for the possibility that in-migrants to the Pike County plant would choose to locate in the Ravenswood impact area, the distance between the two sites makes it extremely unlikely that this would occur to any significant degree. In terms of this analysis, therefore, the Ravenswood site should experience few

impacts because of cumulative regional labor demands from energy facilities. Construction of the SRC-I plant itself, however, will create impacts ranging from moderate to severe on the socioeconomic infrastructure of the four-county area during the peak construction years of 1983 and 1989.

4.5 MONITORING PROGRAM

This section identifies monitoring measures to be undertaken pursuant to the proposed action. In the event DOE chooses the no-action alternative and the industrial partner continues with the project at the proposed site, the monitoring measures to be taken pursuant to that action are set forth in Sect. 2.3.3.

4.5.1 Introduction

Extensive monitoring is planned on and around the plant site throughout the project. A substantial portion of the monitoring program will be required of this project by regulatory agencies, as it would be for any large energy facility or emission source, to demonstrate that the plant is being constructed and operated in compliance with existing environmental quality standards. A portion of the monitoring program will focus on early detection of pollutants or contaminants in ambient and work place environments so that adverse effects can be avoided or mitigated. The remainder of the monitoring program will be used to acquire an understanding of environmental and health effects caused by the presence or release of chemical substances from SRC technology for which no legislated standard exists. The monitoring program presented in this FEIS has been substantially improved over that given in the DEIS in that a preconstruction monitoring program is described. Obtaining this data is one of the fundamental purposes of the SRC-I demonstration project. A summary of monitoring results at the Fort Lewis and Wilsonville pilot plants is presented in Appendix Z.1.

The objectives of the monitoring program are:

- to determine both acute and chronic effects of construction and operation on the biosphere, with particular emphasis on man and his environment;
- to attempt to identify and understand the causes of these effects and direct technological efforts to mitigate them;
- to provide adequate process information for control, optimization, and evaluation of the treatment systems; and
- to demonstrate compliance with environmental quality standards.

The monitoring program has been divided into four segments: (1) environmental, (2) in-plant, (3) health effects, and (4) socioeconomic monitoring. The scope and composition of each segment follow. Where applicable, the monitoring program segments are being designed for each of the chronological phases of the project (i.e., preconstruction, construction, start-up, and operation). The preconstruction monitoring program will be a continuation and supplementation of the baseline monitoring that was conducted for preparation of the EIS. It has been designed to determine a statistically significant baseline for chemical, physical, biological, and socioeconomic characteristics. The preconstruction monitoring program will enable subtle environmental changes due to construction and operation of the demonstration facility to be detected and statistically substantiated. Data will be integrated in an attempt to describe basic ecological interrelationships. Monitoring programs for the construction and operational phases are outlined; however, many of the program details will depend on the results of the preconstruction monitoring program and the final design.

The construction and operation of the plant are subject to a number of environmental and health-related standards and regulations. These standards and regulations for construction (Table 4.62) and operation (Table 4.63) include consideration of occupational safety and health, air quality, water quality, solid waste disposal, spill prevention and cleanup, noise, endangered species, proper management of floodplains and wetlands, and preservation of national historic landmarks. Appendix W identifies all of the permits required for construction and operation of the facility.

Table 4.62. Major standards and regulations applicable during construction

Standard requirement	Responsible agency	Remarks
Air		
National ambient air quality standards	State/EPA[a]	Compliance enforced through permit program
State air pollution control regulations	State	Requirements generally applicable to major construction activities
Fugitive dust control		
Open burning restrictions		
Water		
Water quality standards	State	
Construction effluent quality	EPA/State	Permit(s) required
Construction in navigable waters	Corps of Engineers	Permit(s) required
Control of oil and hazardous materials	EPA/Coast Guard/State	
Solid Waste		
Resource Conservation and Recovery Act	EPA/State	Permit(s) required
State solid waste disposal regulations	State	Permit(s) required
Dredge disposal	Corps of Engineers	
Other		
Noise	EPA	Guidelines only
Endangered Species Act	DOI[b]	
National Historic Preservation Act	State/ACHP[c]	
Floodplains/wetlands management	DOE[d]	
Safety and Health		
Safety and health regulations for construction	DOL/OSHA[e]	29 CFR 1926
Occupational safety and health standards	DOL/OSHA	29 CFR 1910

[a]Environmental Protection Agency.
[b]Department of the Interior.
[c]Advisory Council on Historic Preservation.
[d]Department of Energy.
[e]DOL, Department of Labor; OSHA, Occupational Safety and Health Administration.

The Environmental Protection Agency, the Army Corps of Engineers, and other Federal, State, and local agencies require project sponsors to obtain a variety of permits and licenses to construct and operate the facility. The status of the major permits and licenses can be found in Appendix W of this report. In many cases, these permits serve as action-forcing documents in that they require monitoring. The permitting process provides citizens the opportunity to examine the final permit and license documents.

The monitoring program described in the following sections will determine compliance with the applicable standards.

The environmental monitoring program undertaken will closely follow the procedures, analyses, and strategies, given in DOE's *Environmental Monitoring Handbook for Coal Conversion Facilities*.[53]

4.5.2 Monitoring in the surrounding environment

The chemical, physical, and biological characteristics of the surrounding environment will be monitored to detect and quantify the environmental effects of construction, start-up, and operation of the SRC-I Demonstration Plant. The Preconstruction Environmental Monitoring Program will include the details of the program outlined and will be further refined to meet the needs of EPA, KDNREP, and other scientific and regulatory agencies that are currently reviewing the program. The environmental monitoring programs for the construction and operational phases will incorporate the same elements as the preconstruction program. Detailed

Table 4.63. Major standards and regulations applicable during operation

Standard/regulation	Responsible agency	Remarks
Air		
National ambient air quality standards	State/EPA[a]	Compliance enforced through permit program
Prevention of significant deterioration	State/EPA	Limitations included in permit
New source performance standards	State/EPA	Currently no specific standards for coal liquefaction, standards applicable to certain unit operations
State air pollution control regulations	State	No specific standards for coal liquefaction, generally applicable to industrial emissions
Water		
Water quality standards	State/EPA	Compliance enforced through permit program
Effluent guidelines	EPA/State	No specific standards for coal liquefaction wastes
Spill prevention control and countermeasures plan and spill contingency plan	EPA/Coast Guard	Plan required
State effluent quality standards	State	No specific standards for coal liquefaction wastes
Solid wastes		
Resource Conservation and Recovery Act	EPA/State	Regulations have been promulgated
State solid waste regulations	State	Standards will probably be replaced by the RCRA program
Noise	EPA	Guidelines only
Safety and Health		
Occupational safety and health standards	DOL/OSHA[b]	Standards for coal conversion currently under development
Toxic Substances Control Act	EPA	Applicability to SRC products now being evaluated

[a]Environmental Protection Agency.
[b]DOL, Department of Labor; OSHA, Occupational Safety and Health Administration.

environmental monitoring programs for the construction and operation phases will be available by June 1982 for review by EPA, KDNREP, and other agencies. Elements of the environmental monitoring program are described below.

4.5.2.1 Preconstruction Environmental Monitoring Program

In accordance with the Work Plan described in Appendix EE, a Preconstruction Environmental Monitoring Concept Plan is being prepared which gives details of sampling and analytical techniques to be used in the baseline monitoring programs described below. For preparation of this plan, guidance was taken from ref. 53. This document has been reviewed by EPA, KDNREP, COE, USFWS, and other concerned agencies. Comments have been received and appropriate modifications to the plan are being prepared. Upon finalization, this plan will be distributed to the same location (specified in the Foreword) as the Final Environmental Impact Statement.

Air

The atmospheric monitoring program is designed to provide, quantitatively, the status of the existing air quality at the proposed site of commonly occurring pollutants and those to be

emitted in significant amounts from the proposed plant. The air monitoring program concentrates on Federal and state criteria pollutants and those noncriteria pollutants for which the SRC-I plant might be a significant source. The monitoring location will be on the site at a location judged to be equivalent to that used for the original baseline monitoring program. The program also includes monitoring the CO concentrations along Highway 60 during peak traffic periods. Table 4.64 is a summary of the preconstruction air quality monitoring.

Table 4.64. Summary of the preconstruction air quality monitoring

	Frequency for one year
SO_2, NO_2, CO, O_3, nonmethane hydrocarbons, total reduced sulfur	Continuous
Total suspended particulate, Pb	At least every 3rd day
Respirable particulates	Every 3rd day
Be, Hg, H_2S, fluorides (gaseous)	Monthly
Total fluorides on forage	Monthly
Odor	Three times
Highway CO	Three times
Cyclic organic matter	Monthly
Sulfate, nitrate, trace elements	Every 6th day
Radionuclides	Weekly

Meteorological studies

The meteorological studies are designed to collect data that will enhance the reliability of dispersion modeling of plant emissions. Meteorological data summarized in Table 4.65 will be gathered. This information will be used to determine the distribution and coincident conditions for the following parameters:

- transport wind speed and direction,
- Pasquill-Gifford stability categories,
- reference wind and temperature, and
- mixing height.

Table 4.65. Meteorological monitoring program

	Frequency for one year
At 10 and 60 m above ground level	
Horizontal wind speed and direction	Continuous
Standard deviation of horizontal wind direction (σ_θ)	Continuous
Vertical wind speed	Continuous
Standard deviation of vertical wind speed fluctuations (σ_w)	Continuous
At 10 m above ground level	
Temperature	Continuous
At ground level	
Mixing height	Continuous

Sound-level studies

The sound-level studies have been designed to determine the preconstruction A-weighted ambient sound levels, frequency distribution, and content. Seven locations will be monitored. Monitoring sites along Martin Creek will determine sound levels in an area which the Indiana bat, an endangered species, has been sighted. Other monitoring sites will determine the preconstruction sound levels along U.S. 60 during normal and peak traffic periods and the train pass-by noise levels near the L&N railroad. Foliage on trees and brush affect the propagation of sound; therefore, sound level measurements will be made twice when trees and shrubs are in full foliage and twice when they are bare.

Soil studies

Precipitation, leachate, and liquid leaks and spills pass through and/or over the soil enroute to the aquifer, surface water, or plant root systems. These studies will determine soil transmitting and holding capabilities, methods and speed of infiltration and transport, ability to attenuate contaminants, and the existing chemical composition. Soil borings will be drilled at the proposed sites for the sludge landfill, coal storage piles, SRC storage piles and ash ponds. Soil samples from the borings and surface samples taken on and in close proximity to the site will be analyzed for parameters in Table 4.66. Soil moisture determinations will be made monthly. Physical properties to be measured include density, unit weight, porosity, and permeability. Infiltrating water from an unsaturated zone will be collected quarterly and analyzed for the chemical constituents in Table 4.66.

Table 4.66. Parameters for soil monitoring

pH	Boron
Cation exchange capacity	Cadmium
Nitrates	Chromium
Metal adsorption capacity	Cobalt
Clay mineralogy	Copper
Endrin	Fluoride
Lindane	Lead
Methoxychlor	Manganese
Toxaphene	Mercury
2,4-D	Molybdenum
2,4,5-TP Silvex	Nickel
Pesticide scan	Selenium
Arsenic	Vanadium
Barium	Zinc
Beryllium	

Groundwater studies

The groundwater studies undertaken before construction will establish the existing physical and chemical properties of the primary domestic aquifer at the proposed site. The aquifer's boundaries and the groundwater's rate and direction of movement will be combined with results of the soil studies to formulate a site-specific leachate and spill dispersion model. Twenty-four observation wells dispersed across the site will be monitored quarterly for the static groundwater level and water quality (Table 4.67). Aquifer permeability will be determined around each of the wells; and an aquifer pumping test will be performed on one well to determine the aquifer's transmissivity, storage coefficient, porosity and specific yield. In addition, approximately 14 shallow auger borings will be drilled to identify the areal extent of the impermeable clay boundary adjacent to the river.

Table 4.67. Parameters for groundwater monitoring[a]

Physical	Cadmium
Temperature	Cobalt
Density	Chromium
Odor	Copper
Turbidity[a]	Iron
Taste	Germanium
Specific conductance[a]	Mercury
Other	Lanthanum
Total coliform[a]	Magnesium
Fecal coliform[a]	Manganese
Uranium	Molybdenum
Thorium	Nickel
Radium[a]	Lead[a]
Gross alpha[a]	Rubidium
Gross beta[a]	Antimony
	Selenium
Organic	Tin[a]
Total organic carbon or chemical oxygen demand[a]	Titanium
Phenols[a]	Vanadium
Arylamines	Tungsten
Aliphatic hydrocarbons	Zinc
Mono and polycyclic hydrocarbons	Zirconium
Sulfur compounds	Silver[a]
Chloroganics and chloramines	Total nitrogen
Endrin[a]	Nitrate (as N)[a]
Lindane[a]	Alkalinity
Methoxychlor[a]	Ammonia
Toxaphene[a]	Cyanide
2,4,-D[a]	Fluoride[a]
2,4,5-TP Silvex[a]	Phosphate
Total organic halogens[a]	Total dissolved solids
Inorganic	Total suspended solids
Aluminum	Sulfate[a]
Arsenic	Chloride[a]
Boron	Alkalinity
Barium	pH
Beryllium	Hardness, as $CaCO_3$
Bismuth	Sodium[a]

[a]Includes parameters necessary to meet Interim RCRA requirements (May 19, 1980).

Several sources of materials which have the potential for causing deterioration of groundwater quality will exist within the proposed SRC-I facility. The preconstruction program will be designed to collect baseline data enabling an impact evaluation for the following areas:

- coal storage and handling areas,
- solid waste storage areas,
- solid SRC product storage and handling areas,
- liquid product storage areas, and
- wastewater collection and retention facilities.

Compliance monitoring may be required in the waste storage areas, depending upon determination of the hazardous or nonhazardous nature of the waste. Assessment of the environmental impacts of the proposed SRC facility is a goal of the demonstration project and will include additional groundwater monitoring. The following will be considered in planning groundwater monitoring during the operational phase:

1. the quality of the water collected from between the bottom of the clay liner and the top of the water table and from the unsaturated zone in coal and waste storage areas;

2. the quality of the leachate from within the solid waste disposal area to determine the quality of waters that would potentially recharge the groundwater in that area of the site in the event of liner failure; and

3. the water quality from wells in the alluvial aquifers located hydraulically downgradient from the following areas:

   a. ash pond and metal-sludge landfill,
   b. product storage and loading area (to detect infiltration of spilled product),
   c. wastewater retention area, and
   d. process area.

Parameters in the monitoring programs will include onsite measurement of temperature, pH, and conductivity. The following parameters will be included in laboratory testing of groundwater samples:

- major dissolved constituents,
- major trace elements that are detected in process waste streams or leachates,
- appropriate EPA priority pollutants with emphasis on organic constituents (PNA), and
- priority trace elements designated by regulatory agencies.

Appendix M, Sect. M.2 includes a statement of work for groundwater studies aimed at determining the specific hydrogeologic regime of the plant site.

Surface water quality and aquatic ecology

Some of the more important ways in which change may express itself in the aquatic environment are by shifts in the structure of the community of species, by alterations in the productivity of the system, by development of nuisance growths, and by the accumulation of toxic materials within organisms important in the food web or in the sediments. The accumulation of these substances as they relate to man is of particular concern. The aquatic studies are intended to address these and other potential problem areas.

The industrial partner is performing continuing baseline monitoring to supplement prior efforts. Baseline monitoring from prior years is summarized in Sect. 3.2.2.3 and Appendices H and J. As part of the supplemental monitoring, a far-upstream station has been established to provide a control station which is free from the effects of any of the facility's airborne releases (e.g., fugitive dust or cooling tower drift). The basic elements of the supplemental monitoring program are summarized in Tables 4.68 and 4.69. The distribution and abundance of the major groups of organisms will be sampled. Indicators of ecosystem function will be measured, including primary productivity of periphyton, growth rates of mussels, colonization rates of invertebrates, and food preferences of fish at various trophic levels. Appropriate trace elements and organic compounds will be measured in the water column, sediments, periphyton, mussels, and fish (Table 4.70).

Terrestrial ecology

The terrestrial ecology studies are outlined in Table 4.71. The existing populations, varieties, and interrelationships of the plants and animals on and around the site will be established. Major portions of the site and the surrounding area are used for agricultural purposes. Therefore, this program will focus on determining the biological and chemical conditions of area crops and pastures. The net primary productivity of soybeans, which are sensitive to air pollutants, will be monitored. Permanent terrestrial monitoring sites will also be established on site and off site.

Area surveys for endangered species will continue in this program. A second survey in the areas of Martin Creek and Bryant Ditch for endangered species of freshwater mussels, plants, or fish is planned for early summer 1981.

Table 4.68. Summary of proposed aquatic supplemental baseline monitoring

	Ecosystem structure	Ecosystem function	Ecosystem contamination[a]
Phytoplankton	x		
Benthic Algae	x		
Periphyton	x	x (primary productivity)	x
Zooplankton	x		
Benthic Invertebrates	x	x (growth rates)[b]	x (mussels)
Fish	x	x (gut analyses)	x (herbivores omnivores carnivores)
Ichthyoplankton	x		

[a]Water, colloids, and sediments will also be sampled.

[b]Growth rates will be measured for mussels; rates at which benthic invertebrates colonize artificial substrates will also be measured.

Sources: International Coal Refining Corp., (ICRC) Draft Concept Plan for Preconstruction Environmental Monitoring Program for the SRC-I Demonstration Project, January 26, 1981; Ruth Patrick, Academy of Natural Sciences of Philadelphia, telephone conversation with R. D. Roop, Oak Ridge National Laboratory, April 14, 1981.

Table 4.69. Components of the aquatic studies

	Frequency for one year
Benthic biological studies	3 times
Insect and other invertebrate studies	
Algal benthic studies	
Plankton studies	3 times
Productivity studies	3 times
Phytoplankton productivity and biomass	
Periphyton productivity and biomass	
Fish studies	
Adults and juveniles	3 times
Ichthyoplankton	Biweekly April to September, once in October
Nuisance growth	3 times
Sediment studies	3 times
Chemical analyses of organisms and sediments	3 times
Periphyton, for heavy metals and organics	
Sediment, for heavy metals and organics	
Fish, for heavy metals and organics	
Surface water quality analysis	3 times
Hydrology	2 times

Table 4.70. Analytical parameters for periphyton, Sediment, and Fish

Inorganics	Organics
Antimony	Dibenzothiophene
Arsenic	Fluoranthene
Beryllium	Pyrene
Boron	Benzo(c)phenanthrene
Cadmium	Dibenzo(a,h)anthracene
Chromium	Chrysene
Copper	Benzo(a)pyrene
Iron	Benzo(b)fluoranthene
Lead	Dibenzo(a,c)anthracene
Manganese	Benzo(a)anthracene
Mercury	Orthophenylene pyrene
Nickel	5-methylchrysene
Selenium	Benzo(g,h,i)perylene
Vanadium	Benzo(j)fluoranthene
Zinc	2-methylnaphthalene

A mist netting program is scheduled for early summer 1981 to determine if portions of the site are being used as a summer habitat for a nursery colony of Indiana bats (*Myotis sodalis*). Nets will be set during two periods on a total of 10 nights. A night viewing device and an ultrasonic detector will be utilized in an attempt to determine areas of high activity and roost sites.

Water fowl use of waste ponds on the site and avian mortality from collisions with plant facilities (including the power line at the site) will be observed periodically to determine whether any corrective actions should be taken.

4.5.2.2 Construction environmental monitoring program

The environmental monitoring program for air, meteorology, sound level, soils, groundwater, and terrestrial ecology will incorporate the same elements as the preconstruction program. The program for surface water quality and aquatic ecology will be expanded slightly. In addition to the baseline studies, additional monitoring will be done.

The principal water quality impacts during construction will be minor increases in loadings of sediments, nutrients, and other dissolved substances resulting from (1) site preparation; and (2) construction involving the barge dock, water intake, and wastewater discharge pipes. The NPDES permit (Appendix W) for discharge from the site's sediment control basin will specify the parameters to be monitored and the sampling frequency. Total suspended solids, oil and grease, and pH are typically monitored. During construction these parameters will also be sampled in Martin Creek, Bryant Ditch, and the Green River at the established sampling stations (Fig. 3.11). Sampling will occur at regular intervals, but spot sampling will also be done during key construction events (e.g., dredging) and after selected precipitation events. This sampling will determine if the controls and mitigation measures are successful in controlling potential impacts.

4.5.2.3 Operations environmental monitoring program

The environmental monitoring for air, meteorology, sound level, soils, surface water, groundwater, and aquatic and terrestrial ecology will incorporate the same elements as the preconstruction program with appropriate modifications and the methodologies, design, and techniques presented in the Preconstruction Environmental Monitoring Concept Plan.

Table 4.71. Terrestrial ecology monitoring program

	Frequency
Species	
Flora	Once
Fauna	Once
Endangered species	Continuing
Natural and managed plant community studies	
Identification	Continuing
Quantification	Every 2-3 years (except for forest floor)
Phenology	Annual
Dendrochronology	Every 3-5 years
Aerial photography	Annual
Mapping	Annual update
Animal population	
Insects	Annual
Amphibians	Annual
Avifauna	Annual
Mammals	Annual
Indiana bat	Continuing
Ecosytem processes	
Productivity	Annual
Trophic exchange	Every 2 years
Litter decomposition	Annual
Soil respiration	Annual
Permanent terrestrial monitoring sites	
Onsite	Continuing
Offsite	Continuing
Specific pollutant study	
Trace elements	
Leaf litter	Annual
Soil	Every 2 years
Animals	Seasonal to every 2 years
Air Pollutants	Seasonal
Pasture	
Monocultures	
Natural systems	
Dry fall/wet fall	
Dry fall	Weekly to monthly
Wet fall	Weekly to monthly
Organic compounds	

4.5.3 In-plant monitoring

The In-Plant Monitoring Program will be designed to monitor point source and fugitive emissions, the performance of environmental control systems, and the quality of the workplace environment. There will be four basic objectives to the in-plant monitoring program (see also Sects. 4.1.3.5 and 4.1.3.6):

1. to identify and quantify pollutants in gaseous, liquid, and solid waste effluent streams from the plant including fugitive emissions;

2. to verify that the plant is operating in compliance with environmental control regulations;

3. to determine the performance of environmental control systems used in the plant; and

4. to determine worker exposures in actual workplace environments (Sects. 4.1.3.6 and 4.5.4).

Detailed program development is scheduled to be completed by June 1982. The preliminary plans are discussed below.

Data obtained from the in-plant monitoring program will be correlated with meteorological and operational information. Complete characteristics of the plant's emissions and discharges (often the exit stream from a control system) are necessary to link observations of the environmental monitoring program, described in the preceding section, with plant operations, enhance dispersion models, and verify plant compliance with regulatory requirements.

The detailed development of the monitoring program is scheduled to be completed by June 1982. Preliminary elements of the monitoring plan have been identified and are presented in Tables 4.72 through 4.75. Preliminary elements of the gaseous systems monitoring plan (Table 4.72) reflect primarily that monitoring which must be done to verify compliance with environmental regulations. The detailed plan will identify monitoring which will be done to achieve the remaining objectives.

Fugitive particulate and hydrocarbon emissions during the operational phase have been raised as an environmental issue. The program will specify monitoring locations, methods, frequencies, and procedures for identifying the sources of collected particulates.

Elements of the preliminary liquid systems monitoring plan reflect primarily that monitoring which must be done to identify and quantify pollutants in liquid systems and to assess the performance of pollutant emission control systems. Parameters to be measured and the monitoring program to verify compliance with environmental regulations (primarily NPDES) will be determined in conjunction with cognizant regulatory agencies (KDNREP and EPA). The detailed monitoring program will reflect these determinations.

4.5.4 Health effects monitoring

One of the purposes of the SRC-I demonstration program is to identify any serious health risks associated with the demonstration plant itself and with a future commercial SRC industry and to minimize those risks before the onset of adverse effects.

To understand these risks, the project sponsors are developing a program to

1. monitor routine, fugitive, and emergency emissions from the plant to characterize the actual contaminants leaving the plant (Sect. 4.5.3);

2. monitor the ambient environment to predict impacts and the effectiveness of measures to mitigate them, detect impacts that were not predicted, and in general, to identify how contaminants are transported through the environment and where they appear or accumulate (Sect. 4.5.2);

3. monitor occupational environments to determine worker exposure to routine, toxic, and biologically active chemical compounds so that they may be controlled to within established limits;

4. conduct medical surveillance of the work force to enable early detection of any signs of stress or adverse effects related to occupational health exposures; and

5. conduct research studies to develop a fundamental understanding of how the physical environment and the biological environment respond to the unique chemical contaminants that appear in and around the plant as a result of the project.

The emphasis of the monitoring program is on prevention of adverse impacts through early detection and mitigation.

Elements 1 and 2 (monitoring of plant emissions and of the ambient environment), although related to health protection, are discussed in separate sections (4.5.3 and 4.5.2) of the monitoring program. Element 5 (the research program), is outlined in more detail in Appendix Z. Elements 3 and 4 (personnel exposure and medical monitoring) are uniquely part of the plant operation phase health effects monitoring and will be handled by the medical and industrial hygiene staff at the plant. Detailed personnel exposure and medical monitoring plans are

Table 4.72. Gaseous systems monitoring (preliminary)[a]

System	Monitoring
Indirect heat exchangers (all)	Performance tests for particulate matter, SO_2, NO_x, and CO
Fuel gas fired heaters	Performance tests listed above plus continuous H_2S in fuel gas header
Oil fired boiler	Performance tests listed above plus continuous SO_2, NO_x (if >70% of performance standard), opacity, and either O_2 or CO_2
Enclosed thermal oxidizer	Performance tests listed above plus continuous SO_2, NO_x, opacity and combustion efficiency
Coker/calciner scrubber	Performance tests listed above plus continuous SO_2
Waste oil incinerator	Performance tests for particulate matter and principal organic hazardous constituents
	Record daily charge rate and hours of operation
	Continuous combustion temperature, waste and air feed rates, and CO
	Daily inspection for leaks, spills, and fugitive emissions
Flares	Initial and periodic visual opacity
Coal-preparation and handling exhausts	
General	Performance test for particulate matter
Coal dryer	Continuous temperature at exit of dryer
Noncoal particulate exhausts	Performance test for particulate matter
CO_2 stripper and Stretford absorber	Performance tests for CO, H_2S, and carbonyl sulfide

[a] Reflects primarily monitoring to verify compliance with environmental regulations.

Table 4.73. Liquid systems monitoring[a]

System	Monitoring
Chrome removal	Weekly CR^{+6} removal efficiencies
Metal removal	Weekly removal efficiencies for representative metals
Oil removal	Weekly oil and grease removal efficiencies
Equalization pond	Compositional analysis of any liquid in leachate collection system
Process wastewater biotreatment	Daily removal efficiencies[b]
Sand filter	Daily removal efficiency for TSS
Carbon beds	Breakthrough
Plant discharge or recycle	Continuous biomonitoring Weekly[c] Annually[d]
Sanitary wastewater treatment	Daily removal efficiencies[b]
Cooling tower blowdown	Monthly and event analysis for volatile organics

[a] Reflects primarily monitoring to evaluate performance of environmental control systems.

[b] BOD_5, COD, TOC, TSS, ammonia (as N), pH, fecal coliform, oil and grease, chlorine, alkalinity, and phosphorus.

[c] BOD_5, TSS, oil and grease, phenolics, ammonia as N, sulfide, total chromium, hexavalent chromium.

[d] Parameters shown in 40 CFR 122 Appendix D, Table II, volatiles, acid compounds, base/neutral and pesticides Table III, Table IV, and Table V. If pollutants found, frequency would be specified in NPDES permit.

Table 4.74. Solid waste systems monitoring[a]

Sample	Frequency
Gasifier slag and fly ash	Monthly or as coal feedstock is changed
Chromium removal sludge	Quarterly or as coal feedstock is changed
Metal removal sludge	Quarterly or as coal feedstock is changed
Process wastewater biosludge	Quarterly or as coal feedstock is changed
Spent activated carbon	When removed
Oil removal sludge	Quarterly
Sanitary wastewater biosludge[b]	Quarterly
All leachates from leak detection systems	Event
Leachates from collection system	(Routed to metal-removal system)

[a]All parameters currently required to be investigated by 40 CFR 261 as well as those inorganic parameters indicated as potentially present by coal feedstock analyses; organic parameters to be determined by gross GC mass spectrographic scanning and other applicable methods.

[b]Sanitary wastewater may be combined with the process wastewater for treatment in a single system.

Table 4.75. Fugitive NMHC monitoring

Source	Type of inspection[a]	Frequency of inspection
Pumps[b,c]		
Light liquid	Visual	Weekly, daily
Heavy liquid	Visual	Weekly, daily
Compressors[c]	Visual	Weekly, daily
Valves		
Gaseous	VOC analyzer	Quarterly
Light liquid	VOC analyzer	Quarterly
Heavy liquid	VOC analyzer	Semi-annually
Safety/Relief[c]	VOC analyzer	Annually
Flanges	VOC analyzer	Annually
Drains[c]	VOC analyzer	Annually
Aerial coolers	VOC analyzer	Quarterly
	Visual	Daily

[a]Instrumental monitoring frequency is annual if the component is shown to operate with no detectable emissions (VOC concentrations at all potential leak interfaces less than 200 vppm above background).

[b]Weekly visual inspection for dripping liquids from pumps; daily visual check of centrifugal pump and compressor pressure sensors.

[c]Expected to be maintained in a state of no detectable emissions. The inspection listed for safety relief valves and drains is essentially an annual performance test for the "no detectable emissions" classification.

expected to be finalized during the detailed design and construction phase of the demonstration project. The plans will be based on the results of the ongoing research program (Appendix Z), which includes toxicological testing. A general discussion of these two elements follows.

Worker exposure monitoring

This will be a thorough system of industrial hygiene monitoring and will use methods equivalent to or more current than those specified by the National Institute for Occupational Safety and Health (NIOSH). This system will assess worker exposures to potentially harmful substances and help to formulate both work practices and engineering control to prevent exposure. Frequency of monitoring will be dependent upon an assessment of the potency of toxicants and the initial concentrations measured. Protocols will be developed by a certified industrial hygienist. Initial area and personnel monitoring will be conducted for, but not limited to, the following agents: coal dust, coal-tar pitch volatiles (CTPVs), PNAs, aromatic amines, phenols, creosols, hexane, carbon monoxide, nickel carbonyl, carbonyl sulfide, hydrogen sulfide, sulfur dioxide, hydrogen cyanide, welding fumes, silica, trace metals, noise, lighting, and radiation.

Medical monitoring

A medical monitoring program will be made available to all employees who may be occupationally exposed to coal liquefaction products, and participation in the monitoring program will be encouraged. Examinations designed to detect potential coal-liquefaction-related symptoms will be made before employment and annually thereafter unless a different frequency is indicated on the basis of professional medical judgment. This medical monitoring will help detect medical problems early (should any occur), when prognosis for successful treatment is generally very high.

It is of utmost importance to retain employee records for a sufficient period of time. Because of the occupational health uncertainties inherent in a new industry and the long latency period of potential cancers, employee records will be kept for a period of time consistent with or longer than those stipulated in Federal regulations. These records shall include demographic information as well as comprehensive work histories, exposure monitoring data, and medical surveillance results.

Included in the actual medical screening process will be a physical examination; vital signs, blood chemistries, hematology, and urinalysis; spirometry, and electrocardiograms. Chest X-rays will be ordered as indicated clinically. Special provision will be made for examination of the skin. Bioassay will be used when materials at the workplace, e.g., benzene, lead, suggest that this approach would have utility in a medical surveillance program. The program is based on extensive experience in the chemical industry.

4.5.5 Socioeconomic monitoring

The objective of socioeconomic monitoring is to determine the extent of project-induced employment, population changes, and revenues and their impacts on community systems such as housing, schools, utilities, and transportation. To achieve this objective, the project sponsors will conduct quarterly surveys and interviews with workers and local public officials during construction in the subject areas listed below. The study area will consist of the primary impact counties for the site in question, with special emphasis on those communities affected by construction worker relocations and commuting traffic.

- Population: Baseline population for the area will be monitored as well as the number of project-induced workers, their dependents, and place of residence.
- Housing: The number and type of vacant housing units will be identified as well as the nature and extent of shortages that may develop.
- Public services: Existing capacity and any shortages will be identified for water, sewer, schools, health, police, and fire-protection systems.
- Transportation: The number of trips on important area roads (particularly U.S. 60) as well as travel times and highway capacity will be monitored.

- Fiscal impacts: Project-induced public service expenditures by local communities will be tracked as should major project-induced revenues from material expenditures and taxation.

To ensure local and regional involvement in the monitoring process, a regional citizen advisory review board could be established. The board would engage local citizens and public officials to help identify any additional data that may need to be examined and to help interpret the information gathered.

Because the negative impacts of the project are predicted to occur during construction and because the size of the operation work force will be smaller than the construction force, socioeconomic monitoring will not be needed beyond the first quarter of operation.

4.6 MITIGATION MEASURES

This section identifies mitigating measures to be undertaken pursuant to the proposed action. In the event DOE chooses the no-action alternative and the industrial partner continues with the project at the proposed site, the mitigating measures to be taken pursuant to that action are set forth in Sect. 2.3.3. The following lists of mitigation measures are the major site-specific and process-specific control measures that are responsive to environmental concerns. Some mitigation measures cannot be specified in detail at this time. In some cases studies are currently underway or will soon be undertaken to determine the nature and magnitude of potential environmental problems. In other cases the detailed mitigation techniques will be developed along with the final plant design itself. Construction and operation of the facility will be responsive to the Environmental and Health monitoring program described in Sect. 4.5. This program will be used to determine the effectiveness of the proposed mitigation measures. Where these measures are found to be ineffective, alternative mitigation strategies will be promptly developed and implemented.

4.6.1 Process controls

The following list highlights the discussion of proposed pollution control strategies presented in Appendix C (wherein alternative strategies are also discussed). Sections 2.2.1 and 4.1.4 also present information regarding proposed process controls.

- The proposed plant design incorporates a tertiary wastewater treatment system that emphasizes the removal of toxic metals and organic compounds from the wastewater. The design goal for this system is to recycle treated wastewater within the plant to achieve zero-wastewater discharge. This system will be designed, however, to treat wastewater to the extent that it may be discharged to the Green River when recycle is not possible. An NPDES permit will be obtained for such a discharge. This treatment system will collect and treat all process wastewaters, process area runoff, runoff from all product storage and shipping areas, leachates from the coal storage area, ash ponds, and the metal-sludge landfill, and blowdown from the cooling towers and boilers. Also, spills occurring at either the main process area or the product storage areas will be collected and treated in the wastewater treatment facility, and the residue will be recycled to the process whenever possible (Sect. 2.2.1 and Appendix C).

- Various types of combustion equipment have been considered for the flare/controlled combustor system to destroy hazardous components of process emissions. The system, as proposed, will include thermal oxidizers, a ground flare field, and an elevated emergency flare. These devices will have temperatures and residence times sufficient for burning heavy hydrocarbons and will be used to treat gaseous product emissions from routine venting and anticipated upset conditions. During normal operations and anticipated upset conditions, all air emissions from sources that have significant concentrations of heavy organic compounds will be vented through this system, which can assure relatively complete destruction of organics (Appendix C, Sect. C.2.2.6, Sects. 2.2.1, 2.3.2.2, and 4.1).

- Solid wastes will be disposed of onsite, in compliance with the provisions of the RCRA. Depending on the nature of the waste and its classification under RCRA criteria, appropriate landfills will be designed, also according to RCRA requirements. As currently proposed, all solid wastes with the exception of gasifier slag/flyash and raw water treatment sludge are assumed hazardous for design purposes. All landfills will be equipped with

clay and synthetic liners, a leachate collection and treatment system, a leachate detection system below the liners, and protection from flood inundation. (Landfill designs and operating procedures are described in Sect. 2.2.1 and Appendix C.)

- Fugitive hydrocarbon releases will be minimized through the use of vapor recovery on liquid storage tanks, high-integrity seals and packings, and, where possible, enclosures around processing equipment that typically requires frequent maintenance (e.g., pumps, valves, and compressors) (Sects. 2.2.1 and 4.1.4.3 and Appendix C).

- The base of the solid-product and coal storage areas will be filled above the 100-year flood elevation. The tank farm for liquid storage will be diked to above the elevation of a 500-year flood and will be of sufficient capacity to hold the contents of the tank, plus water from a 10-year 24-h rainfall, and the water for use in the event of a fire. The hazardous waste landfill will be built above the 500-year flood elevation and diked to an elevation of 119 m (390 ft). A pump will return any of these liquids to the wastewater treatment facility (Sects. 2.2.1 and 4.8 and Appendixes C and D).

- Sulfur in the feed coal will be converted to hydrogen sulfide (H_2S) in the gasification and hydrogenation process. This H_2S will be separated from the gases by absorption and converted to by-product elemental sulfur by the Claus process. The Claus plant will include a redundant, 100%-capacity spare train. Tail gases from the Claus plant will be treated by a Beavon sulfur recovery unit to further reduce atmospheric emissions.

- The plant will purchase washed coal, which will have less silt than run-of-mine coal and will thus generate fewer fugitive emissions. Emissions from coal handling will be reduced by the use of enclosures around transfer points, covered conveyors, and water sprays. Dust suppression will be used on coal and solid SRC storage areas.

- Excavation and dredging equipment on the Green River will tend to obstruct part of the navigable channel during construction. Suitable markings will be deployed in order to provide warning to passing river traffic (Sect. 4.2.2.1).

- Active and reserve coal storage areas and solid SRC storage areas will have compacted clay liners. Leachate accumulation at the liner surface will be collected at the perimeter of the storage area and routed to wastewater treatment. Close supervision of foundation preparation will be carried out to ensure that the proposed liners will be adequate (Sect. 4.2.2.2).

- To prevent release of biologically active materials from the wet cooling towers, processing units that typically contain these materials will be equipped with aerial coolers or indirect cooling systems (Sects. 2.2.1.2, 2.3.2.2, and 4.1.4.1 and Appendix C).

- All wastewater handling areas will be lined to minimize direct infiltration of wastewater (Sect. 4.2.2.2).

- Mitigation measures for noise could include selection of construction machinery to reduce sound generated, scheduling of construction activities to reduce cumulative noise impacts, and the placement of noise barriers.

- Sulfur releases to the atmosphere under normal operating conditions will be minimized by dual parallel train Claus sulfur recovery units (one being a 100% capacity spare), with BSRU sulfur recovery from Claus plant tail gases, and by the use of low-sulfur gaseous fuels.

Appendix C, Sect. C.2, contains a comprehensive discussion of all proposed pollution control systems.

4.6.2 Socioeconomic

4.6.2.1 Mitigation measures for noise levels

Noise monitoring will be conducted to verify predicted noise impacts and to identify any unexpected noise impacts. If noise levels for demonstration plant construction are in excess of

EPA's short-term goals of 65 dB day-night equivalent sound level, they will be mitigated to the extent possible, although it is not anticipated that noise levels during construction will approach this level (see Sect. 3.2.3.2 and 4.2.3.2). Noise levels from demonstration plant operation will be mitigated to the extent possible if they exceed the long-term EPA residential guidelines. Additional residences may be acquired at the proposed site, along the property boundary, if noise levels from the plant are judged unacceptable and other mitigation measures are not deemed appropriate.

4.6.2.2 Mitigation measures for transportation problems during construction

Without effective mitigation, project-induced traffic would entail an unacceptable social impact to the communities in the vicinity of the proposed site.

A number of the available transportation mitigation measures for the Newman, Kentucky site discussed in Sect. 4.2.4.1 have been combined into a unified traffic mitigation plan that should ensure that acceptable levels of service will not be exceeded on U.S. Highway 60.

The project sponsors will: (1) construct a signalized intersection with turning lanes at the SRC-I plant entrance on U.S. 60; (2) encourage voluntary ride-sharing, vanpooling, and bus-riding. This could be accomplished through techniques such as preferred parking, sponsoring or buying vans, a ride-share clearing house, and the establishment of park and ride lots near Henderson and Owensboro; (3) utilize staggered workshifts or establish a second shift to reduce peak period traffic; and (4) establish a company-sponsored busriding program if the preceding measures fail to ensure acceptable traffic conditions on U.S. 60. The busing program would be initiated when traffic congestion on U.S. Highway 60 exceeds the level established in a transportation performance standard to be developed by the project sponsors in conjunction with KYDOT and the Green River Area Development District (GRADD). If and when busing becomes necessary according to this criterion, the program would start with approximately twelve buses (a number sufficient to carry 10% of the projected peak work force of 5000) and would increase by 12-bus increments at regular intervals (2 to 4 weeks) until monitoring reveals that traffic flow has returned to an acceptable level. Project management would attempt to obligate construction workers to participate in the busing program, should it become necessary, through terms of the yet-to-be-established Project Labor Agreement.

In addition to the above actions, Federal, State, and local governments are studying the feasibility of the following mitigation measures to increase the effectiveness of those measures described above: (1) realign curves and improve railroad crossings on U.S. 60 at Stanley and Reed. Much of this improvement is likely to be made regardless of whether the SRC-I project is built; (2) construct temporary ramp from the Audubon Parkway to KY 1554 to accommodate traffic to and from the SRC-I plant site; and (3) upgrade Sauer Lane from KY 1554 to the plant site (a rear entrance will be constructed to allow access from Sauer Lane). If these measures are not undertaken, an increased degree of effectiveness will be required of the four project-sponsored measures described above. Specifically, a substantially larger number of company-sponsored buses is likely to be required and worker participation in the bus-riding program would have to be correspondingly greater.

Prior to the start of major project construction, a detailed traffic mitigation plan would be issued by the project sponsors in cooperation with KYDOT and the Green River Area Development District (GRADD), describing the costs of the measures to be taken and the institutional arrangements that would be necessary for their implementation.

4.6.2.3 Mitigation measures for other socioeconomic impacts

While transportation impacts are expected to be the most serious of all potential socioeconomic effects resulting from SRC-I construction, other mitigation measures would also be taken in the eventuality that the monitoring program reveals significant impacts in the following subject areas.

- Housing: Should shortages result in one or more important sectors of the local housing market, DOE would work with HUD and other agencies to attempt to provide the needed housing units or to encourage private construction to meet the identified need.

- Public services: DOE will work with appropriate agencies to attempt to provide services such as water and sewage treatment, education, and police and fire protection for impacted communities to deal with any significant shortages resulting from SRC-I-induced in-migration. Impending service shortfalls should be identified early so that the needed services can be provided in a timely fashion before major dislocations occur. As discussed in Sect. 4.2.4.1, however, service shortfalls are considered unlikely in the primary impact area as a result of SRC-I construction by itself.

- Fiscal impacts: Should significant public service improvements be required as a result of SRC-I-induced population growth, DOE will work with appropriate agencies to provide assistance to identify potential deficits in the aggregate costs of each jurisdiction's public services and to identify sources of funds to offset such deficits.

Socioeconomic impacts to the primary impact area in all the above subject areas would be monitored, and an annual cost-benefit analysis would be performed. In addition to the possibility of providing compensation for impacts once they occur, mitigation measures could also be taken which prevent or lessen socioeconomic effects in the tri-county area. In-migration to the host region could be reduced, and that growth which does occur could be channelled to those areas best able to accommodate the influx of new residents. Mechanisms for reducing in-migration include the establishment of local construction skills-training programs and policies for the preferential hiring of local workers, while growth can be channelled to the desired areas through the enactment of appropriate land use controls and the careful placement of sewer lines and other capital improvements.

To prevent SRC-I construction activities from contributing significantly to peak cumulative impacts, the SRC-I construction schedule should be coordinated with those of the W. R. Grace and Tri-State Synthetic Fuels facilities to avoid concurrence of their peak or near-peak construction periods. To address those cumulative impacts which do occur, mitigation measures should be developed and implemented jointly by the management of all major construction projects in the area, with a special emphasis on coordinating the mitigation activities of SRC-I, Grace, and Tri-State. To maximize effectiveness, a joint mitigation plan should be developed by the major area developers acting in cooperation with local and regional governments. Such a regional mitigation plan resulting from these efforts would guide the timely provision of those services and accommodations necessary to handle construction-induced growth without any serious disruptions to local infrastructures. Contingency plans should also be made to deal with any worsening of projected impacts which may arise as a result of delayed construction schedules. In the event of construction delays, the potential for SRC-I contributing significantly to severe cumulative socioeconomic impacts would exist without the coordinated scheduling and cooperative mitigation planning described above.

4.6.3 Archaeological resources

Field studies in the area of the site indicated no archaeological resources warranting preservation will be affected by the proposed project. The results of the archaeological survey conducted for this Statement have been made available by DOE to the State of Kentucky. A determination by the State of Kentucky is shown in Appendix U. For further information concerning archaeological resources, refer to Sects. 3.2.4.7 and 4.2.4.

4.6.4 Land

During the detailed design stage, a construction environmental management plan will be prepared. This plan will specify the construction practices and procedures as well as facilities which will be used to minimize soil erosion and to prevent sedimentation. Particular emphasis will be given to the following (see Sect. 4.2.1.2):

- scheduling of site preparation activities to minimize the area disturbed at any time,
- early construction of drainage collection and permanent sediment control facilities,
- utilization of construction practices and grading techniques designed to minimize erosion,
- utilization of temporary sediment control facilities,

- removal and proper storage of topsoil for use in revegetation of disturbed areas,
- prompt revegetation of disturbed areas and use of mulch or other temporary protection on areas that cannot be revegetated immediately, and
- utilization of dust suppression techniques to prevent wind erosion and fugitive dust.

4.6.5 Water

- The process area will be graded and filled to protect the facility from floods of 500-year frequency or less. Although the base of the liquid product tank farm, and the slag/ash ponds will be below the elevation of the 100-year flood, these areas will be diked to an elevation greater than the 500-year flood. The base of hazardous waste landfills will be above the 100-year flood.
- Sanitary wastes produced during construction will be treated onsite or sent to a disposal facility offsite, and any toxic materials used in construction or uncovered during dredging will be handled so as to minimize infiltration into groundwater of spilled materials or leachates (Sects. 2.2.1, 4.2.1.2, and 4.2.2.3 and Appendix C and Appendix Y). During operation, sanitary waste will be treated in the wastewater treatment system.
- When zero discharge cannot be achieved (e.g., when wastewater recycling equipment is inoperable) during low-flow conditions for the Green River, plant shutdown or reduction of plant throughput might be required to prevent adverse effects on water quality and aquatic biota and to ensure compliance with standards. The NPDES permit will address such contingencies.
- All runoff up to that resulting from a 10-year 24-h storm will be collected and diverted to a treatment facility that will either treat the water before discharge to the Green River or recycle it for process use. In the event of a spill in the main process area or within the product storage and shipping area, the spilled material will be collected in the site drainage system and treated before discharge to the river (Sect. 2.2.1 and Appendix C).
- Good engineering practices will be implemented in the site's construction drainage plan. Sedimentation will be controlled by retention dams and other appropriate structures. Discharge from retention structures is anticipated to meet limitations recommended by the U.S. EPA. Seeding and mulching of the completed areas as construction progresses will also help to reduce the control erosion (Appendix C and Appendix GG).
- Rainwater runoff from the process area, possibly containing pollutants washed from process equipment and other facilities, will be collected, monitored (Sect. 4.5), and treated before infiltration into the groundwater occurs (Sect. 2.2.1 and Appendix C).
- The risk of groundwater and surface water contamination will be reduced by collection and treatment of coal pile leachates and runoff and by soil compaction or lining of the storage area (see Sects. 2.2.1 and 4.2.2.2 and Appendix C) to reduce infiltration.
- Spills on the site will be collected by the plant drainage system and treated by the wastewater treatment system (Sect. 2.2.1 and Appendix C).
- Major process units and storage vessels will be provided with secondary containment (dikes) to retain accidental releases such as spills (Sects. 2.2.1 and 4.2.2.2).
- Prevention of possible contamination will be handled by careful preparation of the process area, appropriate spill containment facilities, and prompt cleanup of spills that do occur (Sects. 4.2.2.2 and 4.1).
- Although the apparent risks of contaminant movement through the ground are low, the alluvial aquifer will be monitored on a quarterly basis at several points to determine if contamination of the shallow groundwater system is occurring. If contaminants are detected in the groundwater, DOE will evaluate the significance of the impact of these contaminants and design the appropriate mitigation measures as needed (Sects. 4.2.2.2 and 4.5 and Appendix HH).

- Wastewater treatment sludges and other wastes containing potentially hazardous substances will be disposed of in an approved hazardous waste landfill. Current plant design calls for the construction of a compacted clay liner, placement of a synthetic liner below the solid waste disposal area, and drains to collect the leachate for analysis and treatment (see Sect. 2.2.1 and Appendix C for cross-sectional diagrams). Groundwater beneath this disposal area will be monitored according to the monitoring plan in Sect. 4.5.

- Clay liner and synthetic liner compatibility studies will be carried out to ensure that the leachate generated does not adversely affect the stability of the liner material (Appendix C, Sect. C.2.3.2).

- Hydraulic dredging will be employed to lessen the impacts associated with shoreline dredging and excavation operations (Appendix Y).

- Runoff composition in excess of 10-year, 24-h storm will be simulated using a computer model such as the EPA Short Storm Water Management Model (SSWMM), and the analysis will be provided to EPA and KDNREP for use in establishing effluent limitations.

4.6.6 Aquatic ecology

- If possible, construction-related disturbances to the Green River shoreline area will be minimized by conducting dredge and excavation operations during the late summer and early fall periods of low flow. At these times, the suspension and dispersion of disturbed sediments from other sources will be at a minimum, and the spawning and larval development of most fish species will have been completed.

- Two intake structures are under consideration; a conventional and a submerged structure. The proposed conventional intake structure will be equipped with one or more sets of vertical traveling screens designed with an approach velocity of 0.15 m/s (0.49 ft/s) at mean low water conditions (when velocities will be highest). The design will also be in keeping with good practice so that flow will be distributed as evenly as possible through the screens, with minimal eddies, dead spots, and hot spots. Free passage for fish will be maintained insofar as possible. The above design considerations will help to reduce greatly the potential for impingement (Sects. 4.2.2.4 and 2.2.1 and Appendix C).

- A diffuser-type discharge structure will be used to promote rapid mixing and dilution of effluent in the receiving water. Discharge velocity of the jet diffuser structure will be kept sufficiently high [1.5 m/s (4.9 ft/s)] to prevent fish from staying near the point of discharge, thus minimizing exposure of fish to potentially hazardous conditions (Appendix C and Sect. 4.2.2.4).

Appendix K includes a detailed discussion of fish and wildlife mitigation options.

4.6.7 Air quality

- Land clearing, grading, excavation, and other preparation activities will be scheduled to minimize the area disturbed at any time (Sects. 4.2.1.2, 4.2.2.3, and 4.2.3.1).

- Dust suppression measures such as water sprays and polymer coatings will be used to reduce fugitive dust from disturbed areas and stored materials such as topsoil and clay (Sects. 2.2.1 and Appendix C).

- Temporarily disturbed areas will be promptly revegetated (Sects. 4.2.1.2 and 4.2.2.3).

- Mobile equipment meeting applicable emission standards and maintenance will be used as required to assure continued compliance (Sect. 4.2.3.1).

- Alternatives to open burning for disposal of debris from land clearing will be used wherever feasible (Sect. 4.2.3.1).

- Open burning of cleared vegetation is not planned. Should open burning become necessary, it will be performed in accordance with applicable regulations and at times when meteorological conditions favor rapid dispersion of emissions (Sect. 4.2.3.1).

- Particulate control measures to be incorporated in the demonstration plant include the use of gaseous fuels in fired heaters, enclosures of coal-handling equipment and use of fabric filters to control emissions from such equipment, and the use of dust suppression techniques to control fugitive emissions from coal and solid SRC storage and handling areas and slag disposal areas (Sect. 2.2.1 and Appendix C).

- Sulfur oxides will be controlled primarily through the recovery of elemental sulfur, scrubbing, and the use of low sulfur gaseous fuels (Sect. 2.2.1 and Appendix C).

- Emissions of nitrogen oxides will be controlled through the use of gaseous, nitrogen-free fuel and low NO_x burner designs (Sect. 2.2.1 and Appendix C).

- Hydrocarbon emissions resulting from leaks in process equipment and piping will be minimized through an extensive inspection, monitoring, and maintenance program. Hydrocarbon storage tanks will be equipped with vapor recovery systems, and any uncondensed hydrocarbons will be routed to the flare and controlled combustor system. Hydrocarbons released by process upsets will be routed to the controlled combustion and flare system (Sects. 2.2.1 and 4.1 and Appendix C).

- Fugitive hydrocarbon controls will include routine inspection and maintenance for valves and fittings, the use of double block valves, use of high quality mechanical seals, enclosure of selected equipment in ventilating buildings or shelters, and use of unventilated enclosures around critical valves, fittings, and equipment (Sects. 2.2.1 and 4.1.4.3 and Appendix C).

- Reduced sulfur compound emissions (hydrogen sulfide, carbon disulfide) will be controlled through recovery as elemental sulfur (Sect. 2.2.1 and Appendix C).

- Sulfur in tail gases from the sulfur recovery unit will be converted to sulfur dioxide by incineration before emission (Sect. 2.2.1 and Appendix C).

4.6.8 Terrestrial ecology

Mitigation measures used to minimize emissions to the atmosphere (Sect. 4.6.1), impacts on geology and soils (Sect. 4.6.4), and impacts on air quality (Sect. 4.6.7) will also serve to minimize impacts to terrestrial biota. Mitigation of impacts on fish and wildlife is discussed in Appendix K. Additional mitigation measures include the following:

- As final construction plans and facility designs evolve, plans will be formulated to minimize the clearing of forest on the site.

- To minimize impacts on the Indiana bat, riparian forest on the site along Martin Creek will not be cleared.

4.6.9 Occupational health

Industrial hygiene training and protective equipment for the work force will be provided, and adherence to safe, proper maintenance procedures will be conducted to minimize environmental release and personnel exposure (Sect. 4.1.4.6). The program will be partially based on the experience gained with the programs at the Fort Lewis and Wilsonville SRC pilot plants (Appendix Z.1) but will go beyond these programs and include state-of-the-art techniques available for other industries processing similar hazards.

The program is discussed in Sects. 4.5.4, 4.1, and Appendix Z and will include the following elements:

- Engineering controls are expected to prevent exposures to materials having acute chemical toxicity and to reduce concentrations of all regulated substances to within limits specified by OSHA, except during emergency conditions (e.g., fires and explosions). Accordingly, the major thrust of the industrial hygiene will be to minimize the impact of exposure to biologically active materials.

- To provide the greatest amount of protection it will be assumed that all process streams having the potential to contain carcinogenic materials are carcinogenic. Until or unless toxological studies have identified a stream as being noncarcinogenic, it will be treated as a potential hazard to workers, and all applicable elements of the occupational health program will be followed in dealing with that stream.

- The primary mechanisms for worker exposure to these biologically active materials will be through dermal contact and inhalation. The industrial hygiene program will be primarily designed to control both mechanisms of exposure. Worker education and training are the first element of the program. Because the core of any successful occupational health program is worker acceptance and participation, a stated goal of the program is worker acceptance and participation. The means of attaining this goal are threefold: (1) initial training of new employees and visitors, (2) annual retraining, and (3) periodic health and safety meetings. The latter will allow airing of individual concerns and permit review of emergency procedures. The workers will be familiar with the potentially hazardous nature of process materials and with the mechanisms of exposure through contact and (indirectly) through ingestion due to skin contact.

- The proper use of protective equipment and clothing helps to minimize any adverse health effects of worker exposure to coal liquefaction materials that may pose health hazards. For normal operations, employees in areas where contact can occur will be issued and required to wear, when needed, overalls, underwear, socks, leather boots with oil resistant soles, and gloves, rainsuits, and parkas. In the event of a spill of toxic materials or work assignment that might lead to personal contamination, the employee may be asked to wear special protective equipment such as synthetic rubber boots, special gloves, an impervious rain suit, face shield, goggles, and/or respirator. Hearing protection will be provided in areas with high noise levels. Visitors entering the plant will be provided with protective clothing to prevent contamination of their street clothing.

  In order to protect the worker and to prevent transport of coal liquefaction contaminants off the plant site, special procedures and facilities have been developed for employees working in areas where contamination may occur. The key elements in the design and use of the change facility are the segregated clean and dirty areas and a mandatory daily shower and shampoo for workers. All employees must pass through a change facility when entering or leaving the plant areas where contamination can occur. Monitoring of personal hygiene effectiveness by ultraviolet light scanning will be assessed as a technique for improving worker hygiene. If this monitoring is concluded to be a safe and effective practice, it will be made available to workers as they pass through the change facility.

- The second element of the worker protection program is a carefully designed set of specific work practices. The demonstration plant will follow comprehensive and specifically defined work practices that will cover the following areas: personal contamination, washing practices following accidental contamination, eating, drinking, smoking, material transferrals, material storage, material disposal, maintenance procedures, and emergency plans and procedures. These work practices will be in accord with accepted principles of industrial hygiene followed in other industries that have successfully and safely handled hazardous materials in the past.

- Medical monitoring is an important third element in the program. A medical monitoring program will be made available to all employees who may be occupationally exposed to coal-liquefaction products, and participation in the monitoring program will be encouraged. Examinations designed to detect potential coal-liquefaction-related symptoms will be made prior to employment and annually thereafter unless a different frequency is indicated on the basis of professional medical judgment. This medical monitoring will help detect medical problems early, should any occur, when prognosis for successful treatment is generally very high.

- It is of utmost importance to retain employee records for a sufficient period of time. Because of the occupational health uncertainties inherent in a new industry and the long latency period of potential cancers, employee records will be kept for a period of time consistent with or longer than those stipulated in federal regulations. These records shall include demographic information as well as comprehensive work histories, exposure monitoring data, and medical surveillance results.

- The fourth element of the program is a thorough system of industrial hygiene monitoring, using methods equivalent to or more current than those specified by the National Institute for Occupational Safety and Health (NIOSH). This system will assess worker exposures to potentially harmful substances and help to formulate both work practices and engineering control to prevent exposure. Frequency of monitoring will be dependent upon an assessment of the potency of toxin, and the initial concentrations measured. Protocols will be developed by a qualified industrial hygienist. Initial area and personnel monitoring will be conducted for, but not limited to, the following agents: coal dust, coal-tar pitch volatiles (CTPVs), PNAs, aromatic amines, phenols, creosols, hexane, carbon monoxide, nickel carbonyl, carbonyl sulfide, hydrogen sulfide, sulfur dioxide, hydrogen cyanide, welding fumes, silica, trace metals, noise, lighting, and radiation.

4.7 THE CARBON DIOXIDE ISSUE

The discussion of the climatic impacts of CO_2 emissions is included in Sect. 1 and Appendix V.

4.8 FLOODPLAIN/WETLANDS REVIEW

The proposed plant layout for the SRC-I facility at the Newman, Kentucky site will occupy a portion of the Green River floodplain between river miles 18.5 and 19.8 (Fig. 3.9). The proposed layout (Figs. 2.3 and D.1) indicates that the three ash ponds, the area required for liquid product storage (tanks), the SRC solid product storage area, and the coal storage area will be located within the existing 100-year floodplain. In addition, a small area of riparian hardwood forest on the Green River shoreline will be destroyed for construction of the water intake/discharge and barge loading/unloading facilities. The major area of the floodplain that will be encroached upon is devoted to agricultural use — approximately 90%. Although this agricultural land does not represent a unique or beneficial habitat for plant or animal species, the soils have been classified as "prime" farmland for agricultural purposes by the U.S. Soil Conservation Service. Elimination of these soils from agricultural use may be viewed as contributing to the continuing loss of this valuable national resource. The area of shoreline and riparian hardwood forest that will be lost as a result of this action may also be viewed in the same way. A major portion of the national riparian areas have already been destroyed (see Sect. 4.2.1.3).

With the use of proper design and construction techniques, flood risks to the proposed project are likely to be negligible. The Green River pool south of the site is normally maintained at an elevation of 106.4 m (349 ft) by a lock 16 km (10 miles) downstream. The 100-year flood elevation has been determined to be 117 m (385.0 ft) MSL, and the 500-year flood elevation has been determined to be 119.4 m (388.0 ft) MSL by the U.S. Army Corps of Engineers. Because of relatively flat, low-lying topography, it is expected that approximately 67% of the proposed site will be inundated in the event of a 100-year frequency flood. To protect the integrity of the process area and associated structures, the elevation of the site in these critical areas will be raised by grading and filling to an elevation of 119.4 m (388 ft).

Changes in the 100-year frequency flood elevation resulting from grading and filling selected site areas and constructing SRC-I facilities have been calculated to be insignificant. By using the U.S. Army Corps of Engineers HEC-2 computer model, it was concluded that site development would increase the 100-year frequency flood elevation an average of 0.01 m (0.02 ft), or about 0.67 cm (0.25 in.), along the floodplain cross section immediately upstream of the plant area (see Appendix E).

At the proposed site, several small farm ponds and small areas of riparian forest that serve as wetland habitat could be destroyed during plant construction. Because it is indicated that these areas are not unique, the impact of their loss would probably be minimal.

Given the physical constraints of the site, the present facility layout plan utilizes nonfloodplain areas as much as possible. Because of facility requirements and the local topography at the site, however, it does not appear to be possible to avoid a certain amount of floodplain encroachment at the proposed Newman site. Therefore, a preliminary floodplain/wetlands determination and assessment was undertaken in compliance with Executive Order 11988, "Floodplain

Management," and Executive Order 11990, "Protection of Wetlands." This review followed the regulations established by DOE, published in *Federal Review Regulations* (Title 10, Chapt. X, Part 1022, Subparts A and B, Mar. 7, 1979) (see Appendix D). In Appendix D of the EIS a tentative finding is made that there are no practicable alternatives to the projected floodplain/wetlands impacts. No practicable sites were identified that had no floodplain/wetlands impacts. All reasonable measures for mitigating floodplain/wetlands impacts at the proposed site have been considered (see Appendix D, Sect. D.4.1). The measures adopted for the proposed design are discussed in Appendix D, Sects. D.3.1 and D.4.2.

4.9 NO ACTION

4.9.1 No DOE action – project terminated

If the decision is made to choose the alternative of terminating the contract to go forth with the demonstration project, the SRC-I process may not be demonstrated in the near future and the opportunity to obtain the intended environmental, technical, and economic data on the SRC-I process at near-commercial scale would be greatly reduced. If the proposed SRC-II demonstration plant project is carried out, that project could provide information of a generic nature similar to that which would be obtained from SRC-I such as hydrogen production via gasification; ash and slag disposal; pressure letdown; large-scale oxygen production; wastewater treatment; solid-liquid separation; and high-temperature and -pressure handling of hydrocarbon, hydrogen, and oxygen mixtures. However, the conceptual designs for each of the two SRC demonstration plants have unique features such as solid-liquid separation and wastewater treatment. Demonstrating both technologies would provide a valuable diversity of information and operating experience about alternative designs. The Exxon Donor Solvent and H-Coal pilot plants have been constructed and are currently in the mechanical shakedown and testing phase. These plants could also contribute generic information for advancing the SRC-I technology (Sect. 1).

The adverse impacts on the physical and biological environment and the socioeconomic conditions in the region would not occur if the no action alternative is chosen.

Another aspect of the no action alternative is that the private sector may decide to commercialize the SRC-I technology. If commercialization takes place without the benefit of a demonstration plant, it is likely that development would proceed in a less controlled manner, with large-scale technical and environmental problems solved during the operation of the plant rather than during the design and demonstration of the plant.

4.9.2 No DOE action – project continues under other sponsorship

If DOE withdraws from the project and if the proposed action continues under other sponsorship at the proposed site, the project could, but would not necessarily, result in the same environmental impacts as the proposed action. The project under other sponsorship would be required to comply with all appropriate environmental requirements. Before issuance of appropriate permits, EPA and COE would perform necessary NEPA reviews.

The proposed action discussed in this FEIS includes certain monitoring and mitigation measures that exceed legal requirements and that may not be undertaken if the project proceeds under other sponsorship. These measures include the long-term environmental and health research plan outlined in Appendix Z.2 and ecological, traffic, and other socioeconomic monitoring and mitigation measures.

The major impact associated with this no action alternative would be the unacceptable social impacts on local communities if effective traffic mitigation measures are not undertaken. Other major social impacts would occur because of cumulative effects with other projects if the construction schedule is delayed by transfer of sponsorship from DOE to other parties. A benefit of the project continuing under other sponsorship would be increased tax reveneus.

If ICRC continues with the project without DOE involvement, ICRC has indicated that, although it is not required to do so, it currently intends to carry out the monitoring and mitigation measures described in Sects. 4.5 and 4.6, with the exception of the following: socioeconomic measures and the long-term environmental and health research plan in Appendix Z. ICRC has committed to develop a traffic monitoring and mitigation plan, although not necessarily the specific program identified in Sects. 4.5 and 4.6. The effectiveness of this yet-to-be-developed ICRC plan cannot be evaluated at this time.

4.9.3 Delay the action

Another possible alternative available to DOE is delay of the project and the EIS process until the design for the plant has been finalized and until ongoing environmental and health studies have been completed. It has been suggested that this course of action would give DOE a more comprehensive data base to assess the likely environmental impacts of the project and to decide whether to proceed with it. This alternative might also enable DOE to assess more completely the adequacy of the mitigation measures that will be implemented to ameliorate the adverse impacts associated with the project.

On the other hand, it is estimated that plant design will not be finalized until late 1982. Moreover, some of the research necessary to determine the full extent of the environmental impacts of the demonstration plant must await actual construction, operation, and monitoring of the plant; other ongoing studies will require a substantial amount of time before definitive results can be reported and evaluated. It must be remembered that one of the objectives of this project is to obtain information regarding the environmental and ecological effects of a technology that is unproven and heretofore untested at this scale. This information, along with the effectiveness of environmental control systems, must necessarily be developed in stages. Therefore, even if the EIS were to be delayed until final design is complete, many unknowns would remain concerning actual environmental and health effects.

After seriously considering this delay alternative, DOE has concluded that it is not reasonable because it would mean that a major, irreversible, and irretrievable commitment to the project would be made without benefit of an EIS, perhaps foreclosing other options. By preparing an EIS now, DOE can gain valuable information that can be used to determine whether it should proceed with actions leading to construction and operation of the proposed plant.

REFERENCES FOR SECTION 4

1. NIOSH Special Technical Report, "Coal Liquefaction: Recent Findings in Occupational Safety and Health," U.S. Government Printing Office: DHHS (NIOSH) Publication 80-122.

2. *Criteria for a Recommended Standard ... Occupational Exposure to Coal Tar Products,* DHEW, NIOSH 1977. Publication #78-107 (U.S. Government Printing Office).

3. *Criteria for a Recommended Standard ... Occupational Exposure in Coal Gasification Plants,* DHEW (NIOSH) Publication #78-191 (U.S. Government Printing Office).

4. Percival Pott, *Chirurgical Observations Relative to the Cataract, the Polypus of the Nose, the Cancer of the Scrotum, the Different Kind of Ruptures and the Mortification of the Toes and Feet,* Hawks, Clarke, and Collins, London (1775).

5. U.S. Department of Health, Education and Welfare, "Criteria for a Recommended Standard-Occupational Exposure to Coke-Oven Emissions," Washington, D.C., 1973.

6. R. Doll et al., "Mortality of Gasworkers — Final Report of a Prospective Study," *Br. J. Ind. Med.* 29: 394-406.

7. P. J. Lawther, B. T. Commons, and R. E. Waller, "A Study of Concentrations of Polycyclic Aromatic Hydrocarbons in Gas Works Retort Houses," *Brit. J. Industr. Med.* 22: 13-20 (1965).

8. S. A. Henry, N. M. Kennaway, and E. L. Kennaway, "The Incidence of Cancer of the Bladder and Prostate in Certain Occupations," *J. Hyg.* 31: 126-37 (1931).

9. S. Kuroda and K. Kawahata, "Uber die gewerbliche Entstenhung des Lungenkrebses bei Generatorgasarbietern," *Z. Krebsforsch.* 45: 36-39 (1936).

10. N. M. Kennaway and E. L. Kennaway, "A Study of the Incidence of Cancer of the Lung and Larynx," *J. Hyg.* 36: 236-67 (1936).

11. Pacific Northwest Laboratory, *Biological and Chemical Properties of SRC-I Process Solvent and Fractions Derived From the SRC-I Solid Product: A Status Report,* Draft, prepared for DOE under contract DE-AC06-76RLO-1830, Richland, Wash.

12. T. D. Jones et al., "Empirical Observations in Support of 'Carcinogenic Promotion' As a Tool For Screening and Regulation of Toxic Agents," in Proc. 5th Int. Symp. *Polynuclear Aromatic Hydrocarbons,* Battelle Columbus Laboratory, Columbus, Ohio.

13. J. V. Frei, "Comment on Epidermal Hyperplasia and Tumor Promotion," *J. Natl. Cancer Inst.* 59: 299 (1977).

14. R. K. Boutwell, "The Function and Mechanism of Promoters of Carcinogenesis," in *Critical Reviews in Toxicology,* Vol. 2, Issue 1, CRC Press, Cleveland, Oh., 1974.

15. R. J. Sexton, "The Hazards to Health in the Hydrogenation of Coal," IV. The Central Program and the Clinical Effects. *Arch. Environ. Health* 1: 208-31 (1960).

16. A. Palmer, "Mortality Experience of 50 Workers with Occupational Exposures to the Products of Coal Hydrogenation Process," *J. Occup. Med.* 21: 41-44 (1979).

17. H. F. Kraybill, "Assessment of Current Approaches in the Evaluation of Carcinogenicity in Animal Models and Their Relevance to Man," in *Monographs on Environmental Carcinogenesis,* R. E. Olsen, Ed., Marcel Dekker, Inc., in press.

18. H. M. Rabes and R. Szymkowiak, "Cell Kinetics of Hepatocytes During the Preneoplastic Period of Diethylnitrosamine-induced Liver Carcinogenesis," *Cancer Res.* 39: 1298-1304 (1979).

19. Battelle Pacific Northwest Laboratory, *Biomedical Studies on Solvent Refined Coal (SRC-II) Liquefaction Materials: A Status Report,* PNL-3189, Richland, Wash., October 1979.

20. Pacific Northwest Laboratory, *Initial Chemical and Biological Characterization of Hydrotreated Solvent Refined Coal (SRC-II) Liquids: A Status Report*, draft, prepared for DOE under contract DE-AC06-76RLO-1830, Richland, Wash.

21. J. R. Newman, "Effects of Industrial Air Pollution on Wildlife," *Biol. Conserv.* 15: 181-90 (1979).

22. Pacific Northwest Laboratory, *Annual Report for 1979 to the DOE Assistant Secretary for Environment*, Part 2, "Ecological Sciences," PNL-3300.

23. Southern Company Services, *Solvent Refined Coal Burn Test*, July 1979.

24. ATEC Associates, *Preliminary Geotechnical Engineering Study, 2000 TPD Solvent Refined Coal Facility*, prepared for Wheelabrator Cleanfuel Corporation and Kentucky Center for Energy Research, 1977.

25. ATEC Associates, *Liquefaction Analyses, 6000 TPD SRC Plant, Newman, Kentucky*, prepared for Rust Engineering Co., June 1980.

26. R. R. Johnson and J. F. McCormick, Technical Coordinators, *Strategies for Protection and Management of Floodplain Wetlands and Other Riparian Ecosystems*, General Technical Report WO-12, U.S. Dept. of Agriculture Forest Service, 1978.

27. R. Arbib, "The Blue List for 1980," *Am. Birds* 33: 830-35 (1979).

28. J. R. Newman, "Effects of Industrial Air Pollution on Wildlife," *Biol. Conserv.* 15: 181-90 (1979).

29. U.S. Environmental Protection Agency, "Effects of Sulfur Oxides in the Atmosphere on Vegetation," rev. Chap. 5 in *Air Quality Criteria for Sulfur Oxides*, Report EPA-R3-73-030, Washington, D.C., 1973.

30. W. W. Heck and C. S. Brandt, "Effects on Vegetation: Native, Crops, Forest," in *Air Pollution, Vol. 2: The Effects of Air Pollution*, A. C. Stern, Ed., Academic Press, New York, 1977.

31. U.S. Department of the Interior, U.S. Geological Survey, *Water Resources Data for Kentucky, Water Year 1978*, Water Report KY-78-1, Frankfort, Ky., 1979.

32. E. M. Stern and W. B. Stickle, *Effects of Turbidity and Suspended Material in Aquatic Environments, Literature Review*, Technical Report D-78-21, Dredged Material Research Program, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss., June 1978.

33. Bureau of National Affairs, "Fish and Wildlife Service List of Endangered and Threatened Wildlife," *Environ. Rep.* 101: 1501-20 (1979).

34. H. M. Braunstein, Ed., *Environmental and Health Aspects of Disposal of Solid Wastes from Coal Conversion: An Information Assessment*, Report ORNL-5361, Oak Ridge National Laboratory, Oak Ridge, Tenn., September 1978.

35. R. M. Cushman, S. G. Hildebrand, R. H. Strand, and R. Anderson, *The Toxicity of 35 Trace Elements in Coal to Freshwater Biota: A Data Base with Automated Retrieval Capabilities*, Report ORNL/TM-5793, Oak Ridge National Laboratory, Oak Ridge, Tenn., June 1977.

36. S. G. Hildebrand, R. M. Cushman, and J. A. Carter, "The Potential Toxicity and Bioaccumulation in Aquatic Systems of Trace Elements Present in Aqueous Coal Conversion Effluents," in *Trace Elements in Environmental Health-X, 1976, A Symposium*, D. D. Hemphill, Ed., University of Missouri, Columbia, 1976.

37. S. E. Herbes, "Partition of PAH between Dissolved and Particulate Phases in Natural Waters," *Water Res.* 11: 493-96 (1977).

38. U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors*, Report EPA-PB-275-525, 1977.

39. U.S. Environmental Protection Agency, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions,* Report EPA-450/3-77-010, Washington, D.C., March 1977.

40. R. B. Braid, Jr., *Chronic Underprojecting of Work Forces at Nuclear Power Plants,* Oak Ridge National Laboratory, Oak Ridge, Tenn., 1980, unpublished.

41. L. Blair and W. Stevenson, Appendix A, *The Construction Labor Force Model,* Oak Ridge Associated Universities, Oak Ridge, Tenn, 1980.

42. J. S. Gilmore, "Boom Towns May Hinder Energy Resource Development," *Science* 191: 535-540 (1976).

43. C. T. Koebel, *1979 Housing Report for Kentucky,* Urban Studies Center, University of Louisville, 1979, pp. 205, 247.

44. Bureau of Administration and Finance, Kentucky Department of Education, 1980.

45. Personal communication, Dr. Copelen, Indiana Department of Education, Dec. 5, 1980.

46. Transportation and Economic Research Associates, Inc., *Analysis of Transportation Impacts, Newman, Kentucky SRC-I Plant,* Falls Church, Va., December 1980.

47. Green River Area Development District, *Energy Development Impact Mitigation Plan: Transportation Element,* March 1981.

48. *Analysis of Traffic Impacts of the Synthetic Gas Demonstration Plant Program,* Baskett, Kentucky, a report by Tippetts-Abbett-McCarthy-Stratton for Ebasco Services, Inc., March 1980.

49. Draft EIS for D. B. Wilson Station Units 1 and 2, March 24, 1980.

50. Alf D. Shepherd, *A Spatial Analysis Method of Assessing Water Supply and Demand Applied to Energy Development in the Ohio River Basin,* Report ORNL/TM-6375, Oak Ridge National Laboratory, Oak Ridge, Tenn., August 1979.

51. R. M. Davis et al., *National Coal Utilization Assessment: A Preliminary Assessment of Coal Utilization in the South,* Report to the Assistant Secretary for Environment, Department of Energy, Report ORNL/TM-6122, Oak Ridge National Laboratory, Oak Ridge, Tenn., October 1978.

52. Air Monitoring Data Summary, 1979 TVA Paradise Steam Plant.

53. M. S. Salk and S. G. DeCicco, Eds., *Environmental Monitoring Handbook for Coal Conversion Facilities,* ORNL-5319s, Oak Ridge National Laboratory, Oak Ridge, Tenn., 1978.

54. Lawrence Berkeley Laboratory, *Instrumentation for Environmental Monitoring — Air,* 1st ed., Berkeley, Calif., July 1975.

55. A. C. Stern, Ed., *Air Pollution Vol. III, Measuring, Monitoring, and Surveillance of Air Pollution,* Academic Press, New York, 1976.

56. C. A. Black et al., Eds., *Methods of Soil Analysis,* American Society of Agronomy, Madison, Wisconsin, 1965.

57. L. G. Everett et al., *Monitoring Groundwater Quality: Monitoring Methodology,* EPA-600/4-76-026, June 1976.

58. F. S. Sanders et al., *Strategies for Ecological Effects Assessment at DOE Energy Activity Sites,* ORNL/TM-6783, Oak Ridge National Laboratory, Oak Ridge, Tenn., 1980.

5. LIST OF PREPARERS AND PROFESSIONAL QUALIFICATIONS

5.1 PROJECT MANAGEMENT

Steven G. DeCicco, Development Staff, Environmental Impact Section, Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Chemical Engineering, Pollution Control, Environmental Impact Assessment, Synthetic Fuel Technology, Fluidized Bed Coal Combustion, Environmental Monitoring

Education:

B.S.	1973	Chemical Engineering	New York University, New York
M.S.	1977	Chemical Engineering	Massachusetts Institute of Technology, Cambridge

Years of Experience — 7
Total Publications — 10

Allen R. Arbogast, Chief Geographer, Foster Miller Associates, Oak Ridge, Tennessee

Technical Specialty — Rural Land Use and Socioeconomic Change

Education:

B.S.	1972	Geography and Sociology	Concord College, Athens, West Virginia
M.S.	1973	Geography	Marshall University, Huntington, West Virginia
Ph.D.	1980	Geography	University of Tennessee, Knoxville

Years of Experience — 4
Total Publications — 2

A. J. Kuhaida, Jr., Senior Geographer, HDR Sciences, Knoxville, Tennessee

Technical Specialty — Geomorphology, Climatology, Hydrology, Environmental Impact Assessment

Education:

B.S.	1967	Geography	East Tennessee State University, Johnson City
M.S.	1971	Geography	East Tennessee State University, Johnson City
Ph.D.	1980	Geography	University of Denver, Denver

Years of Experience — 9
Total Publications — 15

5.2 METEOROLOGY AND AIR QUALITY

Charles C. Gilmore, Research Associate, Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Meteorology

Education:

B.A.	1973	History	Montclair State, Upper Montclair, New Jersey
M.S.	1976	Meteorology	Rutgers, New Brunswick, New Jersey

Years of Experience — 4
Total Publications — 0

Richard R. Boyd, Senior Meteorologist, Dames & Moore, Park Ridge, Illinois

Technical Specialty — Meteorology and Air Quality

Education:

B.S.	1968	Chemistry	Southern Illinois University, Carbondale
M.B.A.	1972	Business Administration	Southern Illinois University, Carbondale

Years of Experience — 12
Total Publications — 0

Francis C. Kornegay, Research Associate, Energy Division, Oak Ridge National Laboratory

Technical specialty — Meteorology and Air Quality

Education:

B.S.	1973	Meteorology	Purdue University, West Lafayette, Indiana
M.S.	1975	Atmospheric Sciences	Purdue University, West Lafayette, Indiana

Years of Experience — 5.5
Total Publications — 20

5.3 GEOLOGY, HYDROLOGY, AND SOILS

Richard H. Ketelle, Research Associate, Environmental Impact Section, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Environmental Geology

Education:

B.S.	1973	Geology	University of Tennessee, Knoxville
M.S.	1977	Geology	University of Tennessee, Knoxville

Years of Experience — 3.5
Total Publications — 2

5.4 SOCIOECONOMICS

Martin Schweitzer, Urban Planner, Social Impacts Analysis Group, Regional and Urban Studies Section, Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Urban Planning, Social Change Analysis, Environmental Impact Analysis

Education:

B.A.	1972	Psychology	University of Michigan, Ann Arbor
M.S.	1978	Planning	University of Tennessee, Knoxville

Years of Experience — 3
Total Publications — 10

Robert B. Braid, Jr., Political Scientist, Social Impacts Analysis Group, Regional and Urban Studies Section, Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Political Science, Energy Policy, Environmental Impact Statement Coordination for Social Impact Analysis Group

Education:

B.S.	1964	Political Science	Lambuth College, Jackson, Tennessee
M.A.	1967	Political Science	University of Tennessee, Knoxville
Ph.D.	1970	Political Science	University of Tennessee, Knoxville

Years of Experience — 10
Total Publications — 25

Lois Martin Bronfman, Political Scientist, Social Impact Analysis Group, Regional and Urban Studies Section, Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Social Impact and Policy Analysis

Education:

B.A.	1962	Political Science	Michigan State University, East Lansing
M.A.	1964	International Relations	Johns Hopkins University, School of Advanced International Studies, Washington, D.C.
Ph.D.	1973	Political Science	University of Oregon, Eugene

Years of Experience — 7
Total Publications — 15

Sam A. Carnes, Political Scientist, Social Impact Analysis Group, Regional and Urban Studies Section, Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Social Impact and Policy Analysis

Education:

B.A.	1968	Chemistry	University of New Mexico, Albuquerque
M.A.	1970	Political Science	University of New Mexico, Albuquerque
Ph.D.	1978	Political Science	Northwestern University, Evanston, Illinois

Years of Experience — 5.5
Total Publications — 15

R. C. DeVault, Research Associate, Social Impacts Analysis Group, Regional and Urban Studies Section, Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Social Impact Analysis

Education:

B.S.	1970	Engineering Science	University of Tennessee, Knoxville
M.S.	(in progress)	Engineering Science	University of Tennessee, Knoxville

Years of Experience — 5
Total Publications — 20

Robert J. Gaston, Chief Economist, Foster Miller Associates, Oak Ridge, Tennessee

Technical Specialty — Economist

Education:

B.S.	1963	Business Administration	Ohio State University, Columbus
M.A.	1964	Economics	Ohio State University, Columbus
Ph.D.	1972	Business Economics	University of California, Los Angeles

Years of Experience — 25
Total Publications — 15

James E. Hill, Senior Economic Geographer, HDR Sciences, Alexandria, Virginia

Technical Specialty — Socioeconomic Impact Assessment

Education:

A.B.	1958	Zoology	University of Tennessee, Knoxville
M.S.	1959	Geography	University of Tennessee, Knoxville
Ph.D.	1963	Geography	University of Tennessee, Knoxville

Years of Experience — 8
Total Publications — 15

Barry Hyman, Economist, HDR Sciences, Santa Barbara, California

Technical Specialty — Local Government Finance

Education:

B.A.	1975	Management Science	State University of New York, Binghamton
M.A.	1978	Urban Economics	University of California, Santa Barbara

Years of Experience — 3
Total Publications — 3

Michael W. Mayfield, Geographer, HDR Sciences, Knoxville, Tennessee

Technical Specialty — Geomorphology and Hydrology

Education:

B.S.	1977	Geography	West Carolina University, Cullowhee
M.S.	1980	Geography	University of Tennessee, Knoxville

Years of Experience — 3
Total Publications — 6

Luisa Freeman Menendez, Analyst, TRW, Inc., Oak Ridge, Tennessee

Technical Specialty — Socioeconomic Impact Analysis, Cost/Benefit Economic Analysis, Energy Systems Impact Analysis, Urban Impact Analysis, Regional Studies, Regulatory Analysis

Education:

B.S.	1978	Economics	Mary Washington College, Fredericksburg, Virginia
M.S.	(in progress)	Urban and Economic Geography	University of Tennessee, Knoxville

Years of Experience — 2
Total Publications — 8

Robert A. Niehaus, Principal Economist, HDR Sciences, Knoxville, Tennessee

Technical Specialty — Environmental and Natural Resource Economics

Education:

B.A.	1972	Government	Oberlin College, Oberlin, Ohio
Ph.D.	1979	Economics	University of Maryland, College Park

Years of Experience — 6
Total Publications — 10

Richard L. Schultz, Principal Associate, TERA, Falls Church, Virginia

Technical Specialty — Transportation Economics

Education:

A.A.	1950	Business	Junior College of Connecticut, Bridgeport
B.S.	1952	Transportation	University of Pennsylvania, Philadelphia

Years of Experience — 30
Total Publications — 0

E. Jonathan Soderstrom, Research Associate, Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Evaluation and Social Impact Analysis

Education:

B.A.	1976	Psychology	Hope College, Holland, Michigan
Ph.D.	1980	Psychology	Northwestern University, Evanston, Illinois

Years of Experience — 4
Total Publications — 10

John H. Sorensen, Research Associate, Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Resource Analysis, Geography

Education:

B.A.	1973	Geography	Clark University, Worcester, Massachusetts
M.A.	1974	Geography	University of Colorado, Boulder
Ph.D.	1977	Geography	University of Colorado, Boulder

Years of Experience — 1
Total Publications — 12

Robert J. Verlaan, Environmental Analyst, HDR Sciences, Santa Barbara, California

Technical Specialty — Socioeconomic Impact Assessment

Education:

A.A.	1975	General Studies	Santa Barbara City College, Santa Barbara, California
B.A.	1977	Experimental Psychology	Westmont College
M.A.	(in progress)	Environmental Planning	California State University, Northridge

Years of Experience — 3
Total Publications — 6

Jeffrey M. Young, Environmental Geoscientist, HDR Sciences, Santa Barbara, California

Technical Specialty — Physical Resources Impact Assessment

Education:

B.S.	1976	Geography/Geology	Lockhaven State College, Lockham, Pennsylvania
M.A.	1978	Geography	Arizona State University, Tempe

Years of Experience — 3
Total Publications — 4

5.5 WATER QUALITY AND AQUATIC ECOLOGY

R. D. Roop, Research Associate, Environmental Impact Section, Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Impact Assessment for Aquatic Environments

Education:

B.A.	1971	Biology	Hiram College, Hiram, Ohio
M.A.	1975	Ecology	State University of New York, Stony Brook

Years of Experience — 7
Total Publications — 13

R. M. Cushman, Research Associate, Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Aquatic Ecology and Toxicology, Aquatic Invertebrates

Education:

B.S.	1971	Zoology	Swarthmore College, Swarthmore, Pennsylvania
M.S.	1975	Ecology	University of Tennessee, Knoxville

Years of Experience — 8
Total Publications — 14

Susan C. Turbak, Staff Scientist, Science Applications, Inc., Oak Ridge, Tennessee

Technical Specialty — Impact Assessment for Aquatic Environments

Education:

B.A.	1970	Biology	University of California, Santa Cruz
M.S.	1975	Microbiology	Cornell University, Ithaca, New York

Years of Experience — 6
Total Publications — 7

5.6 TERRESTRIAL ECOLOGY

Roger L. Kroodsma, Research Staff Member, Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Terrestrial Ecology

Education:

B.A.	1966	Biology	Hope College, Holland, Michigan
M.S.	1968	Zoology	North Dakota State University, Fargo
Ph.D.	1970	Zoology	North Dakota State University, Fargo

Years of Experience — 10
Total Publications — 14

G. W. Suter, Research Associate, Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Animal and Soil Ecology, Environmental Effects Monitoring

Education:

B.S.	1970	Biology	Virginia Polytechnic Institute, Blacksburg
Ph.D.	1976	Ecology	University of California, Davis

Years of Experience — 5
Total Publications — 7

W. W. Tolbert, Project Manager, Science Applications, Inc., Oak Ridge, Tennessee

Technical Specialty — Environmental Impact Assessment in Terrestrial Ecology

Education:

A.A.	1968	Biology	Wingate College, Wingate, North Carolina
B.S.	1970	Biology	Wake Forest University, Winston-Salem, North Carolina
M.S.	1972	Ecology	University of Tennessee, Knoxville
Ph.D.	1976	Ecology	University of Tennessee, Knoxville

5.7 PLANT DESIGN

Steven G. DeCicco (see Sect. 5.1).

J. A. Klein, Chemical Technology Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Environmental Control Technology, Chemical Process Engineering

Education:

B.S.	1967	Chemical Engineering	University of Wisconsin, Madison
Ph.D.	1972	Chemical Engineering	Princeton University, Princeton, New Jersey

Years of Experience — 9
Total Publications — 13

John S. Gordon, TRW Energy Systems, McLean, Virginia

Technical Specialty — Coal Combustion Systems, Chemical Process Engineering

Education:

B.C.E.	1953	Chemical Engineering	Cornell University, Ithaca, New York
M.S.	1956	Chemical Engineering	Ohio State University, Columbus

Years of Experience — 27
Total Publications — 50

A. R. Irvine, Chemical Technology Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Chemical Process Engineering

Education:

B.S.	1947	Chemical Engineering	Texas A & M University, College Station

Years of Experience — 34
Total Publications — 27

Douglas Lee, Chemical Technology Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Chemical Engineering

Education:

B.S.	1969	Chemical Engineering	Iowa State University, Ames
M.S.	1973	Chemical Engineering	Iowa State University, Ames
Ph.D.	1978	Chemical Engineering	Iowa State University, Ames

Years of Experience — 5
Total Publications — 8

Suman P. N. Singh, Development Staff, Chemical Technology Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Specialty — Chemical Process Engineering, Environmental Technology

Education:

B.S.	1964	Chemical Engineering	Indian Institute of Technology, Bombay, India
M.S.	1967	Chemical Engineering	Oklahoma State University, Stillwater
Ph.D.	1973	Chemical Engineering	Oklahoma State University, Stillwater

Years of Experience — 10
Total Publications — 14

5.8 OCCUPATIONAL AND PUBLIC HEALTH EFFECTS

P. J. Walsh, Group Leader, Health Effects and Epidemiology, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Technical Speciality — Environmental Scientist

Education:

B.S.	1964	Nuclear Physics	North Carolina State University, Raleigh
M.S.P.H.	1965	Health Physics	University of North Carolina, Chapel Hill
Ph.D.	1968	Environmental Sciences and Engineering	University of North Carolina, Chapel Hill

Years of Experience — 12 (8 years National Institute of Environmental Sciences, 4 years ORNL)
Total Publications — 50

Experience:

Walsh's professional experience and publications have involved exposure, dosimetry, and potential health effects of long-term, low-level exposure to environmental pollutants. Work has included assessments of (1) exposure, dosimetry, and health effects of pollutants associated with fossil, solar, and nuclear technologies and (2) methods for energy conservation. Current activities include risk assessments for (1) direct and indirect coal liquefaction technologies and (2) oil from shale. These activities are funded by EPA, DOE, and NIOSH.

Walsh is Health and Safety Research Division Coordinator for the ORNL Life Sciences in Synfuels Program. His group is the focal point for overall health risk assessments in this program. He recently cochaired the third ORNL Life Sciences Symposium on Health Risk Analysis, which included national and international leaders in the field.

He has participated by invitation in workshops and task forces on such subjects as exposure assessment, health risk analysis, indoor air pollution, and research needs in environmental health sciences. As a member of ORNL's Speakers' Bureau and as a former ORAU lecturer, he speaks to various public groups on health effects of energy technologies.

5.9 HAZARDS IDENTIFICATION

Harold A. Mitchell, Engineering Division, Union Carbide Corporation, Oak Ridge, Tennessee

Technical Specialty — Mechanical Engineering and Systems Engineering

Education:

B.S.	1963	Mechanical Engineering	Louisiana State University, Baton Rouge
M.S.	1965	Mechanical Engineering	Louisiana State University, Baton Rouge

Years of Experience — 6

Bronson R. Everman, Engineering Division, Union Carbide Corporation, Oak Ridge, Tennessee

Technical Specialty — Mechanical Engineering and Systems Engineering

Education:

B.S.	1963	Mechanical Engineering	University of Kentucky, Lexington

Years of Experience — 19

Appendix A

COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT AND DOE RESPONSES

INTRODUCTION

The Draft Environmental Impact Statement (DEIS), DOE/EIS-0073-D, was filed with the Environmental Protection Agency on January 9, 1981, and a notice of availability was published in the *Federal Register* on January 16, 1981. Copies of the DEIS were sent to Federal, State, local agencies, interested groups, and individuals with a request to comment on the document. Copies of the statement were also provided to those who requested them. Additionally, the opportunity to comment on the draft statement was provided at public hearings conducted in Owensboro, Kentucky, on February 23, 1981, Henderson, Kentucky, on February 24, 1981, and Stanley, Kentucky, on February 25, 1981.

The official public comment period ended March 2, 1981. All substantive comments received pertaining to the DEIS were considered and addressed in the preparation of the Final Environmental Impact Statement, including comments on the DEIS made at the public hearings.

A detailed review of comments received on the DEIS revealed that many of the commenters focused on similar issues. The primary issues raised were related to (in alphabetical order): (1) Air Quality, (2) Health and Safety, (3) Monitoring and Mitigating Measures, (4) Plant Design, and (5) Socioeconomics. Responses to these issues as well as other concerns that were raised are presented in this Appendix and by revisions in the text where appropriate.

This Appendix is divided into 3 subsections as follows:

- A.1 provides listings of the commenters. The listing includes two separate lists. The first list of commenters includes those Federal, State, and local agencies, groups, or individuals who submitted written comments on the DEIS. This alphabetized list is numbered and the numbers serve as identification keys for comments and responses in Sect. A.3. The second list includes those individuals who participated in the public hearings in Owensboro, Henderson, and Stanley, Kentucky, and the numbers also serve as identification keys for the summarized comments in Sect. A.3. Complete transcripts of those hearings are available for public inspection at the locations noted in Sect. 6 of the Summary.

- A.2 provides reproductions of the letters received on the DEIS.

- A.3 contains a synthesis of the comments on the DEIS and DOE responses. Letters received (Appendix A.2) and transcripts of the public hearings were reviewed to identify specific comments. Because of the similarity of issues raised in many of the letters and speeches at the hearings, comments were grouped in subject areas (e.g., Water, Air, Plant Design, Socioeconomic) and synthesized according to issues. Where a number of secondary issues are associated with a primary issue, they may be included with a primary comment. Some relevant issues were raised by only one commenter and are included within the appropriate subject area. With all comments, the governmental agency, group, or individual raising the issue is identified by number corresponding to the numbered list in Sect. A.1. Each identifying commentor number is followed by the page number (e.g., commenter 1, p. 2) of the commentor's letter where the comment appeared originally. The reader may turn to Appendix A.2 to find the comment in its original context. Comments by a speaker can be found in the section of the public hearing transcript in which that speaker took part.

Appendix A.1

COMMENTERS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

AGENCIES, ORGANIZATIONS, AND INDIVIDUALS SUBMITTING LETTERS
REGARDING THE SRC-I DRAFT ENVIRONMENTAL IMPACT STATEMENT

		Page
1.	Dr. Edward Alcott	A-13
2.	Mrs. Joan L. Alcott	A-14
3.	Peter X. Armendarez	A-15
4.	Michael Bouvier	A-16
5.	Mrs. Paul Castlen	A-17
6.	John Caton, Kentucky Audubon Council	A-18
7.	A. B. and Gwendolyn Chiborek	A-21
8.	Patricia Colburn	A-22
9.	Commonwealth of Kentucky, Department of Fish & Wildlife Resources	A-24
10.	Commonwealth of Kentucky, Department of Transportation	A-27
11.	Commonwealth of Kentucky, Department for Human Resources	A-29
12.	Commonwealth of Kentucky, Department for Natural Resources and Environmental Protection	A-31
13.	Commonwealth of Kentucky, Office of the Governor	A-38
14.	Vivian G. Craig	A-39
15.	City of Evansville, Office of the Mayor	A-40
16.	Daviess County Fiscal Court (2 letters) County Judge/Executive Commissioners	A-41
17.	Environmental Policy Institute	A-43
18.	Evansville Environmental Protection Agency	A-48
19.	Evansville-Vanderburgh County Department of Health	A-54
20.	Iomas Evans	A-56
21.	L. T. Grannan, Jr., Audubon Coalition	A-57
22.	Kathleen Graney	A-66
23.	Green River Area Development District	A-67
24.	Fred Hauck	A-70
25.	Betty Helm	A-75
26.	Anne and Steve Henderson	A-76
27.	Karen Hollweg	A-77
28.	Stephen Jones, West Kentucky Coal Operator's Association, Inc.	A-78
29.	Andrew D. Jorgensen, Valley Watch, Inc	A-80
30.	Kentucky Heritage Commission	A-81
31.	Gregory A. McCarty	A-83
32.	Sam McDowell	A-84
33.	William A. McManus, M.D.	A-85
34.	Mrs. William McManus	A-86
35.	Rev. James L. Menser	A-87
36.	Mrs. Darrell Mosley	A-88
37.	National Science Foundation	A-89
38.	National Wildlife Federation Indiana Conservation Council, Inc. Natural Resources Defense Council	A-90
39.	Lee K. Nelson	A-131
40.	Christopher Prendergast	A-133
41.	Thomas M. Rivers	A-134
42.	Linda Roberts	A-137
43.	Mrs. F. H. Russell	A-138
44.	Sassafras Audubon Society (2 letters)	A-139
45.	Stephen M. Sanner	A-143

		Page
46.	Sierra Club, Cumberland Chapter	A-144
47.	Mary Ann Snyder	A-148
48.	Hugh T. Spencer, Valley Watch, Inc	A-149
49.	Lorena Stephen	A-150
50.	Mrs. Camilla Taylor	A-151
51.	George Trigg, Jr., Citizens for Responsible Growth	A-152
52.	Jean Trigg, Citizens for Responsible Growth	A-153
53.	University of Kentucky, Office of State Archaeology	A-155
54.	U.S. Department of the Air Force	A-156
55.	U.S. Department of the Army, Corps of Engineers	A-157
56.	U.S. Environmental Protection Agency, Region IV	A-159
57.	U.S. Department of Health and Human Services	A-174
58.	U.S. Department of Housing and Urban Development	A-176
59.	U.S. Department of the Interior	A-177
60.	Richard A. Wham, M.D., Audubon Coalition	A-178
60.	Betty Wilhoyte	A-186
62.	L. E. Wilson	A-187
63.	William E. Wilson	A-188
64.	Tom Zeller, Valley Watch, Inc	A-191
65.	Synfuel Inquiry Corp.	A-193
66.	Kentucky Department of Energy (see response to Comments of Speaker 75)	A-229
67.	Marion Richardson	A-233

SPEAKERS AT PUBLIC HEARINGS ON THE SRC-I DEMONSTRATION PROJECT

Daviess County High School
Owensboro, Kentucky

Monday, February 23, 1981

1. Paul Morsey
2. J. D. Hume
3. Hon. J. R. Miller, Mayor of Owensboro
4. Stephen Jones, President, West Kentucky Coal Operators' Association
5. Patti Rayburn
6. Fred Hite, Iron Workers Local 103 and Labor for Coal Conversion
7. Patricia Colburn on behalf of T.R.U.S.T.
8. David Adkisson, Owensboro Chamber of Commerce
9. Morris R. Smith
10. Brian Stewart, Teamsters Local 215
11. Bonnie Boyles, Owensboro-Daviess County, Tourist Commission
12. Richard Brown
13. Jim Phillips
14. Cliff Saalwachter
15. Guy Durham
16. Oba Ray
17. J. C. Keown
18. Tommy Thompson
19. Aloma Dew, League of Women Voters
20. Sandra Calhoun
21. Karen Hollweg, National Audubon Society
22. Tom Zeller, Valley Watch, Inc.
23. Hugh T. Spencer
24. Tom Gaston
25. J. C. Turner (Submitted for the record; not read)
26. Harold Baggett, IBEW Local 1701
27. Fred Hauck, Shelbyville, Kentucky
28. John Hagan, U.S. EPA, Region 4, Atlanta, Georgia
29. Norman Dean, National Wildlife Federation presented by Karen Hollweg
30. Edward Gotzy
31. Sam McDowell
32. Dr. Russell Hibbs
33. Max N. Rhoads, Hughes Transit, Inc.
34. Hon. William L. Newman, Mayor, City of Henderson
35. Ann M. Hanat, Evansville, Indiana
36. The Honorable Charlotte Baldwin, Mayor, Madisonville, Kentucky

Henderson County High School
Henderson, Kentucky

Tuesday, February 24, 1981

37. Gardner Weber
38. Bernard Lourie, M.D., Evansville, Indiana
39. Sue H. Atkinson, Evansville, Indiana
40. Dr. Howard E. Dunn, Evansville, Indiana
41. Gene Land, Frankfort, Kentucky
42. Bruce Woodring, Henderson, Kentucky
43. Chris Prendergast, Evansville, Indiana
44. Vincent Light, Evansville, Indiana
45. Harry Ipock, Henderson, Kentucky
46. Louis Smith, Evansville, Indiana

47. Norman Cole, Utica, Kentucky
48. Charles Hill, Evansville, Indiana
49. Jim Kennah, Evansville, Indiana
50. Bob Mayhugh, Central City, Kentucky
51. Dickie Johnson, Henderson, Kentucky
52. J. T. Hall, Henderson, Kentucky
53. Gary Russell, Henderson, Kentucky
54. Hugo C. Songer, Evansville, Indiana
55. Thomas R. Kozel, Ph.D., Evansville, Indiana
56. George F. Trigg, Jr., Henderson, Kentucky
57. Mrs. Jean W. Trigg, Henderson, Kentucky
58. Gordon K. Weddle, Mt. Vernon, Indiana
59. R. D. Barnes, Beaver Dam, Kentucky
60. James Rode, Evansville, Indiana
61. Richard A. Wham, M.D., Henderson, Kentucky
62. Herb Ligon, Madisonville, Kentucky
63. William T. Brinkley, Madisonville, Kentucky
64. Kenneth Gibson, Madisonville, Kentucky
65. Randall Duncan, Madisonville, Kentucky
66. Don Calloway, Madisonville, Kentucky
67. Alan Rodgers, Nortonville, Kentucky
68. Ted Grannan, Evansville, Indiana
69. Jo Ann Causey, Evansville, Indiana
70. Carolyn Nellis, Evansville, Indiana
71. Carolyn Nation, Evansville, Indiana
72. John Lapietra, Owensboro, Kentucky
73. Robert A. Davis, Henderson, Kentucky
74. Roy Montgomery, Henderson, Kentucky

Stanley Elementary School
Stanley, Kentucky

Wednesday, February 25, 1981

75. John Mitchell, presented by James P. Jones, Kentucky Department of Energy
76. Ms. Delores Wathen, Newman, Kentucky
77. Laymond Cain, Owensboro, Kentucky
78. Mabeth Helmers, Owensboro, Kentucky
79. Dr. William Lloyd, Bowling Green, Kentucky
80. Marilyn Mills, Owensboro, Kentucky
81. Hon. Robert Draper, Muhlenberg County, Greenville, Kentucky
82. Bill Brown, Ft. Branch, Indiana
83. Claude Boling, Rockport, Indiana
84. Harlan Johnson, Island, Kentucky
85. Larry Mahoney, Wadesville, Indiana
86. Laney Rideout, Livermore, Kentucky
87. John Beyke, Owensboro, Kentucky
88. Andrew Jorgenson, Mt. Vernon, Indiana
89. John Blair, Evansville, Indiana
90. Thomas Cahill, Henderson, Kentucky
91. Ernie Doan, Madisonville, Kentucky
92. John LaPietra, Owensboro, Kentucky
93. Patsy Hawes Gordon, Maceo, Kentucky
94. Richard B. Phillips, Barnesville, Ohio
95. Robert Barnes, Owensboro, Kentucky
96. Mark Rust, Butler County, Kentucky
97. Pat Colburn, Owensboro, Kentucky
98. R. N. Roberts, Owensboro, Kentucky
99. Richard Stewart, Reed, Kentucky
100. Jospeh A. Wathen, Owensboro, Kentucky
101. Paul O'Bryan, Owensboro, Kentucky
102. Warren Hankins, Evansville, Indiana
103. Ben W. Hawes, Jr., Owensboro, Kentucky
104. H. F. Murphy, Owensboro, Kentucky
105. Mark Boucheric, Reed, Kentucky
106. Stewart Farley, Spottsville, Kentucky

Appendix A.2

LETTERS RECEIVED ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

5618 S. Taylor Ln
Louisville, Ky. 40241

Feb 26, 1980

MAR 0 2 RECD

D. A. Reafsnyder
U.S. Dept of Energy
P.O. Box 1 E
Oak Ridge Tenn.

Dear Mr. Reafsnyder

This letter is to state that I am opposed to the building of the Cyprus plant at Newman, Ky. Its liabilities in my mind far outway its benefits. Because of the documented problems, much more study is needed than is currently being done.

Sincerely
Dr. Edward Wiest

2

3611 South Griffith
Owensboro, Ky. 42301
Feb. 24, 1981

Mr. James A. Reafsnyder
Research and Development Manager
GCG-I Projects Office
U.S. Department of Energy
P.O. Box [illegible]
Oak Ridge, Tenn. 37830

Dear Mr. Reafsnyder:

This is in response to a request for comments on the EIS for Newman, Kentucky GCG-1 demonstration plant. I have a number of objections to the plant at this time. Among them are the prime farm land being used, the flood plain, it being in zone 2-3 for earthquakes, the lack of an epidemiological study done in an area surrounding such a large plant, the number of known and suspected carcinogin and toxic substances emitted, the lack of proven means for environmental and health safety and the fact that there are three other such plants being planned within a fifty mile radius.

Not only would I like to see further study done on this plant but I feel there needs to be a joint study done on the health and environmental effects of all four plants being planned for this area. These studies should not be made individually but together to find the combined effects.

Again, I am definitely against the plant and feel I speak for many, many people in this area. Thank you!

Sincerely,

Mrs. Joan L. Alcott

COMMENTS AND QUESTIONS RELATING TO PROPOSED SRC-I PLANT AT NEWMAN, KY
(Draft Environmental Impact Statement, Vols. I, II)

3

1. Environmental impact considerations in SRC-I studies are generally thorough and well-documented. A large problem area regarding cumulative effects to air quality due to existing power plants and proposed synthetic fuel plants (Appendix CC, Vol. II) is not treated comprehensively. Realistic estimates of air quality deterioration due to these various pollutant sources should be undertaken.

2. The analysis of environmental impacts on water quality by SRC-I statement indicates careful study. The proposed three-stage waste water treatment appears reasonably adequate.

3. Questions posed by the SRC-I process:

   A. How toxic is Hydrogen Sulfide (H_2S) and Carbonyl Sulfide (COS) at the temperature and pressure (450 psi) of the proposed process?

   B. In a "worst scenario", what impact (deaths, injuries) would be expected from a catastrophic situation where release of these gases occurred? How far would their effects be felt to the surrounding area (wildlife and people)?

   C. (Associated with question A). How corrosive is H_2S (and COS) under process conditions (temperature and pressure) to valve systems, pipelines, etc., which might cause the worst scenario situation described above?

   D. Reduced sulfur species, H_2S and COS, are referred to as "non-criteria pollutants" (page C-30). Since the heart of the SRC-I process for the removal of sulfur from coal depends on the generation of large quantities of these materials, should not some criteria be established as to safe limits for these gases? Or, is this a matter to be decided by the demonstration plant?

Peter K. Armendarez, Ph.D.

1224 Parrish
Owensboro, KY 42301

4

FEB 1 8 1981



Our Lady of Mercy Hospital
1006 FORD AVENUE
OWENSBORO, KENTUCKY
42301

February 13, 1981

Mr. James A. Reafsnyder
Research and Development Manager
SRC Projects Office
U.S. Department of Energy
SRC-I Public Hearing
P.O. Box E
Oak Ridge, TN 37830

Dear Mr. Reafsnyder:

Please find my comments on the DEIS SRC-I Newman Project enclosed.

If you have any questions please contact me.

Sincerely,

Michael Bouvier

Michael Bouvier
Director, Personnel/Public Relations

Enclosure

Comments: DEIS SRC-I Newman

My comments are related to health and emergency services.

p.3-44 Our Lady of Mercy Hospital serves the same region as does Owensboro-Daviess County. Physicians in the community maintain privileges at both hospitals. Our Lady of Mercy Hospital is also projecting a 10.5 million dollar expansion and renovation program.

p.3-45 The DEIS states that the number of ambulances at Owensboro-Daviess County is "currently unavailable". There are four ambulances based at Owensboro-Daviess County Hospital. The ambulances are staffed by emergency medical technicians (EMT). Currently 12 of these EMT's are attending paramedic training. Henderson County ambulances are staffed with paramedics.

In addition, the Henderson-Owensboro area is within the operating range of TIKI-MAST helicopter service from Fort Campbell, Kentucky and the MAST operation at Fort Knox, Kentucky. Both units have standby crews available to aid the civilian community.

Police protection in Henderson and Daviess County also includes the services of the Kentucky State Police Post in Henderson.

The DEIS states that "neither of these counties is insurance rated". This is incorrect. The Daviess County system has a 9 rating county wide and a 7 rating for all structures within 1,000 feet of a hydrant. Fire stations are located at Stanley, St. Joseph, Utica, Airport, Sargho, Mosleyville, Masonville, Pleasant Ridge, Thruston, Philpot, Whitesville, Yelvington and Knottsville. Typically, each station has a rated pumper and a rated tanker. In addition there is a variety of special service units, such as rescue vehicles, brush fire units, etc. throughout the county. The entire system is dispatched by a centralized system. Each volunteer is radio dispatched in a system which provides automatic, pre-programmed back-up and support from nearby stations.

p.4-76 Several comments throughout the document seem to imply that the city of Owensboro will have to add to its municipal resources to accomodate the growth expected. Typically, a large amount of the growth has taken place in the urbanized area outside the city limits. I suggest that both Owensboro and Daviess County will have to add personnel to provide government services.

Paragraph 2 on this page states that the "fire department in Owensboro is involved in the provision of emergency medical services". This is no longer true. The ambulance-rescue vehicle is no longer configured as an ambulance. The City Fire Department does continue to provide rescue and extrication services. Some of the fire fighters are EMT certified.

p.4-77 Most of the public finance section ignores the cost of providing additional governmental services. For example, in both Henderson and Daviess Couties, the local governments provide subsidy to the ambulance services. On page 4-76, it is stated that one additional ambulance and additional personnel will be required in order to adequately respond to medical emergencies.

5 FEB 2 1981

Stanley, Kentucky
February 25, 1981

Dear

In regard to the proposed syn-fuel plant at Newman, Ky. It appears utterly ridiculous to take so much of the finest agricultural land in western Kentucky, when there are so many acres on the Ohio and Green River that have already been strip mined & are agriculturally unfit. Why were not some of these sites chosen? The plant will not affect only the purchased land. We have been told by agricultural engineers that within a few years after the operation of such a plant – the emissions will have destroyed the production potential of our farm land.

We have also been told by a professor of physics at Univ of Minnesota (and I quote) that "such an undertaking could be economically disastrous"

Also – it is disgusting to be told that the water in our area will not be affected – who ever prepared the EIS must have the impression that the people of this area are "nincompoops" to accept the contents.

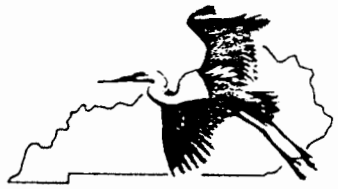
When you have heard so much opposition and you are aware of so many dangers – why ~~must~~ cannot this Newman plant be dropped completely. I can answer my own question with —— money, prestige, and power for our politicians & their friends

Mrs Paul Carlton
Route 7
Owensboro
Ky. 42301

P.O. BOX 376 - HENDERSON, KENTUCKY 42420
TELEPHONE (502) 827-5467

6

President . . . . . Mr. Ronald G. Dodson
Vice President . . . Mr. Ralph E. Madison
Secretary . . . . . Mrs. Mary F. Travis
Treasurer . . . . . Mr. William R. Buster



Kentucky Audubon Council

COMMENTS ON DRAFT ENVIRONMENTAL IMPACT STATEMENT

(SITE SELECTION PROCESS)

SOLVENT REFINED COAL-1

DEMONSTRATION PROJECT

NEWMAN, KENTUCKY

Submitted by

John Caton, M.D.

On behalf of

KENTUCKY AUDUBON COUNCIL

Henderson, Kentucky

February 24, 1981

MAR 0 2

NATIONAL AUDUBON SOCIETY – KENTUCKY CHAPTER MEMBERS
Breathitt County, Buckley Hills, Daviess County, Frankfort, Henderson, Lincoln Trail, Little River, Louisville, Northern Kentucky, South Central, Tradewater River

The proposed action is construction and operation of an industrial plant in accordance with the process design evaluation in the draft Environmental Impact Statement. The environmental impacts of the proposed action must be evaluated in comparison with the impacts of the alternative actions that may be taken by DOE, for example:

> "Select an alternative site, design, or plant layout to further reduce environmental impacts and proceed with construction."

Since the SRC-I plant is a demonstration facility and the DEIS readily points out the many unknown aspects of the facility and that the purpose of the alternative site studies is to locate a site that will "lessen the environmental impacts of the operation" the siting process is worthy of study:

> "In 1976 Rust Engineering Co., under the sponsorship of the Kentucky Center for Energy Research (KCER) undertook an alternative site analysis for selection of a site for a two thousand (2,000) ton per day SRC-I plant. The Rust Study evaluated sites from a list of potential Kentucky sites supplied by KCER. The siting criteria used in the Rust Study were primarily physical, engineering and economic factors that were judged to be important for construction and operation of the SRC-I Plant. The Rust Study consisted of four phases that by eliminating potential sites from a large list, sequentially narrowed the number of potential SRC-I sites. Phase I of the analysis concentrated on potential siting areas and evaluated these areas on general, physical and environmental requirements and constraints. Phase II of the analysis consisted of a more detailed evaluation of the 24 potential siting areas identified in Phase I. This phase reduced the number of potential sites to ten. Phase III of the analysis eliminated five of these ten sites because of site specific , physical constraints and land availability. The final phase included a more stringent evaluation of the physical, cultural and economic constraints of the five remaining sites. In the final phase seven site requirements were assigned weighted values and sites compared. Newman, Kentucky was selected as the preferred site in Rust's Study and Equality and Lewisport were rated as prime alternative sites. At that time the Executive Orders 11988 and 11990 concerning flood plain/wetland encroachment had not been issued and DOE was not a participant in the project."

After this initial siting study the SRC-I Plant was expanded to be a

six thousand (6,000) ton per day plant with the goal of commercial expansion to thirty thousand (30,000) tons per day in the future and the DOE became a participant in the project.

At this time it was decided that an expanded site study should be undertaken. Oak Ridge National Laboratories was chosen to do the study. Section B.3 of Volume II describes the ORNL analysis which evaluates sites "other than Newman for the selection of two reasonable alternative sites for evaluation against Newman."

The purpose of this alternative site comparison is not to select the environmentally preferable site but rather in response to the National Environmental Policy Act, to evaluate reasonable alternatives to the proposed action:

> "A major difference between alternative site analysis performed by Rust's Engineering and ORNL is that ORNL placed primary emphasis on environmental criteria and identified the two environmentally least sensitive sites as alternatives to the Newman site. The Rust site selection study places primary emphasis on engineering criteria."

Since the Rust Study was based mainly on engineering criteria and not environmental, and since the plant proposed at the time was the two thousand (2,000) ton per day facility and not six thousand (6,000) with a goal of thirty thousand (30,000) tons per day, the Rust Study techniques should be considered invalid. Since the ORNL study took into account the expanded size of the proposed plant and used environmental criteria to eliminte potential sites, and was done to meet NEPA requirements, this study should be considered the only valid site selection process. The only problem with the CRNL study is that they didn't consider the Newman site in the process.

If the Newman site had been considered, however, and compared to the Environmental Variable Chart on page B-8 of Volume II of the DEIS which Oak Ridge National Laboratories used to eliminate potential sites because of environmental considerations the Newman Site would fail in every category!

1. WATER QUALITY - Significant impacts on water quality could result from several sources on the Green River, Richland Slough and existing raparian forests.

2. ENDANGERED SPECIES - The Indiana Bat was discovered on the site; however, since the study conducted was done at the wrong time of the year the status of the bat is not known at this time.

3. WETLANDS - Richland Slough was identified in the DEIS as a significant wetland that could be impacted by the plant.

4. GEOLOGIC HAZARD - According to the DEIS the site is located in Seismic Risk Zone 3 which is the highest risk zone.

5. PRIME AGRICULTURE SOILS - Over 91% of the site is classified as prime farmland.

6. GROUND WATER USE - The DEIS states that the seven-day ten-year low flow of the Green River and corresponding ground water could be jeopardized by the plant.

7. AIR QUALITY - At the time of the study Davies County was designated non-attainment for ozone.

This Environmental Variable Chart does not even consider the Presidential Executive Orders of May, 1977, on floodplain and wetland management which were enacted to protect lives and property and restore and preserve natural and beneficial floodplain values. Over one-half of the Newman site is located below the 100-year floodplain in direct violation of these Executive Orders.

THE SITE SELECTION DOES NOT MEET DOE'S OWN RECOMMENDATIONS

In June, 1980, DOE published a document called Synthetic Fuels and the Environment-An Environmental and Regulatory Impacts Analysis. In this document the DOE determined what locations would be best and worst for locating a coal conversion plant. Several categories were considered. Four classes were determined in each category. In the Environmental Health category- which is based on population density and existing cancer rates- Daviess County- the Newman site is in the worst class, and Henderson County is in the next-to-worst class. In the category of Ecological Sensitivity- which is based on prime farm land- the Newman site is in the next-to-worst class. In regards to existing air quality- the cities of Owensboro and Henderson and Vanderburgh County in Indiana are shown to be in the next-to-worst class. All of these factors would indicate that Newman is not a likely site.

This information was available to the proposers of this project, but nownere in the DEIS is this information described. This type of information certainly indicates that the site selection-process is open to question.

Why did the DOE not use this information? The Newman site does not fit the DOE's own criteria.

In summary, the DEIS amply points out that the Newman site is obviously not the correct site to locate the facility and that the entire siting process as presented is an inadequate, incomplete and confusing attempt to select a site not environmentally or economically acceptable for a plant of this size and scope.

[1] All quotations from the SRC-1 draft environmental impact statement.

A. B. CHILDRESS
3823 E 4 ST HWY 60
OWENSBORO, KY.
42301

7

Sept 26, 1981

Mr. James C. Reafsnyder
Mgr. Research & Development
U. S. Dept. of Energy
Oak Ridge, Tenn 37830

Dear Sir —

PLEASE ! NO NEWMAN SYNTHETIC FUELS PLANT

Owensboro and vicinity is now under serious pollution condition. In the last few years utilities and polluting factories have sprung up like a forest. To name a few:—

Green River Steel
Green River Utilities
Owensboro Municipal Plant
(Also producing power for)
(Kentucky Utilities)
Big Rivers Utilities
T V A - Paradise Utilities
Paper Mill in Hawesville, Ky
Union construction a huge
power plant - coal & Kentucky
Power.

Hundreds of overloaded trucks pass our residence daily - overloaded and throwing coal dust everywhere

My wife and I want to take a fighting stand for the health of our children and grandchildren

Sincerely yours,
Mrs. Gwendolyn Childress
A B Childress

8

March 2, 1981

Patricia Colburn
1630 Alexander Ave.
Owensboro, Ky. 42301

James A. Reafsnyder
Research a nd Development Manager
SRC-I Project Office, U.S. Department of Energy
P.O. Box E
Oak Ridge, Tn. 37830

Dear Sir;

In addition to my oral presentation at the Feb. 23, 1981 public hearing on the proposed SRC-I coal conversion plant for Newman, Ky. I wish to submit written comments for your review.

After doing a preliminary cost ratio between the utility power use of the proposed SRC-I plant a nd the energy value of the projected production of the plant (at 20,000 barrels of oil-energy equivalent), there is indeed a cost benefit to the plant.

Unfortunately, I am unable to carry this anelysis any further. I would like to see a cost benefit ratio conducted here, including fuel consumption by truck, rail and barge, socio-economic impacts on surrounding communities, displacement of landowners cost, possible clean-up costs and rail and road maintainance, and loss to crop yield. The work force should be listed once, re; Comments on DEIS on SRC-II plant in Morgantown, W.Va. by Natural Resources Defense Council and National Wildlife Federation.

I am satisfied that the rest of my questions have been addressed by my colleagues.

Thank you for your time and effort.

Sincerely,

Newman project demands public input

Synfuels spell trouble for Owensboro

in my view



By PAT COLBURN

There's T-R-O-U-B-L-E in River City!

That's a capital "T" which stands for the Testing of us and our families, as "guinea pigs." Quoted from the environmental impact statement for the synfuels plant proposed for Newman: "One of the purposes of the SRC-I demonstration program is to identify health and environmental risks associated with the demonstration plant itself . . ."

"T" also stands for Toxics which the proposed Newman plant will spread throughout this area. A recent hygiene study by the National Institute for Occupational Safety and Health indicated that workers at the pilot SRC-I plant in Ft. Lewis, Wash., had been exposed to high levels of potentially cancer-causing chemicals. Our first wealth is health.

"R" is for our Rivers which will be further polluted with spills and whose banks will face greater erosion from increased barge traffic. "R" is also for the railroad. Hope that you don't need an ambulance when an 80-car unit train carrying coal and chemicals comes through town each day.

"O" is for the Oxygen in our air which is dirty now. If that plant comes in, expect a hazy sky and increased fog. If you have breathing problems now, plan to stay inside always.

"U" is for the Utter Stupidity of wasting our best farm land to concrete and steel. If the plant is neither economically nor environmentally feasible, we cannot reclaim the land. Kentucky loses 25,000 acres of farm land a year to developments. While 1,484 acres will be lost to the plant site itself, add on 526 acres for the power line, and keep adding for the new roads, trailer courts, housing and shopping centers, etc.

"B" is for the Billions of dollars in taxes that you and I are giving for studies and to wealthy companies. Our money, not the companies, will pay for the cleanup of their spills and the tremendous cost overruns. The pilot SRC-I plant had two spills last year. The first spill cost us half a million dollars in tax money to clean up. The cost of the Newman plant has already risen from $1.4 billion to $3.1 billion. Start adding on for higher retail prices, higher rents, higher utility bills to offset the plant's power bill and for new roads and services. Daviess Countians, be prepared to start paying an occupational tax. "B" also is for our Birthright which is being usurped in the name of eminent domain. The taking of private land to give to a private company is another step on the corporate socialism ladder.

"L" is for the Little Things that we fail to remember. You bought the hype on jobs, but look closer. Look at all that we're sacrificing for a measly 370 permanent jobs. Nothing in writing commits this plant to use any Kentucky coal. And since the plant will rule out further industrial development in our area, forget about getting your children jobs here in the future. Remember the bit about Italian industrialists possibly becoming partners? Well, they declined, but International Coal Refining Co. is still seeking foreign investors. Patriotism, where are you?

"E" is for Everyone whose life will be affected by this crash program of government giveaway. "E" is also for Energy in which our nation abounds. While huge oil and natural gas reserves are being discovered, and while this nation WASTES one-quarter of its energy supply through inefficiency, does it make sense to further dissipate our money, health and land? Waste not, want not. Let's start planning for a better development of our country, counties and town. "E" also is for the Environmental Impact Statement for the Newman plant and for the other studies for development such as the one being done by the Green River Area Development District. These reports make up the blueprint by which we may plan our social, economic, resource and environmental progress, rationally.

President Reagan has cut this plant out of the national budget, and after many more months of wrangling in Congress the Newman plant will be finished for good. Meanwhile, millions of our tax dollars continue to be given for ICRC's sales job.

If you care about your family, if you care about your pocketbook, if you care about owning your own property, and if you care about the future of this area, now is the time to act!

Don't worry that you might not know enough. Who does? Don't worry if you think you can't write as well as the next person. Don't worry if you think you don't speak as well before an audience. If you want to worry, worry about what this region will be like if you ignore the facts, if you don't write or speak out. If we lose because of apathy or resignation, you may be able to move away, but your family and neighbors may not. It doesn't matter what your particular reasons are. It does matter that you make your opinion known. Help put a stop to this squandering of precious resources. Our scientists, lawyers and experts can fight in the courts and through the webs of bureaucracy, but without your support and your input, it will be a long and painful process.

Attend and speak out at the public hearings for the Newman plant to be held at Daviess County High School at 7 p.m., Monday, Feb. 23 and at Stanley Elementary School at 7 p.m., Wednesday, Feb. 25. Or write your comments — three sentences or three pages — but write before March 2 to: James A. Reafsnyder, Research and Development Manager, SRC-I Projects Office, U.S. Department of Energy, P.O. Box E, Oak Ridge, Tenn. 37830.

Pat Colburn, an Owensboro native, lives at 1630 Alexander Ave. She is a free-lance photographer and spokesperson for TRUST.

FISH & WILDLIFE COMMISSION
HENRY S. FRITZ, JR. HOPKINSVILLE
FAY BRITT, MADISONVILLE
JACK T. BROOKS, LOUISVILLE
DR. JAMES C. SALATO, COLUMBIA
DR. JAMES R. RICH, TAYLOR MILL
CHARLES E. PALMER, JR. LEXINGTON
TIM DASH JENKINS
DR. ROBERT C. WEBB, GRAYSON
DANNY K. COFFEY, JAMESTOWN

9

COMMONWEALTH OF KENTUCKY
DEPARTMENT OF FISH & WILDLIFE RESOURCES
CARL E. KAYS, COMMISSIONER

PHONE 564-3400

RECEIVED
FEB 24 1981
DEPT. NATURAL RES. & ENV. PROT.
POLICY & PROGRAM ANALYSIS

February 24, 1981

Mr. Don Beevers
Office of Special Projects
Department for Natural Resources
and Environmental Protection
4th Floor, Capital Plaza Tower
Frankfort, KY 40601

RE: Draft Environmental Impact Statement (EIS) - Solvent Refined Coal - I (SRC-I) Demonstration Project

Dear Mr. Beevers:

Members of my staff have reviewed the referenced document and offer the following general and specific comments and recommendations.

The Fish and Wildlife Coordination Act (FWCA) requires that all water related projects that are federally funded, licensed or permitted must be coordinated with the U. S. Fish and Wildlife Service and the state Fish and Wildlife Agency. Coordination should consist of assessing the impacts of the proposed action on the fish and wildlife resources of the project area and developing plans for mitigating any losses that may occur due to the impacts. To date, we are unaware of any meaningful efforts to comply with the provisions of the FWCA.

A letter, presented in Volume II, Appendix I, page 14, mentions the FWCA but does not demonstrate an effort to get coordination and planning underway. Also, this Department was not contacted regarding this letter. It is our opinion, therefore, that coordination between the U. S. Fish and Wildlife Service (USFWS), the Kentucky Department of Fish and Wildlife Resources (KDFWR), and the Department of Energy (DOE) be implemented as soon as possible and that any mitigatory plans be implemented concurrent with project development.

The FWCA is the keystone in assuring that fish and wildlife resources are given adequate consideration in the development of our natural resources and its implementation cannot be overlooked.

ARNOLD L. MITCHELL BLDG. #1 GAME FARM ROAD FRANKFORT, KY. 40601

Many of the impacts to fish and wildlife resources that are associated with the development of SRC-I and its proposed commercialization are indirect. They should, however, be addressed more fully in the documents.

Socioeconomic impacts such as increased demand for transportation systems, housing and other activities associated with the development of SRC-I will usurp many acres that are currently available for production of fish and wildlife resources. These acreages should be considered in assessing overall project impacts.

Increased and accelerated loss of habitat through increased coal mining to provide coal to the SRC-I facility will impact fish and wildlife resources. As stated earlier, these acreages should be considered in determining overall project impacts.

Development of the SRC-I facility on prime farmland presents a strange dichotomy especially in light of the fate and well-being of fish and wildlife resources. As prime farmland is taken out of production for development of the synthetic fuel industry, agricultural production falls proportionally. In efforts to maintain agricultural production levels on a statewide or nationwide basis, increased pressure is exerted to bring lands currently not in agricultural production into production. The situation is well exemplified in Kentucky.

The major drainage basins of the Jackson Purchase region of Kentucky are currently slated for drainage by various agencies of government. The reason being to increase the agricultural base of the region, the state, and the nation.

The major portions of the drainages in the Purchase region currently exist as wetlands or bottomland hardwoods. Both of these habitat types are extremely valuable to fish and wildlife resources. Should drainage of these systems occur, fish and wildlife resources will be devastated. Again, no consideration is given in the document for these types of cause and effect relationships when development is proposed on prime farmland.

For the purpose of organization, specific comments on impacts associated with the development of the SRC-I facility and other synthetic fuels programs in western Kentucky will be provided catagorically. The major catogories are aquatic and terrestrial wildlife. Comments are as follows:

Aquatic

Page 1-34, Section 1.4.2.1 - Water availability.

Determinations as to the availability of water should take other water uses into consideration. Development of all or any of the six proposed facilities should consider the instream flow needs of the aquatic organisms which exist in the area of the facility(ies). Extensive research has been conducted in the

western United States to determine the water needs of aquatic organisms. Further, extensive litigation has determined that the water needs of fish and wildlife resources are legitimate uses that must be provided for in the development of user schemes.

While instream flow needs for fish and wildlife resources has just recently come to the forefront in the eastern United States, the precedence upholding their importance has been established. This point should be elaborated upon in the Final EIS and guarantees provided that instream flows for fish and wildlife will be maintained.

Page 1-38, Section 1.4.3.3 - Water availability

This section draws the distinction between withdrawn and consumed water. Consumed water, or water that is chemically or physically altered is 12,000 gal/min. for the SRC-I facility. Further (page 4-100), it is stated that 2 percent, 7 percent, and 30 percent of the 7-d, 10 year low flow of the Green River will be consumed with the SRC-I demonstration facility, the SRC-I commercial facility, and the SRC-I combined with the other projects, respectively.

Entrainment of phytoplankton, zooplankton, larval fish and other aquatic organisms that are unable to escape intake velocities will result in their death. The percentage of water taken in tends to reflect the percentage of the basic food chain available to aquatic organisms that is lost. This has a potential devastating effect upon an area of the Green River that is, in our professional opinion, already severely degraded. Losses of this magnitude during the flow regimes described are unacceptable. Information regarding entrainment rates during normal flows should also be addressed.

Much research has been conducted on the design of intake structures to lessen impingement of fishes. Plans for mitigating impingement should also be addressed.

Water quality problems in the Green River are adequately addressed, however, the worst case scenario (page 1-35, Table 1.6 and page 1-41, section 1.4.3.4 - Water quality) that is constructed warrants concern. Documented assurances that the Best Available Current Technology (BACT) will allow for zero discharge (page 1-41 and 42, section 1.4.3.4 - Water quality) should be provided.

On page 4-100, the section on water quality and aquatic ecology describes the possible impacts of water quality on aquatic ecology. The effects inflicted upon aquatic organisms through heavy metal uptake and accumulation are generally subtle and cryptic. Impacts may be beyond prevention by the time they are discovered. Attention to this problem is essential and should be addressed further.

The document describes precautions that will be taken to contain spills and control runoff water on the site. Due to the importance of Richland Slough to resident and migratory fish and wildlife resources, particular attention should

be given to that portion of the site which drains into Richland Slough via Bryant Ditch. Further, all precautions should be taken to eliminate the entry of sediments into the Richland Slough area.

Excavation and subsequent destruction of the riparian zone along the Green River will be necessitated for the construction of the barge slips (page 4-24, paragraph 4 and page 4-26, last paragraph) and water intake and discharge structures. To offset damages to the aquatic system and the associated terrestrial wildlife species, we recommend that the riparian zone be re-established where feasible by revegetating with species indigenous to the area. Revegetation should be at a density (stems/acre) similar to that which exists in undisturbed sections of the Green River. Species composition should reflect the relative importance values of species indigenous to the riparian zone.

The document correctly identifies sedimentation (page 3-23, paragraph 2) as being the most significant pollutant entering the Green River. We concur. We are likewise of the opinion that the shearing effects of continual barge traffic may adversely effect aquatic organisms (page 3-23, paragraph 2). Since the barging of coal to the SRC-I facility will undoubtedly be a major coal transportation mode, the impacts of shearing action and the resuspension of sediments that results will continue and intensify an already identified problem. The recovery potential of aquatic resources will be eliminated as the problem is aggravated.

Increased barge traffic will also tend to compound the problem of fisherman harassment on the Green River.

Terrestrial

Page 1-47, Section 1.4.4.3 - Soils.

We agree that the large volumes of ash that will be generated by operation of the SRC-I facility could cover large areas of topsoil. In light of current technology, such a practice should not be instituted.

Coal fired power plants, likewise, have ash disposal problems. They, however, either stockpile the topsoil prior to ash deposition or obtain additional topsoil to fill over the disposed ash. In any case, open disposal methods of ash such as you indicate should be abandoned.

Disposal sites should be lined with an impervious material after the topsoil has been removed and stockpiled. As the disposal area is filled, the topsoil should be redeposited on the ash and the area revegetated. Revegetation should consist of planting a grass/legume community of orchard grass and clover which should then be allowed to proceed through natural succession.

Page 1-47, Section 1.4.4.5 - Flora and fauna.

Statements made in this section would lead one to believe that these species

which occur on the SRC-I facility site could and would relocate in adequate habitats. Stockpiling of wildlife as you describe does not occur as adjacent habitats are probably at or near carrying capacity and, therefore, incapable of incorporating the displaced individuals.

A more realistic statement would be that those individuals of species occupying the site would perish. Further, the area will be permanently lost to production of wildlife species for the life of the project.

Volume II, Appendix K - Terrestrial Ecology.

While the documented occurrence of the federally endangered Indiana bat (*Myotis sodalis*) is important and warrants special consideration, we feel that the terrestrial ecology of the area should be addressed in sufficient detail to make the public aware of the overall value of the site to wildlife.

Even though the terrestrial ecology of the SRC-I site is documented in the Environmental Report, this report is not readily available for public review.

We concur with the findings concerning the Indiana bat and support your recommendations for attempting to minimize any adverse impacts that could affect it.

Page 2-7 and 8, Section 2.2.1.2 - Supporting facilities, transmission lines.

In addition to the procedures outlined in the document concerning transmission line routing, which includes rerouting the alignment to miss Richland Slough, we recommend that the following practices be implemented along the right-of-ways (ROW).

ROW's that course through areas that must be cleared of existing vegetation should be disked, fertilized, and planted in a manner to establish a two-thirds grass-legume (orchard grass and clover) community and a one-third mixed shrub community. Maintenance of the corridor in this community structure should be accomplished by mechanical means.

Page 3-12, Paragraph 5, Section 3.2.1.3 - Vegetation and Wildlife, Wildlife.

The SRC-I facility is located in the Green River floodplain which has been a historic wintering area for migratory waterfowl. Waterfowl from the adjacent Richland Slough and the Sloughs Wildlife Management Area most certainly use the present site as a feeding area. This benefit will be lost with development of SRC-I. Further, with the proposed construction of other synthetic fuels facilities in the general area, waterfowl usage will be further curtailed.

We are in slight agreement with the statement (pages 4-23 and 24) alluding to the fact that intensive agriculture on the proposed SRC-I site has led to the presence of wildlife communities of relative low diversity. It should be noted that agricultural production, while on a less intensive scale, is a major part of

the management plan on all of our wildlife management areas in Kentucky. Residual weeds and wasted grains that occur in agricultural fields supply food and some cover to resident and migratory wildlife species.

Comments given earlier in the Aquatic category alluded to the protection of the quality of water entering Richland Slough. The swamp rabbit (*Sylvilagus aquaticus*) is known to have occurred in the area in recent years. The swamp rabbit is on our list of species of high state interest and, therefore, should be given special concern with regard to protection of Richland Slough and its water quality.

In summary, we feel that there are many unanswered questions regarding fish and wildlife resources, the impacts that would be wrought upon them, and the methods to be implemented to offset or minimize the impacts. Prompt implementation of the provisions of the Fish and Wildlife Coordination Act should be undertaken to ascertain losses to fish and wildlife and to plan for their replacement.

The professional staff of this Department will be available for technical consultation when the need arises.

Thank you for the opportunity to comment and we look forward to your continuing cooperation.

Sincerely,

Carl E. Kays
Commissioner

CEK:LES:smc

copies: Joe Bruna, Director of Wildlife Management
Bill Graves, Asst. Dir., Wildlife Management
Pete Pfeiffer, Asst. Dir., Fisheries
David Bell, Northwestern District Fishery Biologist
Ben Burnley, Wildlife Biologist
Lee Nelson, Wildlife Biologist
Tom Talley, USFWS
Al Lucas, USEPA
Environmental Section Files

10

FRANK R METTS
SECRETARY

COMMONWEALTH OF KENTUCKY
DEPARTMENT OF TRANSPORTATION
FRANKFORT, KENTUCKY 40622

JOHN Y. BROWN, JR.
GOVERNOR

February 20, 1981

Environmental Review
Office of Special Projects
Department for Natural Resources
and Environmental Protection
4th Floor, Capital Plaza Tower
Frankfort, Kentucky 40601

Gentlemen:

Subject: Draft Environmental Impact Statement
DOE/EIS-0073-D/VI
SRC-1 Demonstration Project
Newman, Kentucky

Attached is a copy of a letter of February 10, 1981, signed by Governor Brown and Frank R. Metts, Secretary of the Kentucky Department of Transportation, which provides KYDOT's comments on the subject environmental impact statement.

Also attached are detailed comments on the draft EIS.

Sincerely,

Henry M. Bennett

Henry M. Bennett
State Highway Engineer

Attachments

cc: Jim Fehr
Bruce Siria
Don Ecton
Tom Scott
A. W. Clements

KYDOT
Detailed Comments on Draft EIS
For SRC-1 Demonstration at Newman, Kentucky

1. A combination of Park and Ride, Busing, and Ridesharing Programs along with staggered daily work schedules should be discussed as a mitigation alternative in more detail in the Final EIS.

2. P. 3-50

a) Statement in EIS
"Finally, the Green River Bridge at Spottsville is very dangerous, ..."

KYDOT Response
We believe the above should be changed to say the bridge is geometrically substandard because of its pavement width of only 20 feet.

b) Statement in EIS
"US 60 between Owensboro and Henderson is presently maintained to provide, at the minimum, a level of service (level D) ..."

KYDOT Response
US 60 is not maintained to provide any specific level of service. Level of service merely describes the quality of flow on the highway.

3. P. 3-5I

Statement in EIS
"In spite of low sufficiency ratings, the state has no plans to widen or upgrade US 60 between Henderson and Owensboro. This is caused in part (1) by the generally negative attitude of the state legislature toward new expenditures and (2) availability of a parallel facility (Audubon Parkway) between the two cities."

KYDOT Response
Item 2 is correct. Item 1 is misleading. At the time the EIS was prepared KYDOT had no plans to widen US 60 because of the current shortage of highway construction funds. Additional consideration is being given at this time because of the potential synfuel plants.

4. P. 3-52(1) and P. 4-81(b)

a) Statement in EIS
"Therefore, the widening of US 60 to four lanes west of Frontier Drive (1.1 miles) is mandatory, regardless of whether the SRC-1 Plant is constructed."

b) Statement in EIS
"The TAM Analysis of Traffic Impacts ... considered widening of US 60 to four lanes west of Frontier Drive (1.1 miles) as mandatory."

KYDOT Response
The widening of US 60 to four lanes west of Frontier Drive regardless of whether the SRC-1 Plant is constructed is not mandatory. Improving US 60 is a desirable project. Although no plans for improvement exist at the present time, additional consideration is being given because of the potential synfuel plants.

5. P. 3-52

Statement in EIS
"Improvement of US 60 to a divided four-lane highway from the US 41 intersection to the eastern Henderson City limit is anticipated by 1986 because of normal traffic growth of local (not SRC-1 related) traffic according to Kentucky DOT."

KYDOT Response
The above statement is incorrect; KYDOT had no plans to four lane this section of US 60, particularly by 1986, at the time the EIS was prepared. Additional consideration is being given presently because of the potential synfuel plants.

6. P. 4-82

Statement in EIS
"For this mitigation alternative to be practical, four-laning past (sic) US 60 would have to receive high priority from KYDOT."

KYDOT Response
Even if four-laning of US 60 were given high priority by KYDOT, it could not be completed in time to accommodate the scheduled peak construction worker traffic. Therefore, four-laning of US 60 does not appear at this time to be the most practical alternative to pursue.

7. P. 3-50

Final EIS may need to discuss why the highway bridge over the L & N tracks near Henderson is a major structural flow constraint.

8. P. 3-51

Table 3.26 - This table describes the level of service for a two-lane rural highway ... not US 60 in particular. Therefore, the reference to US 60 in heading should be eliminated. Table 3.26 - The source should probably by the 1965 Highway Capacity Manual.

9. P. 4-81

In the table the description of the Section for the 1st Section should read "US 60 from US 41 to 0.2 mile east of the Henderson City Limit."

10. P. 4-82

Clarification is needed on who is proposing a new interchange at Audubon Parkway and KY 1554.

11. P. 4-83

Costs shown in the Table for KY 1554 are in error. The costs shown for "1554 to 24 feet" and "1554 three lane" include the cost of the interchange. These estimates should be revised to:

KY 1554 to 24 feet - $5,650,000
KY 1554 three lane - $7,700,000

All estimates should be identified as being based on 1980 costs.

12. P. 4-84

On page 4-84 in the bottom paragraph next to last line, approximately 200 vehicles are identified as using US 60 at peak travel times if a "Park and Ride" Bus Program is used. Under the Section "Park and Ride Rail" on page 4-87 first paragraph this number is 160 vehicles. Since the scenario is the same, the number of vehicles should also be the same.

13. P. 4-82

One of the major problems with any US 60 reconstruction near Henderson is utility relocation. This should be addressed in the EIS.

14. Park and Ride Bus

Estimates of cost of commuter bus service appear to be quite high representing a worst case estimate. KYDOT's analysis of the Hughes proposals lead to an estimated service cost of less than $4,000,000 for the contract period in 1980 dollars. The use of competitive bids or the possibility of providing transit service in-house should also be considered. The final EIS should reflect most probable costs.

15. Park and Ride Rail

It appears that operating costs have been ignored. The cost of diesel fuel to run the locomotive will most likely be the largest cost involved. The final EIS should address this cost and assign responsiblity for it. The cost figures shown in Tables 4.37 and 4.38 misrepresent the facts unless they include all costs.

16. Ridesharing

It is possible to set up a vanpooling program whereby capital costs would be defrayed by program participants. The final EIS should include a discussion of the need for adequate park and ride lots in Henderson and Owensboro to facilitate car, van and/or bus pooling.

DEPARTMENT FOR HUMAN RESOURCES

DEPARTMENT OF FISH & WILDLIFE RESOURCES

DEPARTMENT OF TRANSPORTATION

KENTUCKY HERITAGE COMMISSION

UNIVERSITY OF KENTUCKY

COMMENTS ON

DRAFT ENVIRONMENTAL IMPACT STATEMENT

SOLVENT REFINED COAL - I (SRC-I) DEMONSTRATION PROJECT

NEWMAN, KENTUCKY

DEPARTMENT FOR HUMAN RESOURCES
COMMONWEALTH OF KENTUCKY
FRANKFORT 40621

OFFICE OF THE SECRETARY

11

February 25, 1981

Ms. Jackie Swigart, Secretary
Department for Natural Resources
5th Floor
Capital Plaza Tower
Frankfort, KY 40601

Dear Ms. Swigart:

This letter is both in response to the request for comment on the Draft Environmental Impact Statement for Solvent Refined Coal-I (SRC-I) and for your information.

We have reviewed the Statement in some detail relating to employment, training, and manpower effects, and also related to this Department's responsibility to protect the public health in the Commonwealth.

Manpower and Training

We have no difficulty with the estimates or impacts regarding labor market effects. We did note that there is projected a six-month slippage in the loading schedule but do not feel that it will affect the building trades with regard to their providing the necessary skill craft in accord with our verbal contact with them. The only real difference we find is about a 9% change with regard to the population of carpenters, both floaters and commuters.

In general, we would hope that the labor market impact within the area could be influenced positively if we were able to locate a skill center in the area to allow area unemployed residents to be trained or retrained for high impact skilled trades.

Public Health Effects

There is no doubt that SRC-I will have highly desirable effects on the state's economic development. We feel, however, that there is a real need to voice concern about the health implications of the project.

We have kept in mind that the development of environmental, health, and safety information is one of the stated objectives of DOE's coal liquefication program, and that the proposed plant at the Newman, Kentucky site is one of a series of steps designed to gather that information. In this regard it is comforting to note that the SRC-I model plant at Fort Lewis, Washington had been operational for the past 5 years without documented process induced worker morbidity or mortality; but even at the demonstration level, the Newman plant will be much larger and therefore will compound and magnify the known as well as the unknown hazards and risks adherent in the process. Furthermore, latency periods for chemically induced pathologies are frequently far in excess of 5 years.

The health implications of the SRC-I project outlined in the EIS are complex and distressing. The liquefaction process will produce many known toxic, carcinogenic, teratogenic and mutagenic compounds including highly dangerous aromatic polynuclear hydrocarbons. However, the report indicates that the qualitative and quantitative

compositions of SRC products and wastes will fluctuate with changes in coal feedstock and process conditions making it impossible to predict the specific compounds and exact concentrations of such compounds that will be present in products, intermediate streams, wastes, and occupational environments. (It is disquieting to note that environmental quality standards and emission limitations do not yet exist for most of the classes of compounds that are of concern.) The workers will also be exposed to a number of other hazards including thermal accidents, explosions, and coal dust.

There are also significant community health hazards and risks associated with the proposed SRC-I plant operations. Although it is being designed to minimize atmospheric particulate and gaseous emissions, to treat and recycle waste water, and to dispose of solid wastes without contaminating groundwater, the potential for major upsets in the system with direct or indirect exposure of the public to process materials will always be present. In addition to the relatively innocuous solid product, heavy and light fuel oils will be produced in large volumes and shipped in railroad tank cars to Pittsburg, Pennsylvania and Lake Charles, Louisiana with the possibility of accidents and spills accompanied by fire, air pollution, and water pollution risks any place along the routes.

The EIS is replete with engineering controls and mitigation procedures. However, many of them are described in very general terms, as must be the case because of the experimental nature of the project and lack of knowledge about the process variables at the proposed expanded level of operation.

Other public health implications of the SRC-I project relate to the influx of large numbers of construction workers (up to 3,500 at peak) and attendant stresses on housing, transportation, and services including medical services. These problems will be further compounded when all of the planned synfuel and power plant projects are under construction in the region. Mobile home park development and new housing construction will result in more septic tank and lateral field installations in areas characterized by marginal to poor soil, and increased vehicular traffic - including coal trucks - which will increase the number of accidents and create dust problems with an impact on people who live in areas far removed from the plant locations.

Additional Mitigation Measures Needed

We wish to request that the following additional information or procedures be provided, developed, and identified in the EIS for public health purposes:

1. A selection of representative, sentinel compounds that can be easily detected in air and water, and which will call attention to insidious leaks in the system and trigger appropriate investigation and control procedures.

2. An alarm system which will result in immediate notification of appropriate local, regional, and state officials and agencies should an emergency arise.

3. A system to collect and store human tissues and materials from the food chain in the area for future analysis and comparison purposes when more knowledge is gathered on the metabolites of process related chemicals and their biologic effects.

In Addition, the Department is continuing its dialogue with the Kentucky Department of Energy Officials on the development of a more effective system for collecting and analyzing mortality and morbidity data.

This has been a complicated response but we feel that the issue demands considerable scrutiny on the part of all public officials and agencies. Please let us know if we can provide additional detail.

Sincerely,

W. Grady Stumbo

Dr. W. Grady Stumbo, Secretary
Department for Human Resources

cc: William Sturgill

JACKIE SWIGART
SECRETARY

JOHN Y. BROWN, JR.
GOVERNOR

COMMONWEALTH OF KENTUCKY
DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION
OFFICE OF THE SECRETARY
FRANKFORT KENTUCKY 40601
TELEPHONE 502 564 3350

March 2, 1981

Mr. James A. Reafsnyder
Research and Development Manager
SRC Projects Office
U.S. Department of Energy
P.O. Box E
Oak Ridge, Tennessee 37830

SUBJECT: Solvent Refined Coal I (Newman, Kentucky) - Draft Environmental Impact Statement

Dear Mr. Reafsnyder:

This Department, acting as the official state clearinghouse for state agency review of Environmental Impact Statements, hereby formally submits for your consideration comments on the Draft Environmental Impact Statement (DEIS) for the proposed Solvent Refined Coal (SRC-I) project in Newman, Kentucky.

These comments, in accordance with the National Environmental Policy Act and associated regulations, should be given appropriate consideration in the Final Environmental Impact Statement (FEIS) along with other public comments.

On behalf of the Commonwealth of Kentucky, I would like to thank you for the opportunity to comment on the SRC-I project, and hope that these comments will assist you in addressing the environmental issues concerning this project.

Sincerely,

Jackie Swigart
Secretary

JS:jq
Enclosures

cc: Jim King
William Sturgill

KDNREP1

Department for Natural Resources
and Environmental Protection's Comments
on the Draft Environmental Impact Statement
for SRC-I (Newman, Kentucky)

GENERAL

1. Cumulative Impacts

Although the DEIS does address the cumulative impacts of the SRC-I project and other proposed coal conversion facilities and coal-fired generating plants in the general area, it is the Department's position that some of the cumulative impact issues have not been adequately addressed. The Department is concerned about the impacts of this project and similar projects on the prime agricultural land resources and the agricultural economic base of Kentucky (See Section 4.2.1.1). The proposed project is located in the western section of Daviess County where the largest percentage of the county's prime agricultural land is located, and 90% of the proposed site is covered by prime soils. Continual conversion and loss of the agricultural land base is affecting the Commonwealth's capacity to produce food and fiber for future needs. Loss of prime agricultural land results in marginal land being brought into production. These marginal lands generally have steeper slopes, higher erosion hazards, equipment limitations, and other limiting factors for agriculture, and utilization of these lands for agriculture increases sediment and soil erosion, produces water quality degradation, increases conservation practice costs, increases energy input, decreases crop yields, and takes those marginal lands out of uses for which they are better suited.

Impacts related to support industries, such as coal mining, should be given further consideration in the FEIS. Although the DEIS indicates that mining impacts related to the project are expected to be minimal, this is a questionable conclusion. Also, the impacts of transporting coal and other goods to and from the sites should be considered.

Similarly, impacts on community-related utility services need additional evaluation. For example, no definitive consideration is given to the domestic water supply treatment and distribution system requirements necessary to support new residential development associated with project construction. Likewise, construction related impacts on necessary wastewater treatment facilities have not been adequately addressed in the DEIS. The FEIS should contain a more complete discussion of localized and cumulative fiscal, physical, and institutional infrastructive impacts associated with construction and operation of the SRC-I and related facilities.

The cumulative impact section conclusively reports that SRC-I would be relatively noncontributory to cumulative impacts because of its construction schedule. It should be noted that this schedule has already slipped due to many factors, including the six-week delay in publishing the DEIS. The schedule will also be altered by the financing arrangements for the project. Thus, the conclusive statement should be reconsidered.

The DEIS aptly points out the "potentially serious cumulative impact" of water consumption in the area. It notes that two synthetic fuel plants and two coal-fired generating plants alone could exceed 30% of the Green River's 7-day, 10-year low flow. This does not take into account the other area energy-development needs nor the competing agricultural, domestic and other industry demands. These factors

should be carefully weighed in the FEIS. While cumulative air quality impacts are acknowledged in the DEIS, the detail of this analysis is limited. As a point of information, note that the Department is cooperating with the Kentucky Department of Energy to perform air quality modeling in the area as part of a regional cumulative impact analysis. It is the Department's understanding that the Kentucky Department of Energy will hire a consultant to do the analysis based on available data. These results, if available, should be incorporated into the FEIS.

2. Environmental Health Impacts

The failure of the DEIS to include an explicit consideration of the short- and long-term local and regional environmental health impacts represents one of the single largest deficiencies in the environmental assessment document for the proposed facility. Instead of developing community health baselines for both the immediate impact area and the region and proposing long-term (10-year minimum) epidemiological studies to assess the effect of the proposed action on human health, the health maintenance strategy offered in the DEIS is limited to toxicological testing for acute animal response and biomedical/clinical studies for acute worker or occupational exposure. Utilization of this proposed approach completely eliminates the possibility of being able to quantitatively determine the health risks or effects (biological or economic) truly associated with the proposed action. The overall monitoring strategy for the project should be significantly expanded to provide for an epidemiological study that will define and clarify current local and regional health characteristics, analyze health effects, and eventually serve as part of the basis for helping to determine the environmental significance of the project in terms of both benefits and costs associated with maximizing local and regional societal and individual well-being.

WATER

1. Monitoring

The following additions to the proposed monitoring program are believed to be necessary to provide enough essential information for sound water quality decisions to be made: (1) In-plant biomonitoring for use during discharge should be incorporated into the treatment system proposal, and (2) biomonitoring should be incorporated into the long-term monitoring strategy for the facility so that sediment and tissue residue can be checked on a periodic basis. The FEIS should be revised to incorporate these proposals. The Department should be provided with all reports from ongoing and upcoming monitoring activities.

2. Flooding Impacts

The Department's Division of Water, in conjunction with the Corps of Engineers, Dames and Moore, and Rust Engineering, has determined that the Ohio River is the controlling surface watercourse at the site, and that it will cause the maximum flooding damage in the project area. While the DEIS reports that a hydraulic analysis was conducted for the Ohio River, the document does not indicate whether any site or project construction will occur in the Ohio River floodway. An additional map specifying the floodway limits and an explanation of whether the site will be inside or outside of the Ohio River floodway should, therefore, be included in the FEIS.

3. Water Availability

The DEIS mistakenly considers withdrawal and consumptive use impacts only if they represent a portion of the seven-day once in ten-year flow (7Q10). (The EIS reports that up to 30 percent of the 7Q10 may be consumed by energy production facilities in the area.) Unfortunately, this approach overlooks the environmental and cultural impacts on competing instream (e.g., navigation, aquatic biota, etc.) and offstream uses of consuming 3.6 mgd at demonstration scale project level.

Because both instream and offstream use impairment directly corresponds to low flow conditions, the 7Q10 must be considered as the critical flow Accordingly, water withdrawals will not be permitted if this flow level is reached at mile 19 on the Green River While an availability problem is not expected in association with pilot scale operation, the probability of a raw water supply problem occurring is greatly enhanced with operation of a commercial-size facility. To avoid adversely impacting any other existing beneficial use, an explicit study of instream and offstream flow impacts will be required prior to the development of a commercial scale capability and permitting initiation of start-up operations. The FEIS should specify that such a study will be conducted.

4. Spill Control and Emergency Response Impacts

The DEIS contains no Spill Prevention Control and Countermeasure (SPCC) plan and no detailed designs for any storage facilities. Instead, the document simply promises a rapid clean-up if a site spills occurs. Furthermore, the DEIS indicates that storage area spills will be drained into the facility's wastewater treatment plant, yet the DEIS does not address the impacts of such loadings on the plant's wastewater treatment system. Therefore, the DEIS does not provide enough information in this area to afford the Department an opportunity to determine either probable or possible impacts.

Because the facility is expected to produce 1,422 metric tons of liquid fuel each day and two coal feedstock shipments are expected by train each week, it is absolutely essential that a SPCC plan be prepared and provided for review as soon as possible. Without this information, a decision on the adequacy of spill control and response capabilities cannot be determined. This information should be prepared and included as an appendix to the FEIS.

5. Industrial Wastewater Treatment Impacts

Zero-discharge is the preferred wastewater treatment alternative for the facility. This alternative would result in the least damage to Green River water quality. Severe groundwater contamination from carcinogenic organic and heavy metals may, nevertheless, result unless considerable care is taken in landfilling all solids generated from the evaporative cooling system associated with the zero discharge option. In addition, the DEIS should be revised to explicitly address the build up of high salt concentrations caused by continuous recycling if the zero discharge alternative is selected. (The salt problem is not addressed in the DEIS.)

The use of chromate or phosphate as a corrosion inhibitor in the cooling system should be avoided unless the adverse effect of these constituents on biological treatment units can be negated. Also, high dissolved solids concentrations in the cooling water should be avoided by ion exchange or osmosis.

Regardless of the alternative ultimately selected for wastewater treatment, the FEIS should be revised and expanded to address the following specific points:

- While biological treatments should be able to remove most of the carcinogenic phenols, organics, and polynuclear aromatics (PNA), parallel biological treatment units should be provided to avoid the impact of severe shocks.

- Metal removal is proposed to be accomplished by using a two-stage precipitation unit (first stage at pH 11.0 and second stage at pH 8.5) with effluent fed to a biological unit via an equalization pond at a pH of 8.5. Since the best efficiency of the biological unit can be obtained at a pH range of 6.5 to 7.5, pH adjustment must occur before any effluent enters the biological system.

- Because even a slight upset in the production process will produce very high levels of phenol in the effluent, every attempt should be made to reduce phenol concentrations by adding powdered activated carbon in the equalization pond. High phenol concentrations resulting from process upset were not addressed in the DEIS.

- Any NPDES permit for the SRC-I facility should include effluent limit controls for PNA, organic, and trace element releases resulting from occasional accidental or chance malfunctions.

- Disinfection should be by ozonation, rather than chlorination, with the effluent passed through a final pH adjustment to obtain neutral pH conditions.

- The presence of nitrogenous compounds is not addressed in the DEIS. Incorporation of a dependable method of nitrate and nitrogenous compound removal (e.g., biological degradation) should be required in the FEIS.

- The DEIS suggests that nearly all sulphur and ammonia will be removed. Actual coal conversion process performance records indicate that complete sulphur/ammonia removal is impossible because of the presence of organics and metals. The FEIS should discuss the problem and provide an effective solution.

- The DEIS indicates that during a failure of any system in the wastewater treatment unit, the untreated or partially treated wastewater will be discharged directly to the Green River. This is totally unacceptable. Adequate and secure on-site storage should be provided to contain the wastewater until full treatment can resume. This alternative should be specified in the FEIS.

- The FEIS must contain a much more detailed discussion of diffuser design (Figure C.6) and its capability of achieving essentially complete mixing.

6. Pollutant Discharge Impacts

The DEIS contains a number of deficiencies in regard to pollutant discharge impacts on receiving waters, including:

- The DEIS contains insufficient ecological, pnysiochemical, and toxicological information on whicn to reach conclusions about probable discharge impacts. Furthermore, the preponderence of this information will not be fully available until after the demonstration facility begins operation. Therefore, the Department reserves the right to make decisions on the discharge impacts of the proposed project until the information that is necessary becomes available.

- If insufficient discharge mixing results under 7Q10 conditions, the project sponsor must apply to have a mixing zone established under Kentucky's water quality standards. In that event, only up to one-half of the 7Q10 may be allowed for wastewater dilution.

- The biological monitoring data referenced in the 1977 Environmental Report, Appendix H, is only referenced; it is not provided for review. This report should be made available for review and comment prior to finalizing the EIS.

7. Miscellaneous Specific Comments

In addition to the preceding general comments, the following specific revisions should be made:

- Page 3-17 (3.2.2.3) Green River:

  Kentucky does not designate stream uses for food processing and industrial use.

- Page 3-17 and Tables H.1 and 4 7:

  It needs to be stressed that the mainstem of Green River and all other tributaries in the project area fall under the jurisdiction of Kentucky's Water Quality Standards and not ORSANCO's standards or EPA's Redbook limits.

- Table 4.7: BOD_5:

  Minimum allowable treatment of secondary level assumes a maximum BOD of 30 mg/l and not 40 mg/l as reported.

- Page 3-19:

  Recent physiochemical data does not support the statement that Pond River is a low pH stream. The DEIS and any decisions based on this misinformation should be revised accordingly.

- Page 3-26, Paragraph 4:

  Tissue residues were measured for organic and inorganics cpds, but mercury levels were excluded or not reported in the table on residue analysis. This information should be added in the FEIS. Recommendations for expanded baseline biological monitoring to be covered in FEIS include:

  1. That Zn, Hg, Cu levels be determined in fish tissue (whole body).

  2. Mussel tissue should be analyzed for organic and inorganic residues due to the sessile nature and long-life history of these organisms. This should be done upstream as a baseline for determining the efficiency of the proposed treatment plant.

  3. Macroinvertibrates should be measured for organic and inorganic residue due to their increased abilities to bioaccumulate many of these cpds in ranges up to 10,000 times.

- Section 4.6.6 (page 4-140):

  The FEIS must contain more information on the design and efficiency of the water withdrawal intake screens. The screens should be designed to reduce or prevent potential impingement of larval fishes.

- Section 4.2.2.4:

  Site plans that incorporate during the construction phase BMPs to reduce the impact of suspended materials on the aquatic system should be prepared, and the BMP designs should be implemented.

AIR

1. Since the Selexol unit has large sulfur emissions, alternative control methods should be considered in the FEIS (See Section C.3.1.1).

2. Since the soda ash scrubber presents a solid waste problem and has a venturi with large energy requirements, alternative control methods should be considered in the FEIS (See Section C.3.1.1).

3. In Table C.5 (pg. C-41) the proposed efficiencies for flanges, and valves in heavy liquid service are too low and should be increased.

4. Since the plant produces sulfur, why is an external source of H_2SO_4 required? (pg C-42)

5. If the oil/water seperator is enclosed to prevent fugitive NMHC emissions, how will the buildup of explosive levels of NMHC be prevented? (pg C-42)

6. The impact of heavy non-methane hydrocarbon emissions may exceed the ambient allowable - one hour average. Page S-10 gives the total hydrocarbon ambient impact as 42 ug/m^3. Assuming 25 percent of this to be heavy NMHC (See Page C-42) then the impact would be 10.5 ug/m^3 = (42 x 0.25). Kentucky does not have an ambient standard for heavy NMHC, and, therefore, uses an adjusted TLV calculated according to the following formula:

   Ambient allowable - one hour average (A) = (TLV ÷ 168 hr/wk of operation)

   For heavy NMHC, a TLV of 0.2 mg/m^3 for coal tar pitch volatiles was used (see page 4-8).

   A = (0.2 mg/m^3 ÷ 10) (40 ÷ 168 hr/wk) = 4.8 ug/m^3

   Therefore, the projected impact (10.5 ug/m^3) exceeds the guideline (4.8 ug/m^3) by more than a factor of two. The FEIS should reevaluate the impact of these emissions to include an analysis of the expected NMHC emissions from the coal dryer, and fugitive emissions resulting from leaking valves, pump seals, flanges, cooling systems, and waste water treatment.

7. The air emissions from waste treatment processes including dewatering, aeration, biological treatment, cementation, etc. should be identified in the FEIS.

8. In the NO_x calculations for boilers having over 100 mmbtu/hr of heat input, was the emission factor for power plant boilers used as recommended in AP-42, Table 1.4-1, footnote i?

9. In Table C.9 on page C-51, the emissions from the equivalent power plant with Flue Gas Desulfurization appear excessive. Emission calculations should be presented in the FEIS.

10. Tables C.11 and C.12, and Figure C.14 contain information on sulphur emissions during startup and shutdown which is inconsistent with the PSD application (Tables 4.5.4 and 4.5.5, and Figure 4.5.1). Table 4.16 contains information which is inconsistent with the PSD application (Table 10-6). These inconsistencies need to be reconciled.

11. What are the modelled ambient impacts (including flaring) for startup, shutdown, and emergencies for all pollutants including NMHC? How do the modelled impacts compare with the ambient standards, the PSD increments, and the adjusted TLV of question 6, above? Is vegetation damage possible?

12. Page 2-12 states that refractory organics are present in the waste water treatment system. Where else are refractory organics present in the SRC-I process? How will they affect combustion processes, such as startup, shutdown, emergency flaring, the controlled combustor, etc? What are the hazards?

13. Do the plant's emissions of SO_2, H_2S, and CO comply with the Process Gas Stream Regulation 401 KAR 59:105?

14. What is the basis of the assumed 100% efficiencies of control for the inspection and maintenance of those pieces of equipment listed in Table C.5 as having 100% efficiency?

15. What are the results of the cooling tower drift deposition modeling discussed in Appendix 5.4?

16. Although the DEIS addresses PSD applicability, supporting information in the form of a PSD application which demonstrates PSD compliance is deficient.

17. In addition, it is the Department's opinion that a number of the comments which were made on the preliminary DEIS concerning air quality issues have not been dealt with adequately in the DEIS. Therefore, for the record, those comments are repeated here and should be addressed in the FEIS.

    - The Department has the responsibility under KRS 224.033 to provide for the control of emissions of potentially hazardous matter and toxic substances. Evaluations of facilities with the potential to emit substances that may be harmful to the health and welfare of humans, animals and plants will be made on an individual basis by the Department (see 401 KAR 63:020). The description of occupational and health effects provided in the DEIS is inadequate for the Department's evaluation purposes as it provides little meaningful data upon which to understand the health risks associated with the project.

      Information is needed on the toxicity and other hazards of the compounds to be emitted from the plant during both normal operations and upset conditions. An analysis of the individual hazards of the hundreds of minor compounds is not required at

this time, and compounds may be grouped into larger classes, e.g., phenols, benzene, heterocyclic sulfur, etc., with those compounds of major health concern identified. For each emission stream, the estimated concentration of the major classes should be provided along with an exposure assessment, i.e., the concentration of the toxic materials of concern in time and place at its interface with the target populations (occupational and surrounding populace). If insufficient data is available, a range should be provided using best available estimates.

It is suggested that the expected emission levels be compared with those found in petroleum refineries, coke ovens or other facilities with similar emissions to provide some perspective on the relative hazards associated with plant operation. Potential health effects should be described and safe exposure limits (both acute short term and trace long term) should be provided so that a risk assessment can be determined. Ambient monitoring in the plant and the surrounding area should be conducted for those compound classes found to be of major concern and/or "indicator" compounds to ensure maximum protection of public health.

The notice to prepare a DEIS for the project (see Federal Register, Vol. 44, No. 196, October 9, 1979), states that the "exposure of the public to noise and odor will be included in the EIS." Discussion of these two topics is insufficient. The plant will produce several gaseous emissions that will create odors, e.g., H_2S, NH_3, NMHC. Odorous emissions should be calculated and modeled to assure that they do not exceed odor threshold levels, Kentucky's secondary standard for H_2S of 14 ug/m^3 - one hour average, or the ambient odor standard of seven dilutions.

The noise sampling sites are not specifically located. Are any residences located closer to the facility site than the sites measured? What was the sampling time associated with the measurements recorded? It is unclear as to the cause of the high background ambient noise level for the Sauer Lane sites since it appears that the other sites which are closer to the impact range of surface transportation have lower values. Clarification is needed.

Two major sources of noise include steam blowout and the railroad marshalling area. The FEIS should provide a description of their location, expected occurrence frequency, and predicted noise levels.

The predicted noise levels should include the effectiveness of the proposed muffler system for the steam blowout and the frequency of occurrence should include any night-time operations. Also, is this operation related only to the construction phase or will this occur when the plant is in operation? A description of railroad marshalling activities should include the plans for unloading coal from railcars.

- A design description should be included for the controlled combustor (including the amount of combustion air, residence time, temperature, and turbulence) and for the flare (including height, amount of combustion air, completeness of combustion, flame characteristics, and opacity). What are the expected emissions of particulate, NMHC, PNA, CO, NO_x, H_2S, SO_2, and other sulfur compounds? Provide estimates of the frequency and duration of flaring. Document that flares (in combination with the other plant emissions) will not violate the ambient standards, PSD increments, the odor standards, or opacity standards (see 401 KAR 63:015, Flares). What flared substances will fall out on the ground (such as pulverized coal and NMHC liquids) and what will be the temperature on impact? How far away will the flare cause noticeable night-time illumination?

- What are the expected emissions (type and rates) from the following sources: cooling tower (particularly chromates), wastewater treatment facilities (e.g., H_2S, NH_3, NMHC) and the calciner?

- What are the emissions from the coal dryer, including NMHC, and sulfur compounds released as the pulverized coal is dried?

SOLID AND HAZARDOUS WASTE

1. Seven wastes are listed in the DEIS as being hazardous (Page C-32). Therefore, this facility will be required to register with the US EPA and this Department as a hazardous waste generator. Also, since hazardous wastes will be stored and disposed of on the site, a storage permit and a disposal permit will be required. A special waste permit will be required for the raw water treatment sludge. All solid wastes generated by coal burning facilities are subject to regulation if they are either listed as a hazardous waste, mixed with a hazardous waste or exhibit any of the characteristics of a hazardous waste (40 CFR 261.3). Such wastes might include metal cleaning waste, boiler blowdown, and listed commercial products (40 CFR 261.33 E and F) that are discarded.

2. The proposed hazardous waste landfill site is on the border between earthquake zones #2 and 3. Since zone 3 is a high risk area, it is the Department's position that hazardous waste should not be landfilled unless it can be persuasively demonstrated that the design will provide adequate groundwater protection in the event of an earthquake. The FEIS and permit applications should address this problem in more detail and assess feasible alternatives to landfilling (See Section C.2.3.2).

2. The proposed ash pond landfills (Figure D.1) will be below the 100-year flood level. The FEIS and permit applications should identify how the base of the ash pond landfill will be protected from the 100-year flood or other alternatives (such as dikes) will be applied to protect the landfill from a 100-year flood.

LAND RESOURCES

1. From 1967 to 1977 Daviess County lost 3,000 acres and Henderson County lost 1,900 acres of prime farmland. While the DEIS points out that the project site is only a small portion (0.3%) of the total prime farmland in Daviess County, this is only a small portion of the actual impact which this project will have on the conversion of agricultural land in Daviess and surrounding counties. The FEIS should more definitively address agricultural land impacts associated with the power-line right-of-way to the project, possible widening or improvement of U.S. 60, and other direct impacts associated with the project and add these costs to the total annual value of agricultural production that would be forfeited.

2. In addition to the direct impacts on prime agricultural land associated with this project, there will be considerable indirect impacts in conjunction with associated housing, highway, commercial, and other development. This project is likely to cause growth in those areas which have the largest percentage of prime farmland, western section of Daviess County. One indirect effect that can be expected has been identified by the National Agricultural Lands Study as the "impermanence syndrome" which results in rising land values as population increases, farm subdivision, and eventual conversion to nonagricultural uses. The final impact of this project could be the total loss of some of the most productive agricultural land in Kentucky.

3. Protecting or retaining prime agricultural land should be a more important factor in site selection (See Section 2.3.2.1). Agricultural land and prime agricultural land constitutes more of the proposed site than the alternative sites. In addition, indirect effects on agricultural land are not adequately considered in the site selection process.

4. Soil erosion control measures should be further identified in the FEIS. In addition, the Department's Division of Conservation should be provided the opportunity to comment on the Construction Environmental Management Plan which should describe in detail the potential for erosion and sedimentation problems associated with the project and control measures.

5. The FEIS should specify that the clearing, construction, reclamation, and maintenance of the transmission line right-of-way will follow the suggested guidelines of the U.S. Department of Agriculture/ Department of Interior contained in the publication: Environmental Criteria for Electric Transmission Systems.

JOHN Y. BROWN, JR.
GOVERNOR

COMMONWEALTH
OF KENTUCKY

Office of the Governor
FRANKFORT, KENTUCKY 40601

February 10, 1981

Mr. James A. Reafsnyder
Research and Development Manager
SRC I Project Office
U.S. Department of Energy
Post Office Box E
Oak Ridge, Tennessee 37830

Dear Mr. Reafsnyder:

I have examined the draft environmental impact statement (DEIS) recently published by the U.S. Department of Energy (DOE) on the solvent refined coal demonstration project (SRC-I) proposed for construction in Newman, Kentucky. I have particularly studied those sections which may require Kentucky's cooperation and assistance.

One primary concern expressed in the DEIS concerns possible adverse impacts on local transportation associated with construction and operation of the project. I recognize that the present highway system, and in particular U.S. 60, would be inadequate to handle anticipated traffic once the project begins, and I recognize that unless the road system is improved, or other measures adopted, a favorable decision for the construction of the SRC-I plant may be in doubt. Since I regard the construction of the plant as being both in the national and local interest, I am committed to taking whatever action is required by the State of Kentucky to remedy any transportation obstacles.

I have noted that there are several alternatives for resolving the local traffic problem. These include transporting workers by rail, by bus, or by car pooling and making various highway improvements. I assume that DOE has not yet decided which of the mitigating measures will be used. If DOE should decide that the only practical solution to the transportation problem is the improvement of the highways, by one or more of the methods outlined in the DEIS, DOE may rest assured that the State of Kentucky will provide in timely fashion the funds or other support for the needed road improvements. We reserve, of course, the right to seek assistance from the federal government for improvements to a national highway such as U.S. 60.

In all events, I wish to assure you again that the State of Kentucky supports the SRC-I program, and will cooperate to the fullest extent.

Sincerely,

John Y. Brown. Jr.
Governor

Frank R. Metts
Secretary, Department of Transportation

2/23/81

MAR 0 2 [illegible] Monday 23

14

Sec.

As an active volunteer in my community, the wife of an attorney, and mother of two small children, I would like to register my concern about the construction of the Newman plant in Daviess County, Kentucky. I feel the impact, particularly the environmental impact, is far greater than many in our community realize.

Setting March 2 as the cut-off period for comment is certainly not allowing enough time for area residents to discuss the lengthy Environmental Impact Statement. Please reconsider this date.

Thank you.

Sincerely,

Lucas G. Craig

P.S. - Let me go on record as opposing construction of the plant and its detrimental effects on Owensboro.

CITY OF EVANSVILLE
CIVIC CENTER P.O. BOX 3836
EVANSVILLE, INDIANA 47737
(812) 426 5000

OFFICE OF THE MAYOR
MICHAEL D. VANDEVEER

15

March 3, 1981 MAR 9 0 RECD

Mr. James A. Reafsnyder
Research and Development Manager
SRC-1 Project Office
U.S. Department of Energy
P.O. Box E
Oak Ridge, Tennessee 37830

Dear Mr. Reafsnyder:

Please consider the contents of this letter as part of the public comment document on the preliminary Environmental Impact Statement of the SRC-1 Project. The following comments direct themselves to possible socio-economic impacts of the proposed SRC-1 Project.

The City of Evansville has thus far concluded that:

I.) More attention should be give to various socio-economic impacts of the proposed plants. Areas needing further attention include: a) behavioral science information, b) predictive case studies and c) evaluative case studies.

The Draft Environmental Impact Statement presents an unclear picture in regard socio-economic impacts of the proposed plant.

II.) The need exists for the Department of Energy to make public any data available concerning Socio-Economic Impact Assessment Models as they relate to either Henderson, Kentucky or/and Evansville, Indiana.

The City of Evansville is engaging in its own Socio-Economic Impact Assessment model based on Purdue University's Purdue Energy Model. This modeling will greatly increase our awareness of possible affects of the proposed SRC-1 plant in the Evansville SMSA.

III.) The City of Evansville has elected to proceed with caution on the proposed SRC-1 plant as it relates to socio-economic impacts. We have, however, expressed our concern that certain health-related questions be answered before approval of the plant is given. These questions currently are part of the public testimony.

The City of Evansville is researching all possible available resources on possible impacts.

We will continue to be in contact with your office regarding the above concerns.

Thank you for your attention to our situation.

Very truly yours,

Christopher Weaver
Administrative Assistant
to the Mayor

CW:pm

FEB 2 6 1981

16

WILLIAM J. FROEHLICH
COUNTY JUDGE EXECUTIVE

COUNTY OF DAVIESS
COURTHOUSE
OWENSBORO, KENTUCKY 42301

COMMISSIONERS
JAMES L. FINLEY - West
PAULINE A. [illegible] - East
ROY STOOPS - Central

February 23, 1981

Mr. James A. Reafsnyder
Research and Development Manager
SRC Projects Office
U.S. Department of Energy
SRC-I Public Hearing
P. O. Box E
Oak Ridge, TN 37830

Dear Mr. Reafsnyder:

The United States Department of Energy's Environmental Impact Statement on the Solvent Refined Coal (SRC) plant in Newman, Kentucky, includes a great deal of comprehensive information about the possible effects of air pollution caused by operation of the plant.

This Impact Statement includes a section which discusses predicted effects of emissions on vegetation in the area. The Statement concludes indicate that the air contaminent levels resulting from operation of the demonstration facility will be well below levels which are currently known to cause damage to crops.

Tobacco, grain crops, and pasture grasses, plants which grow throughout the area, are known to be sensitive to air pollution. Production of these crops, as well as others, are of primary importance to farmers in Western Kentucky.

We were pleased to read in the Draft Impact Statement that a comprehensive monitoring program has begun and will be continued throughout the operation of the SRC-I plant, and that special attention will be paid to sensitive vegetation such as tobacco and grain crops. We urge you to follow through with the plan to closely monitor crops and other vegetation in the area for visable signs of air pollution stress and for any changes in species abundance.

We must determine conclusively the impact of the SRC-I plant on crops near the plant site while the demonstration plant is operating. If the need for further pollution control is determined, appropriate steps must be taken.

The monitoring program discussed in the Draft Impact Statement appears to be an ambitious one. We have been told that a detailed monitoring plan based on this outline is about to be published. As representatives of agricultural interests in this area, we wish to suggest the following for inclusion in the detailed monitoring plan:

First, the program should pay special attention to crop productivity and should outline plans to study long-and short-term productivity effects on area crops. Second, the detailed plan package should be reviewed by appropriate state and county agricultural concerns.

By taking an active part in the review and approval of the monitoring program, we can be confident that our interests will be protected, beyond the general assurance in the Environmental Impact Statement.

Thank you for your consideration of this matter.

Sincerely,

Bill Froehlich

William J. Froehlich
County Judge/Executive

David Warren
County Commissioner

Roy Stoops
County Commissioner

Ronnie Wells
County Commissioner

WF/DW/RS/RW:mp

WILLIAM J. FROEHLICH
COUNTY JUDGE/EXECUTIVE

COUNTY OF DAVIESS
COURTHOUSE
OWENSBORO, KENTUCKY 42301

COMMISSIONERS

February 27, 1981

Mr. James A. Reafsnyder
Research and Development Manager
SRC Projects Office
U.S. Department of Energy
SRC-I Public Hearing
P. O. Box E
Oak Ridge, TN 37830

Dear Mr. Reafsnyder:

The Daviess County Fiscal Court sent a letter (copy attached) to you for consideration and placement in the final EIS on February 23. Our Citizens Advisory Committee has recommended that the Statement, attached, be included as an amendment to the above mentioned letter.

The amended statement is endorsed by the Daviess County Fiscal Court and your consideration in this matter is greatly appreciated.

Sincerely,

Richard I. Lewis
Administrative Assistant

RIL:mp

Enc: 2

William J. Froehlich
County Judge/Executive
Daviess County Fiscal Court

WILLIAM J. FROEHLICH
COUNTY JUDGE/EXECUTIVE

COUNTY OF DAVIESS
COURTHOUSE
OWENSBORO, KENTUCKY 42301

COMMISSIONERS

Amendment to February 23, 1981 letter:

Even though the Environmental Impact Statement has gone into detail about environmental safety, we are keenly aware of the potential for adverse health effects to the citizens of Daviess County that may arise in the areas of air, water, solid waste and hazardous material due to the construction and operation of the proposed SRC-I plant at Newman. We feel that all pertinent to date data, including the Fort Lewis and Wilsonville plant operational data, should be transmitted to the Fiscal Court for review by this body.

Environmental Policy Institute
317 Pennsylvania Ave. S.E. Washington, D.C. 20003
202/544-2600

Statement of 17

The Environmental Policy Institute

on

The Draft Environmental Impact Statement

For

The SRC I Demonstration Project

Submitted to

The U.S. Department of Energy

March 2, 1981

The Environmental Policy Institute is a research and citizen information organization, dedicated to the conservation of our natural resources. At EPI there are currently several projects underway which involve the assessment of energy production technologies and the investigation of new and alternative methods of energy development. We are currently involved in an assessment of synthetic fuel technologies, and welcome the opportunity to comment on the Draft Environmental Impact Statement (DEFS) for the SRC I Demonstration Project. We believe that it is particularly important that the first plants selected for development in the new industry must employ the safest and most efficient technologies and controls available.

Our assessment of the DEIS leads us to conclude that there is no guarantee that the SRC I project will pursue such a course of development. In fact, it is difficult to glean much specific information at all from the statement. The DEIS is presented without final plant designs, with only "highly conceptual" emissions data, and with many relevant environmental, health and safety studies far from completion. Such a document clearly fails to meet the directive of the National Environmental Policy Act that an EIS provide a detailed description of the proposed project, and "... provide full and fair discussion of significant environmental impacts...." It is our belief that a great many questions remain with respect to plant design, operation and impact. The following comments are intended to help identify

some of the areas in which the DEIS is particularly weak.

SRC I Process

The DEIS does not justify the need to develop a process whose primary product is a solid fuel. In fact, in a discussion of alternatives, the DEIS presents a rather confused description of the purposes of the SRC I process. In discussing the need for the program, the DEIS accurately identifies our energy crisis as primarily a liquid fuels problem (although it would have been even more accurate to identify the shortage of transportation fuels as the crux of the problem). The alternatives examined are those designed to affect oil imports. It is here where the uncertainty arises. First of all, the DEIS fails to identify, much less discuss, an expanded energy conservation program as a feasible alternative to the coal liquefaction program, even though it had earlier identified energy conservation as "an immediate and cost effective way to deal with the energy problem." More importantly however, this program justification and the subsequent examination of alternatives imply that the SRC I process will provide mainly liquid fuels. This is not the case. As the DEIS points out:

> The primary product, which is a liquid at process temperature, is a high-heating-value, low-sulfur, low-ash fuel product that may be directly substituted for oil or coal in certain applications. Three products will be produced in the proposed demonstration facility: solid SRC I boiler fuel, anode grade coke, and a hydrogenated liquid boiler fuel. Each of the products will account for approximately one-third of the total.

Thus, two-thirds of the product will be a solid, and not all of the liquid fuel will be able to be upgraded to transportation fuel. Consequently, the little liquid which will be displaced will be No. 2 and No. 6 fuel oils,

and not the more strategically important transportation fuel.

If the purpose of the project is to reduce our dependence on foreign oil, one is led to doubt that the SRC I process is an effective or efficient technology to employ. If the purpose is to develop a clean burning solid fuel, the SRC I process should be compared to processes which use coal in combination with control technologies.

The DEIS also states:

> The production rates of solids and liquids can be varied from as much as 85% solids with 15% liquids to as little as 10% solids with 90% liquids all involving minimal wasteful gas production.

Presumably, the higher liquid yield is to make the process more attractive. The DEIS should describe what changes, if any, in the technology, process, resource requirements or environmental impacts would result from a shift in the product mix. Also, as the process is shifted to yield more liquid, the DEIS should explain how the SRC I process remains different from the SRC II process.

This question takes on great importance in light of the fact that the Department of Energy (DOE) is planning simultaneously to construct an SRC II demonstration plant in Morgantown, West Virginia. Both the SRC I and the SRC II processes were tested in a single facility at Ft. Lewis, Washington. Given these facts, why isn't it possible to again use one plant to demonstrate the technologies?

Project Size

The DEIS also fails to justify the construction of such a large scale

plant (6000 TPD). This is 120 times the size of the largest SRC plant now in operation (50 TPD, at Ft. Lewis, Washington). There is no discussion of constructing a smaller sized plant, even though both the contractor (ICRC) and the Kentucky DOE advocated the construction of a 2000 TPD plant. In fact, in its original proposal to the DOE, Wheelabrator Clean Fuel Corporation stated that a 2000 TPD plant

> has been selected as the largest size for which commercially available equipment can be practically employed, yet is sufficiently large to permit extrapolation to full commercial size with reasonable technical confidence.

A smaller scale reactor would reduce the cost of the project, decrease procurement time and, according to the contractor, still provide the information needed to make a decision on commercialization. Thus, it is incumbent upon the DEIS to explain why it is necessary to bear added financial expense, and environmental and technological risk involved with a 6000 TPD plant when there is no compelling reason to construct such a large plant.

Selection of the Newman, Kentucky Site

The controversy over the selection of Newman, Kentucky as the site for the project is only heightened after reading the DEIS. The document notes that the site was the most suitable based upon a 1976 study conducted by Rust Engineering Company. However, this study only applied criteria judged to be important for construction and operation of the plant--physical, economic and engineering. Environmental compatibility was not included in the criteria. Furthermore, sites included in the study were confined to Kentucky.

A subsequent study, placing primary emphasis on environmental criteria, was conducted by the Oak Ridge National Laboratory (ORNL). Yet, if the environmental criteria used to eliminate alternative sites in the Oak Ridge study were applied to the Newman site, it would be unacceptable according to all seven criteria. One wonders, then, what standards have been used to justify the environmental acceptability of the Newman site?

Moreover, the development of the SRC I plant at the Newman Site will encroach on an active floodplain and have an impact on wetlands at the site. Therefore, it is necessary, under Executive Orders 11988 and 11990 to determine if other sites would offer a practical alternative to reducing the floodplain/wetlands effects caused by development of the Newman site.

Unfortunately, the preliminary determination included in the DEIS only contains a 3 paragraph discussion of the practicability of alternative sites. While the report notes that "the extensive screening process produced no potential site that complies with basic siting constraints, is environmentally acceptable and does not require encroachment on a floodplain," it does not show the results of the study, nor does it offer a relative comparison of the alternative sites to the Newman site.

Furthermore, there apparently is some consideration being given to downsizing the plant to 3000 TPD. If the plant size is reduced, we contend that it will be necessary to conduct a completely new comprehensive review and analysis of the feasibility of alternative sites to comply with the NEPA mandate to examine alternatives, and to fulfill the requirements of Executive Orders 11988 and 11990.

Monitoring

The DEIS points out that a substantial portion of the monitoring program will be devoted to demonstrating compliance with existing standards. Much less attention is given by the DEIS to monitoring emissions of currently unregulated substances. The DEIS indicates that the DOE will develop a monitoring program. However, since the program is not yet developed, and the DOE has not identified which substances will be subjected to monitoring, it is impossible to comment on the adequacy of the proposed monitoring program, or to suggest improvements. Given the multitude of uncertainties surrounding the emissions associated with synthetic fuel technologies, the monitoring program should have been developed before issuance of the DEIS, and made available for public review and comment.

Design Uncertainty

The most troubling aspect of the DEIS is the admission that "only a conceptual SRC plant design exists at this time," and that "existing emissions data are highly conceptual." These conclusions cast doubt on the reliability of the DEIS's data, projections and proposed control technologies.

Yet, the reader is asked to disregard these disclaimers and accept the assurances regarding the reliability of critical control systems.

For example, project plans allow for a 10% discharge of treated water and hold out a zero discharge goal. Yet, no data is provided assessing the reliability of a 10% discharge system, much less one operating at a level of zero discharge.

The same is true for the reliability of the controlled combustor-flare system designed to control emissions.

More importantly, by failing to present a final plant design, reliability data and emission rates, the DEIS does not fulfill the NEPA mandate that an EIS

> ... serve as a means of assessing the environmental impact of a proposed agency action, rather than justifying decisions already made.
>
> ... and inform decisionmakers and the public of the reasonable alternatives which would avoid or minimize adverse impacts.

Emergency Planning

The DEIS does not contain contingency plans for a variety of emergencies which may occur and lead to serious health, safety or environmental problems.

No description is given for emergency preparedness for fires or explosions on the site. It is unclear whether crews on the site will be trained to handle such mishaps and whether there will be appropriate equipment on site to respond to the problem.

There is no discussion of what emergency controls are available, and what damage might result, if retaining walls fail and the liquid storage, SRC product storage, and coal storage areas and the ash ponds are all inundated by flood waters.

Similarly, there are no procedures established to deal with a breach in the landfill liners. According to the DEIS, "avoidance strategies" are being evaluated, but there seem to be no studies designed to address the problem should the event occur.

Conclusion

To summarize, we believe the following are among the issues which still need to be addressed:

- What is the justification for the development of a synthetic fuels process whose main product is a solid fuel?
- What will be the difference between the SRC I and the SRC II processes as the SRC I process is shifted to yield a higher ratio of liquid to solids?
- Why can't both processes be tested in one plant?
- Why is a 6000 TPD facility needed?
- Why can't a smaller (2000 TPD) facility yield all of the necessary information on the operation of a commercial-size facility?
- What environmental standards were used to justify the Newman, Kentucky site?
- What unregulated substances will be subjected to monitoring?
- How will DOE conduct its monitoring program?
- When will the monitoring program plans be available for review and comment?
- What is the reliability of the 10% discharge system?
- What is the reliability of the controlled combustor-flare system?
- What emergency plans exist to deal with fire and explosions on-site?
- What emergency controls are available for flooding of the site?
- What controls are in place to deal with a breach of the landfill liners?

Furthermore, if there is a significant change in the scale of the plant (e.g., downsizing to 3000 TPD), compliance with NEPA and Executive Orders 11988 and 11990 require a new and comprehensive site selection study.

We also believe that the DEIS is not adequate. An adequate DEIS can only be produced when more information is available on the final plant design and emission data, and the environmental, health and safety studies currently in preparation for the plant are completed.

Submitted by:

Robert L. Roach
Environmental Policy
Institute
March 2, 1981

18

Enviromental Protection Agency
City of Evansville
20? Administration Building
Civic Center Complex
Evansville, IN 47708

James A. Reafsnyder
Research and Development Manager
SRC Projects Office
U.S' Department of Energy
SRC-I Public Hearing
P.O. Box E
Oak Ridge, TN 37830

Dear Mr. Reafsnyder:

The following document is presented in response to the Draft EIS on the SRC-I Demonstration Project in Newman, Kentucky. The questions, comments and concerns were prepared by the Synfuels Fact-Finding Committee, representing the Evansville Enviromental Protection Agency.

Pleaseforward any response to the following:

J. Shelton, Director
Evansville Enviromental Protection Agency

Thank you.

Sue Atkinson

Oral Testimony
February 24, 1981, Henderson, Ky.

I am Sue Atkinson, Chairman of the Synfuels Fact-Finding Committee, Representing the Advisory Board of the Evansville Enviromental Protectia Agency, Evansville, Indiana.

This committee has been designated by Mayor Vandeveer as the official agent representing the City of Evansville to provide public comment on the SRC-I Draft EIS, and these questions and comments are the City's expressed concerns directed toward the protection of the enviroment and health of the citizens of Evansville, Indiana. After careful and thorough review of the Draft EIS we wish to provide the following testimony:

Our written comments and questions to be submitted are too lengthy to be presented fully at this time. However, a brief summary of the areas of concern addressed are as follows:

AIR QUALITY - Our concerns clearly are: That though Evansville lies directly in the path of the southeasterly winds - which occur 27% of the time; no mention is made of the Federal Agency that will be responsible for air quality impacts on the Indiana side of the Ohio River;

THAT THOUGH it is well known that a significant part of the SRC-L product becomes contaminated with carcinogenic and mutogenic material, present Federal air quality laws do not address generic carcinogen emissions;

THAT THOUGH it is admitted that fugitive HC emissions predictions are conservative, nevertheless inadequate monitoring procedures and maintenance schedules are presented with which to catain and/or quantify this factor.

THAT THOUGH the wastewater treatment is designed to operate at 90% efficiency, the possibility of phenolics being emitted to the air from the cooling towers is not adequately addressed; providing the possibility that what is not directed into tje Green River may be emitted into the air.

WATER QUALITY

Our concerns in this area include:
The Designations of the waste water treatment plant as a zero discharge system when in fact volatile compounds may be evaporated into the air as well as discharged in the Green River.

The Treatilbility of the water is still in question, and the 2-stage biological treatment process is still under development making a determination uncertain at this time. The disposal provision for potential toxic material solid waste is inadequately answered in relation to flooding and potential earthquake levels.

Health effects are the concern of all; and the timetables, and all prospective epidemiologic studies need to be identified at the outset. The EIS suggests that this identification of enviromental and health risks is a major purpose of the SRC-I demonstration plant, yet expansion to full-scale commercialization may be considered within two years.

In conjunction withthese concerns for testingand the lack of studies directly related to the health effects of SRC-I, is the factor of the cumulative effects, not only of 4 or 5 synfuel plants but the 4 - 5 cool powered generating plants in the area. All of this is inadequately addressed.

In terms of regulator responsibilities: The areas of greatest concern continue to be the inadequacy of present Federal Laws; the unknown requirements for best available control technology; the unproven reliability of modeling and monitoring techniques; the inexact mechanisms for cooperation between USEPA regions; the degree of commitment to permit schedules as described; and the designation as lead agency of the DOE; which also has the mechanism for providing funding for the project.

Here, then, are just a few of the many concerns, and unanswered questions we perceived and identified in the draft EIS as prepared for the Newman project. We feel that these exact areas of concern will be identified by other groups and individuals to much the same extent as we have presented them. These comments, questions and concerns should be comprehensively addressed and answered before any construction begins on the SRC-L project.

Thank you for allowing the City of Evansville to offer this testimony.

Air Quality Comments and Questions
on Draft EIS
SRC-I Demonstration Project
Newman, Kentucky
DOE/EIS-0073-D/VI

Given the fact that the wind direction at the plant site is out of the south to southeast 27% of the time (p. 3-29) and Evansville lies in this direction, the potential for air pollution impacts to our community is significant. It should be noted that more than 100,000 Indiana residents live within 30 miles of this proposed plant. In addition, it is well known that a significant part of the SRC-I product becomes contaminated with carcinogenic and mutagenic material (p. ix). This can be viewed as a consequence of the structure of coal and is in marked difference to that of crude oil. Unfortunately, federal air quality laws do not address generic carcinogen emissions. These facts lead to a great deal of concern by members of this committee. Specifically, we wish answers to the following questions:

1) What federal agency will be responsible for evaluating the air quality impacts to be expected on the Indiana side of the Ohio River? If it is the Enviromental Protection Agency, will Region V in Chicago participate in the review of this EIS?

2) The experimental nature of the process and emission controls has been stressed throughout the draft EIS. For example:

   a) "Existing emissions data are highly conceptual". (p. 1-34)

   b)"...fugitive emissions present the greatest uncertainty..." (p. 1-34)

   c) "Although current and projected enviromental quality standards and emissions limitations require application of state-of-the-art pollution control techniques, standards and limitations do not yet exist for most of the classes of compounds that are of concern". (p. 4-2)

What procedures will be done to monitor the concentration of fugitive emissions that contain hazardous compounds? Perhaps modelling suggests no impact should be expected in Indiana, but the highly toxic nature of the chemicals involved suggests the prudence of ongoing experimental measurements to check calculations. Monitoring for these compounds is not generally performed and requires a significant commitment of time and money. In addition, the very demanding enviroment of the processsor (high temperatures and elevated pressures) might rapidly age seals and other control devices. Will early enthusiastic work on maintenance give way to less rigid inspections after a few years?

3) A major purpose of the demonstration plant will be to evaluate health and environmental risks. "One of the purposes of the SRC-I demonstration program is to identify health and environmental risks associated with the demonstration plant itself and a future commercial SRC industry" (p. XV). The long induction time often associated with cancer agents should be kept in mind. Will the decision to expand to commercial size be made before an accurate assessment of the demonstration plant's health impacts can be made? According to the EIS, this decision may be made in only two years.

4) Will data collected by all parties be promptly verified and released so that municipalities and individuals can judge whether living in the area constitutes an acceptable risk? Reports published years after the fact would not sufficiently serve our interests.

5) It appears that treated waste water will be used in the cooling towers (p. xii). If the treatment is less efficient in degrading the hazardous chemicals than expected, this would create a significant potential for widely dispersing a variety of toxic agents.

6) Since the demonstration plant is expected to consume about 70% of the 24-hour PSD increment for TSP (p. 2-25), what effect will this have on Evansville's TSP problem (currently designated non-attainment for secondary standard) and future PSD-related development? In addition, the EIS cites the particulate emissions as "a significant limitation to commercialization" (p. 2-26) and "suggests that the fugitive emission rate from the commercial plant would have to be less than the rate from the demonstration plant if the plant is to consume less than 100% of the allowable PSD increment" (p.2-25). If expansion does occur, again, what will this mean for Evansville?

7) With regard to the commercialization limitations associated with TSP, the EIS states "there are no nearby sources to offset except for particulates generated during agricultural activities" and further suggests that the purchase of land for the cessation of agricultural activity could be an offset (p. 2-25). How much land would be required for this? If this is a serious consideration, shouldn't the impacts of such action be discussed?

8) The EIS states that with respect to cumulative effects, air quality impacts "will add slightly to problems of non-attainment of TSP standards in the cities" (p. 4-101). Does this include Evansville?If so, what mitigation measures are proposed? In accordance with section 126 of the Clean Air Act Amendments of 1977, would this put Kentucky in violation of their State Implementation Plan if proper notice of opportunity to object is not offered to Evansville's air quality control region?

9) In light of the recent indictment of the Ohio Valley by EPS and the Ohio River Basin Energy Study with regard to acid rain shouldn't any additional source of acidic sulfate formation in rainwater, as described on page 4-49, be further studied and projected? Also, is in-depth monitoring of the occurrence of this phenomenon during operation of the demonstration facility and its relationship to the SRC plant being considered? If not, shouldn't it be?

AIR QUALITY
HC EMISSIONS

INTRODUCTION: The following discussion will address the various hydrocarbon emissions and their controls pertaining to the proposed SRC-I Project and the possible effects on the City of Evansville.

Hydrocarbon emissions from the SRC-I project will consist of point source emissions and fugitive type emissions. Point source emissions are those that originate from smoke stacks, elevated flares, and the controlled combustor. Point source emissions are more easily quantified than those emissions coming from fugitive type sources. Fugitive type emissions originate from leaky valves, pipe fittings, pumps, compressors, and also from storage tank breathing losses. Due to the nature of the fugitive emissions, they are difficult to quantify. Table C.9 on page C-51 of the Newman Draft EIS gives the point source hydrocarbon emissions as being seven tons per year. The total fugitive hydrocarbon emissions are given as 1.77 g/s in table C.7 on page C-50. If the value of 1.77 g/s is projected over a years time, the value would be equivalent to 61.5 tons of HC per year. Therefore, the total plant HC emissions would be approximately 68.5 tons of HC per year. The Draft EIS states that the 1.77 g/s figure is a conservative estimate of the fugitive HC emissions. The estimates used for the emission inventory in sect. C.4 of Appendix C are based on the Wetherold, Provost, and Smith report entitled "Assessment of Atmospheric Emissions from Petroleum Refining". This report is based on emission measuring activities at 13 petroleum refineries throughout the United States, many of which are not controlled as thoroughly as will be done at the proposed demonstration plant. Therefore the estimated emissions are conservative. Section 4.2.3.1 on page 4-47 states that the air quality impacts from plant operations will not threaten the nonattainment status of areas nearby.

The reasons given for the low emission projections from this plant are due to the types of hydrocarbon control techniques utilized in the SRC-I plant design. Most of the liquid storage tanks will be equipped with fixed roofs and any vapors will be sent to a vapor-recovery system and thus not be emitted into the atmosphere. The other storage tanks will be equipped with floating type roofs, with the vapors purged from the space between double seals and combusted in a flare system. Fugitive hydrocarbons will be minimized by providing double mechanical seals (with a varrier-fluid system between the seals) on pumps and compressors, or by use of a system of an equivalent control nature. Use of flanged connections will be minimized to also reduce emissions. Also, thorough inspection, maintenance, and repair programs for process fittings will be implemented at the plant during operation to check the fugitive emissions. Leaky valves will be red tagged and repaired within 15 days after found to be leaking. A flare system will be designed to combust gases that are sent to it during normal operation, as well as during startup, shutdown, and emergencies. The system presently being evaluated will contain elevated flares, handling streams of different pressure ranges, and a controlled combustor (incinerator) to combust liquids that condense from the vapor streams sent to the elevated flares. The aim of the design is to combust all heavy hydrocarbons (which may be toxic and/or carcinogenic) in the controlled combustor. The controlled combustor can be designed for complete combustion of the feed by operating with high-temperature combustion and long residence times. It can be fed at controlled rates from a liquid holding tank.

CONCLUSION:

Provided that all engineered control systems function adequately the hydrocarbon emissions may well be low as predicted during normal operation. The projects fugitive HC emissions will vary significantly depending on the type of maintenance system employed. Inspections of thousands of valves will have to be conducted regularly if leaks are to be maintained at the predicted low levels. If the fugitive HC emissions are significantly higher than predicted, then problems maintaining air quality standards may be expected. Any significant addition of hydrocarbons emissions into the Evansville air shed may adversely affect the ambient ozone levels. Care must be taken in order to mitigate these fugitive emissions or else problems maintaining the air quality standards for ozone may be expected.

Also the possibility of phenolics being emitted from the cooling tower could be a problem. The phenolics are reported to be present in the treated wastewater which will be directed into the cooling towers at a rate of 608 gallons per minute. If this treated wastewater were directed into the Green River it would cause borderline compliance with the water quality standards. By directing this treated wastewater into the cooling towers the process will only be redirecting these phenolics into the air instead of directly into the river Further treatment of the wastewater to remove the organics should be performed or alternative methods of disposing of the treated wastewater should be used in order to mitigate the release of the phenolics and any other volitile organic compounds from the cooling towers.

WATER QUALITY

1. This plant is designed to operate 90% of the time as a zero discharge system of treated waste water. In this operation the treated waste water is used as make-up water for the evaporative cooling tower. It would thus appear that many volatile compounds in the treated waste water will be evaporated off into the atmosphere and may later condense on to the surface. Similarly, non volatile waste water pollutants will be carried out by the drift of small droplets of water and will eventually wash into the river. Thus, the plant is not truly operating in a zero discharge system but is merely indirectly discharging the treated waste water into the river by way of the atmosphere.

2. In the appendix sec. C 2.1.2 it is stated that laboratory programs are currently under way to determine the treatability of the waste water. If thetreatability of the water is in question, how can one predict what waste water pollutant levels will exist at the time of operation?

3. In the two stage biological treatment process, bacteria are to be used to degrade phenols, organic and some inorganics. Is this a proven process and can bacteria live at the concentrations of organics and inorganics that will be present in this system?

4. What provisions will be made to prevent flooding of the coal and solid product storage areas?

HEALTH EFFECTS

General Comments

Will people in Evansville/Vand. Co. become ill as a result of a synfuels plant development in the area? This question is not addressed or even raised in the DEIS document. The 53 pages of Appendix Z are entitled "Health Effects" but say nothing about human disease. Most of the Appendix consists of columns of x'es indicating which materials will be tested in which systems by which laboratories. We can thus learn that naptha, coal dust, gassifier fly ash, green coke, and heavy oils will be instilled into rabbits' eyes to see if they cause irritation.

There is no mention of what specific parameters of human health will be measured either in the workers or the surrounding general population. There is no mention of measuring human levels of toxins emitted by the plant--serum, hair, urine or fat samples to indicate human body burdens of organic and trace metal constituents before and after plant operation. There is no mention of periodic pulmonary function tests.

Prospective epidemiologic studies need to be planned from the outset - perhaps comparing plant employees with matched control groups; prospective studies of elementary school children before and after plant operations would be appropriate. Fertility rates could be examined: the epidemiologic information in local cancer registries should be exploited.

Specific Comments

1. p. 4-2 para 4 Admits that because of "conceptual plant design" and process and feedstock variability, occupational and public health consequences of plant operations can not be predicted.
2. p. 4-2 para 5 Institute W. Va. experienced skin cancer rates 16 to 37 times higher than expected, and not five times higher as stated.
3. p. 4-2 para 6 The industrial hygene program is expected to be much better than prior programs but the details seem no different than those at Institute, W. Va.
4. p. 4-3 para 3 Although hydrocarbons are known to be poorly absorbed orally, the 3 fractions have only been tested for oral toxicity and have not been tested for dermal and inhalation carcinogenesis, which are the major health problems anticipated with PAH.
5. p. 4-4 para 7 "The high pressure used in thses processes ensure some leakage of these materials (PAH)as aerosols"(pg. 4-7 para 5). Possible leaks of high boiling point hydroearbons which have the greatest carcinogenic potential will be detected by "monitoring equipment and visual inspection" What kind of equipment, how often? Is "visual inspection" of all the pertinent equipment pipes, valves, flanges, areial coolers sensitive enough, reliable enough to detect leaks - - is it even possible?
6. Appendix C p. 41 "Leaking flanges will be repaired within 15 days when possible" . This is inadequate where leakage of carcinogens is concerned.
7. How will volatilization and aerosolization of hydrocarbons and trace minerals from the cooling towers be monitored?
8. Legionella pneumophilia the bacterium which causes a severe form of epidemic pneumonia (Legionnaire's disease) has been recovered from the water of cooling towers and evaporative coolers and disease outbreaks have been associated with contaminated air systems. There are no provisions for bacteriologic monitoring or disinfection of the cooling tower water.
9. Toxic solid wastes will be put into a landfill with a clay liner and a leeachate collection system. What potential effects may occur with this process?
10. p. 4-5 para 6 "It is believed that public health impacts resulting from leaching of biologically active organic compounds will be minimal (Appendixes C and P).. There is no information about the organic constituents of leechates from coal, slag, fly dust or SRC product in the appendices - - therefore, no data to support that "belief".

On the other hand DOE/HHS/EPA publication 0-5 MTR-79W 15902 "Health Effects of Coal Technologies" p. 84 states "There is considerable evidence that coal refuse dumps will continue to produce significant quantities of water-borne contaminants for many years after their disposal".

11. p. 4-7 Fugitive particulates are said to be transported only a "short distance". This is vague - - how short is short - - with the proper winds, couldn't some light particulates (in the respirable range and coated with condensed hydrocarbons)be blown to Evansville and Newburgh?
12. p. 4-7 "Engineering controls ... will be designed with the intent of limiting concentrations of fugitive hydrocarbons to within the permissible exposure limits -- (Pel) for coal. tar pitch colatiles in all process areas". Are the limits appropriate for the SRC process stream (re are the heavy distillates not more mutagenic/carcinogenic?)
13. p. 4-8 "Exposure to fugitive hydrocarbons transported away from the plant site will not have a significant health impact because concentrations in the immediate plant area will be held to a low level." See prior comments--Site and frequency of ambient monitoring are not specified except to say that complex hydrocarbons "will be monitored at points where air dispersion modeling predicts greatest exposure for the surrounding public". I would like some monitoring in Evansville/Vand. Co. even if the models don't predict "greatest exposure": models can creash.
14. p. 4-22 "Failure of the leachate containment system beneath the coal storage area should it occur could result in saturation of underlying soils with contaminants that could endanger ground water quality or limit future soil use." In this regard it should be noted that the coal storage will be in an area of high seismic activity (p.L-11 boundary of zone 2 and zone 3) and within the 100 year flood plain area. The clay liners risk being floated up, cracked or broached. It should also be noted that only a 30 day back up of supply of coal is planned. 90 days supply is a more customary back up -- this would triple the amount of stored coal (Approximately 540,000 tons) increase the leechate and further stress the waste water treatment system.
15. Estimates of "worst-case" transportation spill assumes a spill of one tank car at Spotsville, Ky. which would cause water supply emergencies for Evansville, Henderson, and Nashville. If there were a train derailment more than one car might spill into the river -- multiplying the long and short term adverse effects.
16. Although transportation spills are dealt with at length, plant site spills are given rather short shrift. At Fort Lewis, W Wash. the 20,000 gallon spill which occured when a workman failed to turn off a sampling valve threatened local water supply, necessitated soil removal down to 20 feet, pumping of aquifers and cost almost half a million dollars.
17. p. 4-37 p. 4-43 The frequency of discharge of wastewater into the Green River is said to be 10% in several places in the EIS (90% zero-waste water discharge) but apparently is unknowable "the reliability of the wastewater recycling system is uncertain".
18. Most of the effluent going into the Green River will have a high potential for bio-accumulation, synergystic effects and possible biomagnifications. These compounds include aluminum and lead as well as organic compounds potentially toxic to man.

PERMITS

Although the DOE has designation as lead agency, with US-EPA assuming the cooperating agency position, co-authorship of the DEIS was agreed upon and presumed.

Question:
Why was this understanding not formalized; to give US-EPA a stronger position in addressing its concerns and assuring the full consideration of their concerns? Without a formal assurance of co-authorship, can equal jurisdiction be assured?

PERMIT SCHEDULE

Question:

Has application been made by the following:

			Approval Required	Approval Scheduled
1.	US-EPS	-PSD Permit?	1/81	11/80
2.	KY_DNR-EP	-Air Contaminant Source Construction Permit?	1/81	11/80
		Floodway Construction Permit?	4/81	12/80
3.	US-COE	Section 10 and 404e permits Barge Dock?	6/81	1/81
		Water Intake Structure?	6/81	1/81

Will DOE and EPA require a firm commitment to the permit schedule before any construction is allowed?

EVANSVILLE-VANDERBURGH COUNTY DEPARTMENT OF HEALTH
ROOM 127, ADMINISTRATION BUILDING
CIVIC CENTER COMPLEX
EVANSVILLE, INDIANA 47708

February 9, 1981

James A. Reafsnyder
Research & Development Manager
SRC Projects Office
U. S. Dept. of Energy
SRC-1 Public Hearing
P. O. Box E
Oak Ridge, IN 37830

Dear Sir:

The Evansville-Vanderburgh County Board of Health, at its regular meeting on Friday, January 30, 1981, passed the following resolution:

> The Evansville-Vanderburgh County Board of Health views with great concern the proposed concentration of a number of large synfuel plants close to Evansville. We request that all parties concerned, governmental and private, delay the construction of such plants until it can be determined that these synfuel plants will not pose a significant public health hazard to Evansville and Vanderburgh County.

This information is being forwarded to you and other officials concerned with the environmental health conditions existing in southern Indiana.

I would appreciate it very much if you would consider supporting the above resolution.

Yours very truly,

Jane M. Hoopes, M. D.
Health Officer

vms

Owensboro, Kentucky
FEB 2 [illegible] Feb. 25, 1981

20

Dear Mr. Riepenhoff,

I am writing in regards to the proposed Newman, Ky. synthetic fuels plant and all the other synthetic coal conversion plants proposed within a 40-mile radius of Owensboro, Ky. We don't want them and we don't need them!!

We don't approve of the government condemning prime farmland (private property) to turn it over to a private corporation.

We are not willing to risk our health and the health of our children by having them exposed to even small amounts of cancer-causing materials.

Since the taxpayers may be liable, we are not willing to pay for the cost of clean-up of any spills, leaks, or accidents likely to occur!

With inflation rampant, we do not want our tax dollars to pay for a plant that may or may not work.

We cannot afford to compromise our air, water, agriculture and HEALTH for momentary moneymaking guesswork. Synthetic plants probably will be bumped for a technology more advanced employing conservation rather than destruction, abuse, contamination of air, land, people.

FEB 2 7

MAR 0 3

A-56

21

COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

SOLVENT REFINED COAL-1

DEMONSTRATION PROJECT

NEWMAN, KENTUCKY

Submitted by

L. T. Grannan, Jr.

In behalf of

The Audubon Coalition

Daviess County Audubon Society

Evansville Audubon Society

Henderson Audubon Society

Henderson, Kentucky

February 24, 1981

INTRODUCTION

It is beyond the scope of myself as an individual and a representative of the Audubon Coalition to cover all aspects of the Newman, Kentucky SRC-1 Plant discussed in the Draft Environmental Impact Statement. Therefore, I have elected to add my comments on a specific topic of interest to comments made by others associated with Audubon and other concerned organizations.

Specifically, I am concerned with the effects SRC-1 will have on aquatic ecology. As part of my study of the aquatic environment, I have included some questions which may overlap into areas of terrestrial ecology, wildlife habitat, and wastestream engineering especially wastewater retention ponds, fly-ash ponds, and surge ponds.

Many questions have arisen in my mind that I feel should be addressed in the Final Environmental Impact Statement. The following is, very probably, only a few of the questions that need to be intensely discussed and studies before SRC-1 is allowed to be built here in Western Kentucky or anywhere else. With all the unknowns and uncertainties presented in the text of the DEIS, it is my feeling that more time should be spent in a comprehensive study and perhaps an increase in scale of the Fort Lewis, Washington SRC-1 plant.

It is stated in the Draft Environmental Impact Statement for the Newman, Kentucky SRC-1 plant that in the event of spillage of SRC-1 products into the Ohio or Green Rivers, the short term effects of the combination of many dissolved contaminants would be acutely toxic. Phenolic compounds (such as phenol, cresols, and xylenols), basic compounds (such as aromatic amines), and the small amounts of hydrocarbons which would dissolve, would all contribute to the toxicity and would cause massive mortality killing many or most of the aquatic organisms in the immediate spill area. As the contaminated slug of water moved downstream, the concentration of pollutants would be reduced by dilution, uptake by organisms, and adsorption to sediments. Hydrocarbons would also decline in concentration due to volatilization and phytolysis.

Downstream from the zone of massive mortality would be a zone of selective mortality in which the more sensitive species would be killed. Further downstream, organisms would suffer sublethal effects of contamination rather than outright mortality (such as decreased reproductivity and/or mutagenic reactions). As the contaminated slug moved downstream, the decline of contaminants would depend on many unknown factors. Therefore, the size of the above zones of impacts cannot be estimated.

The above statement makes one realize that a spill of any magnitude of SRC-1 product into any body of water would be disastrous! Not only would there be an enormous biological organism kill but what of spilled SRC-1 liquid contaminating municipal water supplies along the pathway of the contaminated slug? What will be the problems occurring as a result of biological contamination of a river due to the deaths of tremendous numbers of aquatic, terrestrial and avian organisms? Would the deaths of these individuals result in a prolonged shutdown of municipal water systems? Would it be up to the taxpayers of the region to absorb the cost involved should there be a shutdown of a city's water supply? Who would be responsible for the massive cleanup and the costs entailed in the event of such a spill? These are only a few of the unanswered questions involved in making the SRC-1 process safe for the aquatic environment. These questions only cover the short term health effects!

On the long term scale, the DEIS continues:

> "Long term impacts would result largely from the less soluble compounds in the SRC-1 product. Close to the spill site, the gross contamination would cause significant aesthetic damage. Oil covered water and shoreline could cause limited mortality to birds and other riparian organisms. (What is considered to be "limited mortality"? That statement comes across as very vague.) Substantial quantities of spilled produce would be mixed with gravel, sediment, and other debris in the river. Contaminants mixed with substrate could pose a long term hazard as toxic compounds leached out. Contaminants adsorbed on fine sediment and organic detritus could be transported downstream thus allowing dispersion of low solubility PNA." (Polynuclear aromatics)

It is further stated that these polynuclear aromatics are not likely to enter solution in sufficient quantities to be extremely toxic but they are susceptible to bioaccumulation and bioconcentration. Some PNA's are considered carcinogenic and just by their presence become serious contaminants in downstream ecosystems, effecting bait fish and feeder populations, sport fish populations, birds, animals and finally man. The latter mentioned could become quite susceptible to bioaccumulation and bioconcentration.

> "There are so many unknown factors affecting the distribution of these organic contaminants in aquatic ecosystems, it is not possible to estimate the severity of these impacts."

How can a project of such immense proportions be given the go-ahead if in case of contamination of a riparian ecosystem it is not possible to estimate the severity of these impacts regarding spills of SRC-1 produce?

It would seem also that implementation of the emergency procedures listed in Section D.D.-6 of the OEIS would be so time consuming that the liquid would have had time to pollute the aquatic environment of the Green and Ohio Rivers for several miles downstream before clean-up was initiated. In that time most water soluble items and volatile organics would have dispersed into the ecosystem. With the preceding scenario in mind what definitive containment and clean-up methods would be inaugurated? No specific implementation methods are given in the text of the DEIS only vague generical terms. It even states that the methods that are mentioned are not feasible except physical removal, which leaves time for major damage to the environment to be done before a spill can be contained. It seems a spill is considered only incidental when the standard fine for such a spill, no matter what the magnitude, is only $5,000.00.

With the discussion of the facts, or premises, as to what would happen in the event of an SRC-1 liquid spill we shall proceed to other questions to be answered before a toxic spill would occur. What is the present state of the Green River, itself, and what can be projected to happen should SRC-1 become a reality?

The Green River is, at this time, classified by the Commonwealth of Kentucky as a multiple use river including public use, food preparation, warm-water habitat for aquatic life, recreation, and industry. The main stem of the Green River falls under jurisdiction of water quality standards formulated by the state.

Being mindful of the above, it is noted that surface water quality in the Green River is not at all as desirable as it should be due to several point and nonpoint source pollution problems including municipal and domestic sewage effluents, industrial discharges from manufacturing

and processing, sediment, runoff from agricultural and animal husbandry practices, and mining and oil production wastes. Heavy sediment loads, coupled with continual barge traffic have produced severe turbidity in the river. The potential impacts of increased sediment and turbidity to aquatic organisms are several-fold. Increased sedimentation may modify or destroy benthic habitat, thereby reducing or eliminating food available for fish. In addition, increased sedimentation may disturb fish spawning habitat and affect the viability of fish eggs and larvae. Similar water quality perturbations may result from floodplain excavation and shoreline dredging and excavation operations. The removal of riparian vegetation creates bank instability with increased erosion and loss of cover for fish. Sedimentation basins should be used to contain construction runoff. Erosion control facilities such as dams, seeding and mulching should be employed to reduce erosion.

The increased volume of barge traffic near the plant site can only be expected to result in increased disturbances of bottom sediments. Recreational potential especially fishing will be lost as increased barge traffic will discourage boaters and fisherman.

Water sampling and monitoring data conducted from 1977 through 1979 characterize some of the already high chemical constituents of the river. Concentrations of some chemicals were often higher than recommended. The river contained levels of iron, manganese, and lead that would be considered unacceptably high for domestic water supplies. Manganese was present in levels twice that recommended for secondary regulations. Selenium was in excess of the recommended concentrations. Mercury and cadmium were also present in concentrations exceeding the criterion for the protection of aquatic life.

We should pay particular attention to the fact that accumulation of heavy metals and other contaminants may lead to chronic low-level effects, particularly among sediment and suspension feeding animals. Phenol and a cyanide levels in the Green River have exceeded the Environmental Protection Agency water quality criteria formulated for the same usage category.

No PNA compounds were detected in the water samples although two PNA compounds, dibenzothiophene and flouranthene were detected in Martin Creek. There was one incidence of benzo (a) anthracene in samples of river bottom.

Even tissue samples from representative Green River fish were analyzed. PNA compounds were detected in both muscle and liver tissue. Tissue phenol levels approached concentrations high enough to cause tainting of flesh.

Considering the past several paragraphs, one wonders what could possibly be worse when already several concentrations of metals and organics exceed water quality standards. Fish in the river have already shown signs of bioaccumulation of PNA's within their bodies. What about concentration increases within the bodies of their predators, including man?

Although the SRC-1 plant is proposed to operate at a zero discharge mode 90% of the time, the probability of this cannot be predicted since the reliability of the recycling system in uncertain. Therefore, that leaves at least 36.5 days or more per year when the plan will operate in a processed water discharge mode. It is during this time, according to the OEIS, that water quality in the Green River will be severely degraded. Discharges of cadmium, chlorine chromium, phenol, and selenium would substantially degrade water quality and would require occasional shutdown

of the plant during low river flow periods to maintain water quality standards. The question here arises: What does D.O.E. consider as occasional plant shutdown? Would shutdown occur for one hour, one day; for what time period? Who will direct the shutdown? Under what criteria? Would it be safer toward the environment to shutdown the plant whenever zero discharge could not be reached? The plant is being designed to operate in a zero discharge mode -- what problems would be encountered in moving plans from 90% zero discharge to 100% zero discharge? Is D.O.E. leaving themselves an "out" if, in fact, a zero discharge mode is non-attainable? Another pertinent question to be asked is when is this 10% discharge to be in effect. When the river is at flood stage? At low flow? The dilution capabilities of the river at and between these two extremes is quite great and could result in severe degradation of water quality if the 10% discharge occurs more often at low flow.

According to the DEIS, a worst case scenario would cause violations of water quality standards for cyanide and chlorine. Because of the potential toxicity for humans and aquatic organisms, worst case discharge of cyanide, chlorine, phenol, and cadmium are considered a significant degradation of water quality. It states further that:

> "Although liquefaction facilities will be designed to meet existing effluent limitation standards it should be noted that the exact constituent makeup of the plant effluent streams is not known, some water quality deterioration will be unavoidable."

How then, is it possible to say that the liquefaction facilities will meet existing effluent limitation standards when the EPA, DOE, and the Commonwealth of Kentucky have not even developed effluent limitations for the plants? Since there are no effluent limitation standards but the contradictory statement is made that existing effluent limitation standards will be met, why does it allow that some water quality deterioration will

be unavoidable as though it will be acceptable?

It should be noted that the whole idea of the National Pollutant Discharge Elimination System (NPDES) permit is to prevent significant deterioration of water quality standards due to effluents released into a body of water.

Mention is made in the DEIS that chemical effluent entering the Green River will be monitored for:

> "bioaccumulation of process specific chemical entities with potential for adverse health effects as determined through ongoing research and established criteria."

What about non-process specific chemical combinations that could potentially be quite hazardous? Again, the exact chemical constituent makeup of effluent streams is not known at this time. In addition to the water quality constituents considered, wastewater from the SRC-1 facility will contain many organic compounds for which no criteria or standards have been established. With the preceeding statements is not one led to believe that since specific chemical constituents are not known, monitoring plans have not yet been established?

Continuing on in the DEIS:

> "In some cases, several of the components are of particular concern since the ambient levels of these components in the receiving water may exceed current criteria. If the surface water quality is to continue to improve, discharges must be kept to a minimum. (Here, minimum needs to be defined. What compounds will be present? Can the SRC-1 plant be built to meet existing criteria?).....discharge of cadmium, chlorine, chromium phenol, and selemium would substantially degrade water quality and could require occasional shutdown during low flow to maintain water quality standards."

Again, what should be considered occasional plant shutdown? It is not felt enough time has been spent studying the

possible problems and effects of zero discharge systems and effluent standards in order to come up with definitive statements to solve problems in those areas where substantial questions have arisen. Information regarding the impact of the demonstration plant on the Green River seems only, at this point, to be monitored so that performance and reliability of wastewater treatment and recycling systems will be established. Is this to be done at the expense of the quality of the Green River? The information and experience gathered is to provide a basis for the design of the commercial scale wastewater treatment system. Is it being admitted that a monitoring system disregarding the health of the Green River is to be put into effect so that at some future date when the plant is scaled up to commercial size the proper environmental controls will be implemented? Only then, if necessary, will back-up wastewater recycling systems be included in the design to ensure that no discharge occurs when river flows would provide insufficient dilution. Why not implement these plans into the present SRC-1 schematic? It would be more economical in the long run and much more beneficial for man and the environment! The phrase in the DEIS about river flows sometimes providing insufficient dilution, lends one to believe that at all flow levels the plant plans only to dilute possible contaminants as their major environmental control method. Is the plant to shutdown only when the river won't provide enough water for their proper dilution levels?

> "Under low flow conditions the mixing zone concentrations of chlorine, cyanide, lead, nickel, silver and

> vanadium may be toxic to sensitive organisms, but most organisms will be exposed for only a few minutes rather than the hours or days of exposure typically needed to produce mortality. Although a few organisms are likely to die because of the discharge, ecological degradation may still result."

Sublethal effects may occur including decreased reproduction. Such impacts cannot accurately be predicted, and monitoring of ecological effects is clearly needed.

Other problems associated with operations of SRC-1 affecting the Green River are the physical dilemmas of water intake and discharge structures. Impingement and entrainment of aquatic phytoplankton, zooplankton, ichthyoplankton, juvenile fish and adults of small fish species will be a hazard particularly during periods of low river flow. The maximum loss of aquatic organisms would require the simultaneous occurence of low flow conditions and maximum density of particularly vulnerable forms of ichthyoplankton. The most detrimental sequence of events would be the occurence of fish spawning followed by minimum flow conditions. Potentially 9.3% of the susceptible organisms could be killed by the commercial plants withdrawal. The possibility exists that water withdrawal for the SRC-1 facility, especially when commercialized, might stress biological productivity within the river.

Another stress point that is physical in nature is the fact that discharge water temperature, especially in winter, will create a small area of warmer water which would be very attractive to fish and other aquatic organisms. These fish could become adjusted to this artificially induced temperature increase and the sudden stoppage of discharge water decreasing the temperature to ambient levels would cause adverse biological

stress and possible lethal effects to the fish themselves. Also, if aquatic organisms are attracted to this area, they may be subjected to greater chemical stresses from potentially hazardous substances in the SRC-1 effluent. The statement that the cumulative water consumption for the SRC-1 commercial plant, the W.R. Grace synfuel plant and the D.B. Wilson and Paradise generating plants could exceed 30% of the Green River's 7-day, 10-year low flow is very alarming. This is especially so considering that the Ohio River Basin Commission has adopted 10% of the 7-day, 10-year low flow as the guideline for identifying potential adverse impacts from water consumption. The projected 30% withdrawal for commercial use was not treated responsibly in the DEIS. Essentially, this means that 30% of the aquatic biota would be removed daily and the withdrawn water would be "dead water" being devoid of life upon its discharge to the atmosphere, waste ponds or Green River. Once food sources are eliminated, fish populations can only follow.

Turning to site specific areas within the Newman SRC-1 Plant, it is noted there are a number of open ashponds, metal sludge landfills, oily wastewater basins, and surge ponds. All these "ponds" are to be lined with "impermeable" clay liners and synthetic liners to protect the surrounding ground area from leachate. Leachate that is collected within the system will be sent to a runoff retention pond. All of these ponds have the potential of being colonized by various aquatic life forms including zooplankton, phytoplankton, mollusks, crustaceans, insects, fish and amphibians. More than likely predatory forms of reptiles will migrate to these ponds as well. With such a repertoire of living organisms, these ponds

could become popular watering and feeding habitats for various aquatic, terrestrial, and avian predators. Considering the possibility of bioaccumulation and bioconcentration in these organisms, a great probability exists for environmental contamination especially if besides outright lethal effects, various sublethal effects could become evident such as decreased reproduction, mutagenic and teratogenic reactions to wildlife populations. The use of active disposal ponds by birds especially waterfowl, for resting and feeding can expose the birds to injection of particulate matter and toxic chemicals dissolved in the water. Birds attempting to use the ponds may also be exposed to the hazards of collision with transmission towers and lines if they are situated close to the ponds. The Illinois Natural History Survey has reported on studies carried out at a power plant in Illinois. Every fall from 1973-75, between 200 and 400 waterfowl were killed by collision with high-voltage transmission lines that cross a slag pit (Anderson 1976). Conclusive evidence was also obtained that waterfowl were ingesting slag (Anderson et al 1975). A total of 453 gizzards were examined, 66% of which contained slag. The material was found more consistently in gizzards of surface-feeding species than in gizzards of diving species with an average of 67% in mallards and 90% in widgeons.

A proposed electric transmission line route intersects Martin Creek and Richland Slough. The DOE is strongly urged to negotiate an alternate route with Big Rivers Electric Corporation to avoid these habitats.

The last item of concern has to do with the construction of the ashponds and liners themselves. According to the DEIS the bottom of the ashpond will be below the level of the

100 year floodplain. Although the "pond" will be protected from direct flooding by a 500 year floodplain dike, problems with the water table rise associated with flooding are likely to occur. The actual pond liner itself will be constructed of a one foot layer of gravel with perforated piping enclosed to collect leachate from the ashpond to be sent to retention ponds. Underneath this layer of gravel will be a three foot layer of impermeable clay. Even though classified by DOE to be impermeable, this layer of clay will allow some leachate through to come into contact with a 20 mil thick layer of plastic -- essentially a gigantic baggie. Beneath this baggie will be a 12 inch layer of sand and soil enclosing another perforated pvc pipe leachate detection system.

On the surface this liner system with its many layers and leachate collection and detection systems sounds very good. But let us look further into the system. Water table level increases will cause the ashpond with its synthetic liner to actually float due to immense water pressures from underneath thus subjecting the liner to tearing and subsequent failure. This problem is intensified when the water table again returns to normal and the ashpond liner settles into a new position. This alternate floating and settling of this ashpond could cause breaching in the liner at several points and as yet nothing has been said how this problem could be alleviated and repaired.

This area is also in a seismic zone rated number 3 being one of the worst in the entire country. Should there be an earthquake and soil liquefaction occurs, the failure of the liner would be imminent. What will protect surrounding

areas from leachate within the pond and how will ground water be protected from this invasion?

Another forseeable problem associated with the mechanics of liner construction is the actual composition of the synthetic liner itself. At this time, according to the DEIS, there is some question as to the compatibility of the clay and the synthetic liner with the leachate. Is there a potential for the liner to react with leachate resulting in failure or disintegration of either of the liners? What is going to protect the surrounding soil and ground water? These questions leave one with an uneasy feeling when the DEIS further states that:

> "Disposal of ash from the facilities and mining wastes could cover large areas of topsoil making these areas permanently useless for productive purposes. Leaching from disposal sites could also adversely affect soil productivity."

WILDLIFE ECOLOGY

As stated in the DEIS, the net effect will be a loss of wildlife habitat on and in areas adjacent to the site. Wildlife populations will decline from changing land use patterns due to land taken for the plant site, mining, waste disposal, roads, railroads and utility corridors. While this fact is stated in the DEIS, the general tone conveyed is that since the site is cropland and no significant habitat types exist, little real impact will be had on wildlife. This is the kind of mentality displayed by developers throughout recent history and has led to wholesale habitat destruction across the nation. Wildlife habitat is relative to land fertility and about 90% of the site is considered to be prime farmland. The statements regarding the fact that since most of the site has been

cleared of timber and is used for agricultural purposes it is of low quality wildlife habitat are somewhat misleading. Agricultural practices are a vital ingredient in managing many public and private wildlife management areas. Farming practices can be used to benefit selected wildlife species. The cropland on the site is currently plowed following harvest especially in years where dry weather conditions prevail. By merely prohibiting fall plowing or limiting to selected fields numerous wildlife species could benefit from the area. Concentrations of waterfowl can be found in the general area during periods of flooding and any available grain crops provide food for migratory birds.

The loss of wildlife habitat at the site especially floodplain forests will likely increase the demand for additional cropland and more clearing of timber for agricultural use in other areas. Impacts at the site could be lessened by wildlife plantings and fallowing selected areas. Trees and shrubs could be planted on the exterior of the facilities to serve as a buffer zone. Vegetation could help serve as a natural monitor of environmental conditions at the site. The Kentucky Department of Fish and Wildlife Resources should be contacted to provide technical assistance in lessening habitat destruction.

A main impact of construction of the barge docking facility will be additional habitat loss (2 acres) along the riverbank which will interfere with normal wildlife use patterns. The loss of habitat will force surviving wildlife to use a smaller area of habitat and thus lower its quality.

Although the Indiana Bat was described, other resident and migratory species at the site and in the immediate area were scarcely mentioned. The swamp rabbit is not mentioned in the DEIS although it is considered to be a threatened species by Kentucky Wildlife biologists. Floodplain encroachment of forested babitat is considered to have a damaging effect on swamp rabbit populations.

The impact of an increased noise level is expected to eliminate many resident species from occupying the site.

As stated in the DEIS, President Carter issued Executive Orders 11988-Floodplains Management and 11990-Protection of Wetlands. These were directivas to Federal agencies to avoid the use of floodplain and wetland resources as sites for Federal actions unless no practical alternatives were available and to minimize impacts where no alternatives exist. The siting of SRC-1 within the floodplain does not appear consistent with the objectives of these orders as they relate to preservation of wetland habitat.

The Fish and Wildlife Coordination Act stresses that all activities of the Federal government be coordinated with state fish and wildlife agencies. This act seems to have been neglected as only token contact with the Kentucky Department of Fish and Wildlife Resources is recorded in the DEIS. Little attention is paid to the fact that the state agency owns and manages a wildlife area directly across the Green River from the Newman site. The Department of Fish and Wildlife should have been contacted and included during the early planning and design stages of the project.

SUMMARY

It is felt that this document presented in behalf of the Federal Department of Energy and the International Coal Refining Company does not fulfill the basic requirements of a Draft Environmental Impact Statement. Much of what is said in the DEIS is very confusing, contradictory, and incomplete.

Plant designs are conceptual and control technologies are untested. Fail-safe mechanisms and mitigation measures have not been developed to protect the work force, the public, and the environment from the health risks associated with SRC-1.

In light of these factors, it is the opinion of the Audubon Coalition that more time should be spent compiling data at the 50 TPD facility at Fort Lewis, Washington and possibly expanding its operating capacity to at least 2000 TPD. The proposed SRC-1 plant should not be built in Newman, Kentucky or anywhere else until more is known about the SRC-1 process.

Ted Grannan
Co-Chairman Audubon Coalition
National Audubon Society
and other concerned individuals

February 28 1981

22

Dear Mr Roetsnjer—

Having attended the hearings on the DEIS for the Newman Co. synfuels plant I am more convinced than ever that this project is being pushed too quickly without leaving sufficient time to study the effects this plant will have on the Ky. I am particularly concerned about two issues: what effect the synfuel plant(s) will have on our air quality & how this effect (if any) will limit other industries from locating in this area. Many people of this area are also disturbed by the idea of using ~~the right of possession~~ eminent domain to procure land for what will eventually be a private use

You may count my vote against the synfuel plant at Newman until some of these questions can be answered satisfactorily

Sincerely

Kathleen Graney

Graney

Green River Area Development District
P. O. Box 628
Owensboro, Kentucky 42301
(502) 926-4433
(502) 826-5183

23

MAR 0 -

February 26, 1981

Mr. James A. Reafsnyder
Research and Development Manager
SRC Projects Office
U.S. Department of Energy
P.O. Box E
Oak Ridge, Tennessee 37830

Dear Mr. Reafsnyder:

My name is William L. Newman, Chairman, Green River Area Development District (GRADD), Owensboro, Kentucky.

I would appreciate the opportunity to comment on the Draft Environmental Impact Statement (DEIS) for the SRC-1 coal liquifaction demonstration project proposed at Newman, Daviess County, Kentucky.

It is the function of the GRADD to assist the local units of government in providing adequate public services for the existing and future growth in the district.

The GRADD Board of Directors does realize the economic benefits and badly needed new jobs this proposed plant could create in our district. However, adequate planning and necessary provisions should be carried out to minimize the adverse socioeconomic impacts in our cities and counties.

After careful review of the DEIS for SRC-1, the Executive Committee of the GRADD has approved the following comments for submission as a part of the DEIS review process.

General Comments:

1. The DEIS has failed to adequately address the cumulative socio-economic impacts resulting from the plant, as well as the impact on air quality, health and future industrial growth for the region.

2. Section 4.2.4 (Economic, Social, and Cultural Impacts) does not clearly project how the quality of life could be affected in the region during construction and operation of the demonstration and commercial phases.

3. The public finance impacts on page 4-78 are too general. The cost of the public services and the potential revenues for the cities and counties in GRADD needs to be identified in detail.

4. The potential socioeconomic impacts for the rural counties are treated as "not substantial." This is true on a regional basis. However, the impacts for a small rural county could be substantial due to lack of existing public services and the lack of financial capacity to mitigate these impacts.

5. The statement on page 4-95 and 4-96: "It is expected that as of July 1, 1981, this exemption will be expected to include coal plants, as well as other synfuel projects." is incorrect.

   There are no plans at present in the Kentucky General Assembly to expand the reduced tax provision on alcohol fuel plants to include synfuel plants.

Transportation Impacts: (pp. 4-80 through 4-91)

1. The existing estimated service volumes for sections of US 60 are not given, nor are the existing peak-hour traffic volumes estimated as a base of comparison to alternatives discussed.

2. Projected traffic origins and destinations are not provided for the project.

3. The source for a vehicle occupancy rate of 1.9 is not cited.

4. The DEIS should cite the number of vehicles over the US 60 service volume, as well as the delay time. Delay time is a poor measure of the extent of improvements required.

5. The DEIS does not address the alternative of a two-lane widening along entirety of US 60 (2-9' lanes to 2-11' lanes with 2' shoulders) for safety and operating improvement.

6. Sauer Lane will require widening and some new structures, if used as described in highway alternative #4 or #5.

7. The cost of KY 1554 interchange does not include the cost of widening the bridge over the Audubon Parkway to accommodate turning movement onto KY 1554.

8. The L&N Railroad train number 761 offers the potential for traffic conflict to the commuter rail alternative as 5:00 a.m. is a crew call time rather than a departure time.

9. The rail commuter alternative does not cite the current long delivery time required for rail passenger cars.

10. The rail alternative does not include overhead costs for system management, or profit, which a private operator would require.

11. The non-structural alternatives (i.e., split-shift/off-site fabrication, etc.) do not estimate the extent of impact, but rather indicate "less than the 'do nothing' alternative."

12. No transportation alternatives address energy consumption or air pollution.

13. The DEIS does not address the cumulative impact of mixing trucks for delivery of construction materials with construction traffic.

14. The DEIS does not address the impact of coal truck traffic on US 60 which should be part of the worst case analysis for the demonstration phase.

15. The DEIS does not address the potential dangers of chemical spills in conjunction with hazardous chemical transport.

16. No alternatives include the cost of funds used or debt service requirements.

17. Most alternatives do not include maintenance costs or increased accident frequency resulting from improvements.

18. The statement on 4-96 that "US 60 will probably have been expanded to four lanes and alternate access routes improved" is erroneous. No plans have been made or projects programmed in the Kentucky Department of Transportation's (KYDOT) five-year highway program.

Health Impacts: (pp. 1-45, 3-44 and 4-76)

1. Section 1.4.3.8, Occupational Safety and Health mentions physical hazards common to any large-scale construction site. It does not address the need for an internal plant safety program to deal with specific hazards.

2. On-site emergency medical services are often required by the unions. If this service was mandated, the need for additional vehicles and personnel at the local level would be eliminated.

3. DEIS does not address the potential mental health problems. National figures show that more than 10 percent of the work force experiences mental health problems that affect work performance. These include alcohol and drug abuse as well as marital/family programs. Employee assistance programs to deal with these areas need to be explored.

4. Health problems and needs in the following categories have been identified by the Subarea Health Council for study but were not mentioned in the DEIS.

   a. Prevention and Detection Services
   b. Primary Care Services
   c. General Acute Services
   d. Specialized Acute Services
   e. Long Term Care Services

5. Section 3.2.4.4, outlines the health manpower and facility statistics for the three counties (Vanderburgh, Daviess and Henderson). These are regional centers for the Tri-State, however the DEIS does not deal with the entire population of the Tri-State region. A more regional perspective of health care availability should be analyzed.

6. Documentation of the EMS capability in the region was not included in the DEIS.

7. Health care and medical facilities have been deleted in the public services section of DEIS dealing with alternative sites (3-63 Vol. I).

Housing Impacts: (pp. 3-42, 3-43, 4-73, 4-74)

1. Housing tenure preferences of construction workers should be more carefully analyzed in relation to the available vacancies. Since incoming construction workers will be either weekly commuters or residents for less than a period of two years, it is doubtful that they will choose to purchase single-family homes. Yet, more than two-thirds of the existing vacancies identified are owner, rather than rental units. Also the plan projects that 50 percent of all the commuters and in-migrants will select single-family residencess; 25 percent will select mobile homes and 25 percent will select apartments; sleeping rooms and transient homes. This needs to be further analyzed.

2. Analysis of the impact in the rental sector should be provided in relation to the impact it will have on low- and moderate-income and elderly families who predominantly use this sector. Vacancies available to this group may be substantially reduced, assuming that construction patterns established over the last 10 years continue (See #3 below). Also, the impact of the Big Rivers Electric Corporation's development in Ohio County, when added to the SRC construction plant, reduced these vacancies by half.

3. It is assumed that the housing vacancies that are currently present will be available during peak construction in 1982. Some analysis of this assumption is needed since the recent trends indicate that production may be dropping substantially, e.g., by 17 percent in 1979 and by 66 percent in the last 12 months. If this rate drop continues, present vacancies may be consumed by new households (normal growth) prior to the arrival of synfuel workers.

4. Although the report accurately estimated transient units available in the three counties, i.e., 3,300, some analysis of how many of those units would be available to construction workers is needed. Presently, about a third of those units are vacant on a given night and only about 10 percent would be acceptable to construction workers in terms of price, i.e., based on interviews with labor representatives, construction workers will probably not pay over $12 per night for transient housing.

5. The mobile home zoning ordinance in Owensboro and Daviess County should be further evaluated as to the number of units that are allowed in the city itself. Although the ordinance gives the names of zones where new mobile homes or mobile home parks are permitted, the existing zoning maps should be reviewed to determine how many units could be placed in those designated areas.

6. Some analysis of the growth impacts in the rural areas outside of the Evansville and Owensboro SMSAs should be provided in terms of impact on current vacancy rates and land use controls. Given differences in existing zoning practices, the ease of development in these areas in relation to the more controlled urban areas could generate considerable growth in bordering rural areas.

I would like to request that these comments be adequately addressed in the final Environmental Impact Statement for the SRC-1 demonstration project.

Sincerely yours,

William L. Newman
Chairman
GRADD Board of Directors

WLM:ed

February 24, 1981

24

Mr. James A. Reafsnder
Research & Devel. Manager SRC Projects Office
U.S. DOE, SRC-1 Public Hearing
P.O. Box E
Oak Ridge, TN 37830

Dear Mr. Reafsnyder:

The attached 7-page statement was esentially my presentation at the Daviess County High School last night. I understand that these comments will appear in the final EIS.

Fred Hauck

HOW GREAT IS THE NEED FOR SYNTHETIC FUELS? FEB 2 7 1991

My name is Fred Hauck. I am from Shelbyville, Ky., near Louisville. Because I have spent more than 35 years in the business world including 18 years in industrial engineering, I am more than a little reluctant to be critical of most industrial initiative. For that reason I have tried to examine the pros and cons of Kentucky's synfuel program dispassionately.

First, let me list the admittedly ambitious goals of the synfuel program as I understand them:

The first goal is to replace 500,000 bbls. of daily oil by 1987, by the expenditure of $88 billion of tax money. This amount of production will replace only 3% of total petroleum consumption, a minute amount.

The next goal is to increase synfuel production by 1992, 11 years from now, to 2 million daily barrels. This is only 11% of current total petroleum needs.

Now the alternatives:

First, More Efficient Cars

This small chart (there are enough extra copies to distribute to at least some of you) uses Department of Transportation data in the lower 2 curves to show that:

Curve (1) All cars on the road today average only 16 miles per gallon of gas, and

Curve (2) All new cars today average just 20 miles per gallon

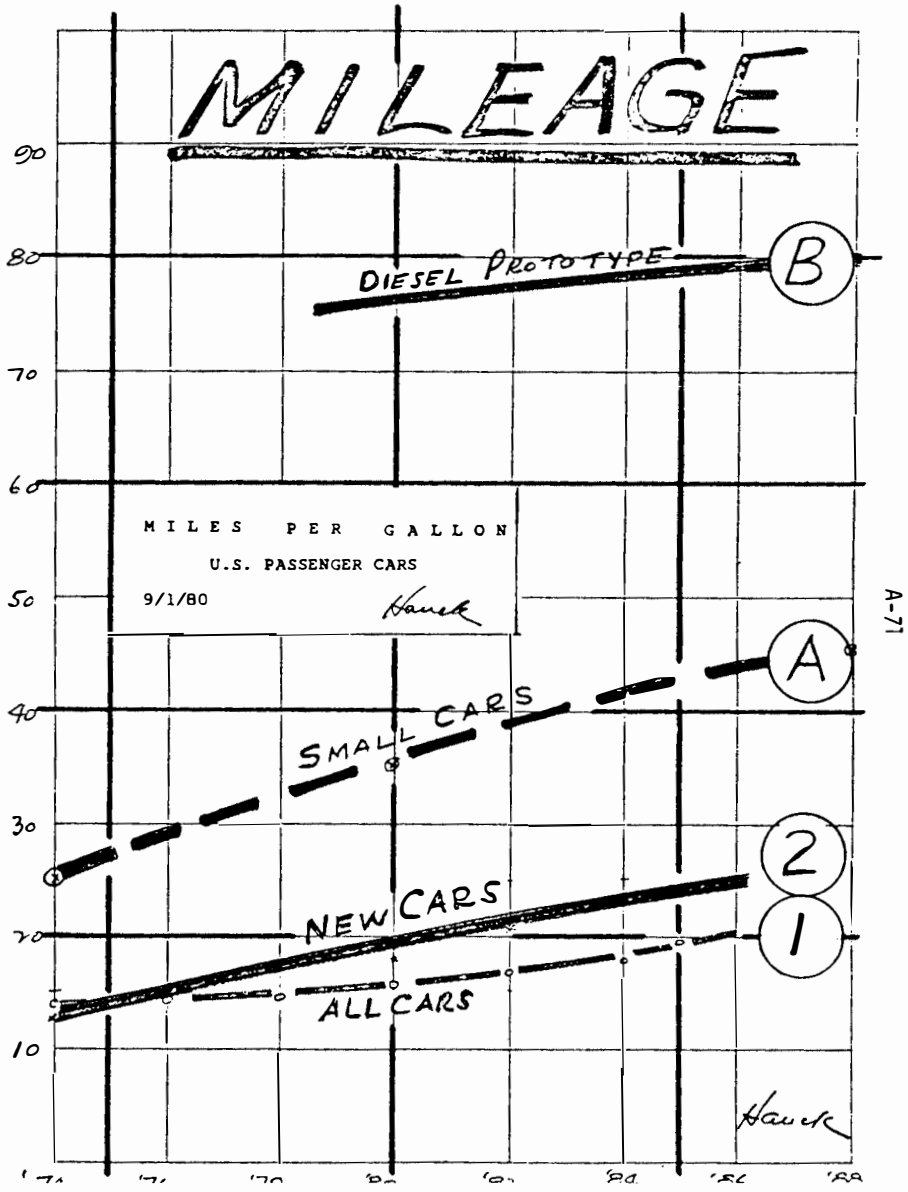
The next curve above these, labeled (A), indicates that many of the new small cars, both domestic and imported, are actually averaging 35 mpg. When all cars attain this average (about 1990), the oil saving will be not the 11% hopefully projected by the $88 billion synfuels program, but 20%, and this of course at no cost to the taxpayer.

The top curve, labeled (B), pictures the 70 mpg possibilities of the small turbo-charged diesel. A car with this type engine recently traveled the 1000 miles from Miami to Washington, DC with 2 people and 200 pounds of luggage, averaging more than 70 miles per gallon of fuel. This sort of milage will produce savings of 5 million bbls of oil per day. This alone is about 30% of total use and could possibly eliminate all imports.

Our handout set also contains an Associated Press article of February 16 quoting Dan Lundberg's oil newsletter "Energy Detente" as saying, "Since the petroleum price increases, . . conservation . . has entered the scene with a vigor that many thought impossible in the 1960's and early 70's."

S. Fred Singer, of the Energy Policy Studies Center at the University of Virginia says, "Oil imports and dollar outflows will drop drastically by the end of this decade."

FRED HAUCK
P O BOX 391
SHELBYVILLE, KY.
40065



MORE COST VS. CONSUMPTION

"Since the petroleum price increases , ... conservation . . . . has entered the scene with a vigor that many thought impossible in the 1960's and early '70's"

Expert says big gas reserves might lower prices a little

2/16/81

Associated Press

LOS ANGELES — The United States' gasoline reserves are growing so rapidly that refineries may be forced to slow down or shut down, and gas prices eventually may drop, an oil-industry analyst says.

Dan Lundberg said there is so much gasoline in storage that refineries are having to operate at "uneconomic rates," and "the industry may have to drink it."

But his Lundberg Letter, a weekly oil-industry periodical, stressed that "regardless of surpluses, certain increased costs must get through to the pump, so a decline in prices is not a reasonable prospect at this time."

The letter said consumer conservation of gasoline and continued production of fuel oil for winter heating were combining to create stocks of 277 million barrels of gas, a near-record amount. Production of heating oil increases gasoline stocks, whether they are needed or not, because the refining processes are linked.

The Lundberg Letter, published Friday, said refinery production runs dropped to 72.7 percent of capacity in January from an already low 76.6 percent in December. Refiners, who generally like to run at about 90 percent capacity, are faced with "even greater slowdowns, perhaps shutdowns," the letter said.

Industry experts say production runs of less than 75 percent aren't profitable for most refineries.

A record surplus of 283.1 million barrels, set in April of last year, brought a 1.2 cent average drop in gasoline prices over an eight-month period.

An official of another oil-industry publication said yesterday that the nation has begun to control its consumption of petroleum products and could be on the way to easing the energy problem "without fully realizing it."

German Chacin, editor of the Energy Detente newsletter, said the U.S. economy has improved its energy efficiency 12 percent since the Arab oil embargo of 1973. He said that translates into a savings of 4.9 million barrels of oil a day.

"Since the petroleum price increases of 1973-74, conservation . . . has entered the scene with a vigor that many wouldn't have thought possible back in the 1960s and early '70s," Chacin said.

Energy Detente is a twice-monthly publication that studies the energy situation in the Western Hemisphere. It is affiliated with the Lundberg Letter.

Hauck
2/17/81

Higher prices alone are causing all of us to use both oil and gasoline much more efficiently than ever before.

The next alternative could well be a more viable program for the coal industry than the proposed synfuel program. For several years a number of innovative research groups have been perfecting colloidal coal-oil-water mixtures containing as much as 70% coal. These fuels can be burned in existing oil-fired boilers with only minor changes to ancillary equipment. The change-over costs are but a small fraction of the costs usually associated with changing from oil to coal. Total fuel costs are significantly lower than current oil costs. Many oil fired boilers now being used could switch to the coal-oil-water mixture and operate at lower overall costs if all capital costs are considered.

Our third alternative is an unexpected abundance of natural gas. By 1985, the new Alaskan Natural Gas Pipeline (see Wall St. Journal article of Dec. 11) will bring 2½ billion cu. ft. per day into the United States, 60% of it to the Dwight, Ill. distribution center near the Indiana border. This 48" natural gas pipeline alone will furnish more than the equivalent of 400,000 bbls per day of synfuel production, and this at a probable cost more than 50% less. Additional imports from both Canada and Mexico can be expected to offset still more petroleum use. Many new high producing gas wells are being found in both the western overthrust belt in the Rockies and in the eastern Allegheny Mountains. A very large well recently found near Keyser, WV, is within 100 miles of Washington, DC. The many economic impacts of gradual natural gas price deregulation can be expected to ease our energy problems long past the year 2000. Higher well-head gas prices are developing so much natural gas within our country's borders that we currently can't even use all the gas that the Canadians want to sell!

Also WSJ 12/11/80

THE IMPORTANCE OF PRICE

The importance of the economic impact of natural gas deregulation (and that of oil as well) is illustrated by the next chart taken mostly from Louisville Gas & Electric data. Note that the steady price increases here have again caused more efficient fuel use. As the real-dollar natural gas price increased 50%, average domestic use per home dropped about 13%. This is roughly the reduction predicted by the classical cost-demand expression that I'm sure some of you will remember from high school and college economics. As energy prices continue to rise even more, such cost-effective measures as automatic turn-back thermostats, more and better insulation, proper shading, passive solar devices, etc. etc. will continue to reduce unit fuel consumption. Both Indiana Gas and Louisville Gas & Electric are now able to serve even more total customers with smaller total cubic feet of sales of gas.

FRED HAUCK
P O BOX 391
SHELBYVILLE, KY.
40065

Northern Border Pipe Wins Loan For Gas Line Leg

An 823-Mile, $1.4 Billion Lap Of Alaska System Gets $1,055,000,000 Financing

By a WALL STREET JOURNAL Staff Reporter

NEW YORK—A consortium of 28 U.S. and Canadian banks agreed yesterday to loan $1,055,000,000 to Northern Border Pipeline Co. for construction of a 823-mile segment of the Alaska natural gas pipeline system.

The five Northern Border Pipeline partners will put up the rest of the money needed to build the $1.4 billion project.

The pipeline initially will take surplus natural gas from Alberta and Alaska to the Midwestern and Eastern markets of the U.S. Construction will start in May and be complete in the fall of 1982. The pipeline will carry 975 million cubic feet of gas a day, or the equivalent of 165,000 barrels of oil a day, enough to heat about two million homes.

"The pipeline will supply additional energy for the U.S. and will replace energy from less secure sources," said Gordon Severs, president of Northern Natural Gas Co., a subsidiary of InterNorth Inc., one of the partners.

One of the largest project financing agreements ever, the arrangement has been in the works for eight years. The banks will get paid with a share of the roughly one dollar-a-thousand-cubic-feet transmission charge. The loans cover about 70% of the anticipated construction cost and have a 16-year maturity.

The governments of Canada and the U.S. have granted the necessary regulatory approvals for the project. More than 70% of right-of-way needed for construction has been acquired.

The Line's Two Legs

The pipeline route will wind through Montana, North Dakota, South Dakota, Minnesota and Iowa. The next construction phase will be another $1Bil[illegible]-dollar extension to Dwight, Ill., near Chicago.

That pipeline will be one of two legs of a pipeline that eventually will reach through Canada to the Alaskan North Slope.

While construction of the Alaska extension hasn't begun, builders of the U.S. leg aren't worried. "This project can stand on its own feet just with the Canadian surplus gas," said Mr. Severs, who is chairman of the partners' management committee.

Natural Gas Surplus

Canada's western provinces have more natural gas than they can export because of their inability to transport it to Eastern markets.

Three companies will buy the gas coming through the pipeline: United Gas Pipeline Co., a Houston-based concern that sells in Eastern areas; Panhandle Eastern Pipeline Co., which markets gas in the Midwest, and Northern Natural Gas Co., an Omaha-based company that sells gas in the Midwest plains.

In building the pipeline, the partners will employ nine pipeline construction firms, pay $500 million for pipe and create about 2,000 steel-industry jobs. About 5,000 workers will help build the line.

Completion Expected by 1985

Mr. Severs said he expects the entire pipeline, including the Alaska extension, to be complete by 1985.

Partners in Northern Border Pipeline Co. include units of InterNorth Inc.; Northwest Energy Co.; Panhandle Eastern Pipe Line Co.; TransCanada PipeLines and United Gas Pipe Line Co., a unit of United Energy Resources Inc.

Canadian Imperial Bank of Commerce is the leading member of the bank consortium. Its share of the financing will be 14%.

7 mil people now
or
10.5 mil later
~ 10,000 to
= 15,000 MW (e)

Northern Border Picks Contractors for First Segment of Pipeline

4/14/81

By a WALL STREET JOURNAL Staff Reporter

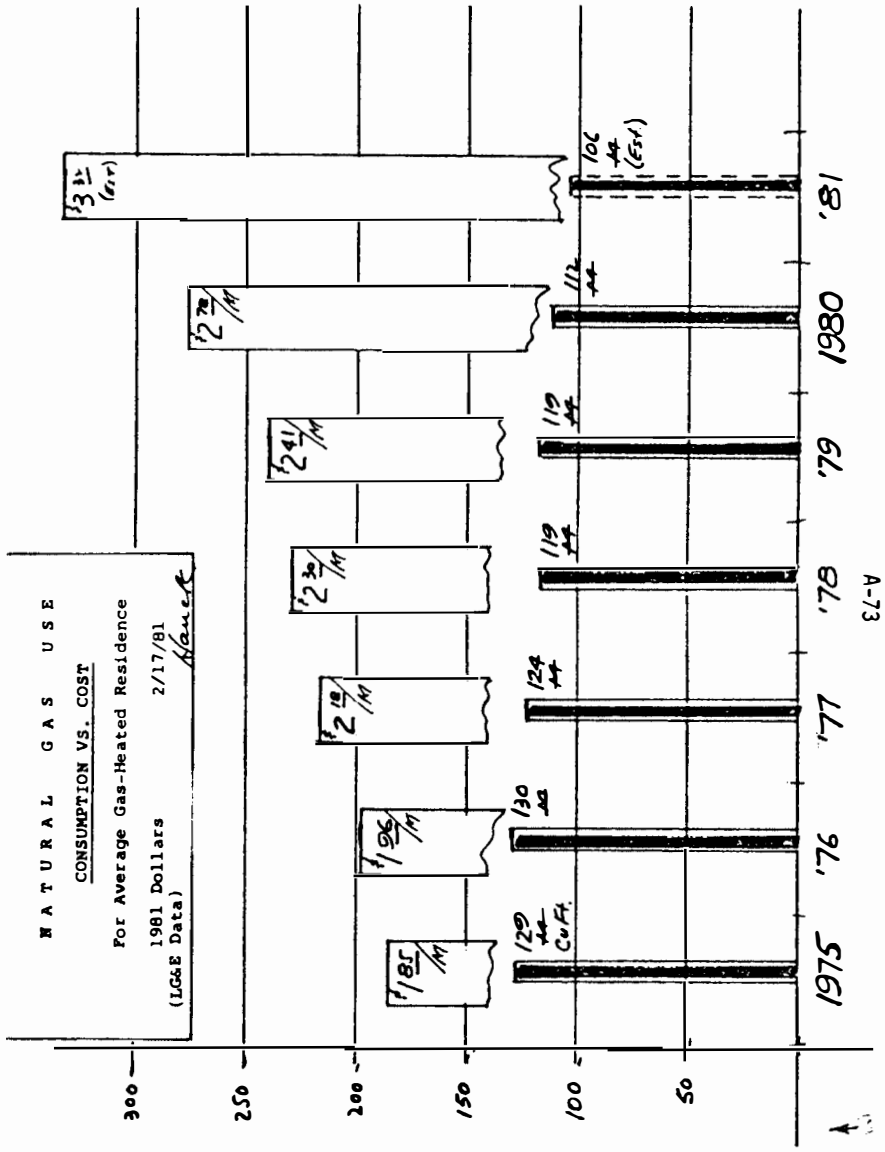
OMAHA, Neb.—Northern Border Pipeline Co. said it selected contractors for construction of the first phase of the eastern U.S. portion of the Alaskan pipeline.

The 823-mile section will transport Canadian gas through Montana, North and South Dakota, Minnesota and Iowa. The project will cost about $1.5 billion, the company said.

Northern Border Pipeline said construction will begin this spring and is expected to be finished by the fall of 1982.

The contractors, who will build segments in different states, are: Leonard Pipeline Contractors and Leonard Pipeline Contractors-Rohart, Inc., both for Montana; Majestic Wiley Contractors Ltd. and Willbros Energy Services Co. for South Dakota; Reading & Bates Construction Co. for Minnesota; and H.C. Price Pipeline Construction Co. for Minnesota and Iowa.

Northern Border Pipeline is a partnership of five energy companies, including Northern Plains Natural Gas Co., an InterNorth, Inc. subsidiary.



A-73

THE LAST CONSIDERATION - OUR NATIONAL DEFENSE

The reprint from "Science" (the last sheet in the set) quotes the following from a recent government report. The Federal Emergency Management Agency says, "Drawing from the experience of World War II, Germany was crippled when its main synthetic fuel and electricity plants were decimated at the end of the war, whereas it would have been impossible to destroy Japan's network of small, decentralized hydropower facilities." Surely we don't want to follow Germany's World War II pattern!

MY CONCLUSION

I reluctantly conclude that the synfuel program would seem to offer little in the way of fuel sufficiency that can't be found more easily, safer and cheaper in other ways. The program would seem more important as Corporate Welfare than as a genuine solution to our energy problems!

Fred Hauck
2/18/81

ON NATIONAL DEFENSE

"The (Federal Emergency Management Agency) report notes that Germany was crippled when its main synthetic fuel and electric plants were decimated

Energy, Security, and War

Sharply contrasting views are presented in two recent studies that focus on national security as it relates to energy. A book put together at Harvard calls for massive oil stockpiling to insulate the country from possible oil cutoffs, whereas a study for the Federal Emergency Management Agency (FEMA) urges decentralization of the country's energy systems in order to reduce vulnerability to attack.

The Harvard book, *Energy and Security*, edited by David A. Deese and Joseph S. Nye, deals with narrower issues than its title implies. The book, a report of Harvard's Energy and Security Research Project, says that the United States has placed too much emphasis on reducing foreign oil imports and not enough on reducing the country's "vulnerability"—that is, the damage that might be done by a cutoff of oil. It states that few long-term policies—such as price decontrol, the synthetic fuels program, conservation, or coal conversion—will significantly reduce the country's near-term vulnerability. Thus, it urges large increases in both strategic and industrial petroleum stocks. The book says the long lead time required for development

> ". . . centralization of our energy systems is increasing our nation's vulnerability, in the name of decreasing it."

of synthetic fuels will prevent them from changing the picture during the 1980's, and "a dollar invested in synthetics is worth much less, in the short run, than a dollar invested in stockpiles." The book dwells at some length on the political situation related to energy in both oil-producing and oil-consuming countries and advocates various measures to deter crises in the Persian Gulf area. It also proposes that the U.S. government develop more detailed strategies for dealing with oil emergencies. But basically, the emphasis is on increasing the stocks of the United States and its allies, with an eye toward the ultimate creation of an international strategic petroleum reserve.

A more frightening question, that of the ability of America's energy network to withstand an enemy attack, is addressed in *Energy Vulnerability and War*, done for FEMA. Asserts Wilson Clark, the energy consultant who headed the study team, "the increasing centralization and energy/materials intensity of our energy systems is increasing our nation's vulnerability, in the name of decreasing it." Although the national petroleum reserve is not discussed in the report, Clark says stockpiling petroleum in a few locations is just the kind of centralization of resources that supplies an inviting target. Drawing from the experience of World War II, the report notes that Germany was crippled when its main synthetic fuel and electricity plants were decimated at the end of the war, whereas it would have been impossible to destroy Japan's network of small, decentralized hydropower facilities.

Clark's report calls the U.S. energy system "highly centralized" and notes that the trend has been toward large size and consolidation in power plants. The proposed Allen-Warner Valley Power System in southern Nevada and Utah, which is to comprise two large power plants and a coal slurry pipeline to the nearby Alton coal field, represents the type of concentration the report decries. Both nuclear plants and synthetic fuels facilities are also regarded as by nature centralized. The report concludes that this country can reduce both its vulnerability to oil import cutoffs and its vulnerability as a target by moving toward dispersed, decentralized, renewable energy supplies. Various forms of energy conservation are discussed at length, including cogeneration—the use of waste heat to power industrial processes—and home insulation. Another study is quoted to the effect that $10 billion a year, over a decade, supplied as interest-free loans for home insulation, would save the country 75 percent of the heat content of the oil now imported into the United States. This was contrasted with the $88 billion synfuels program, which is not expected to replace more than 15 percent of imported oil by 1990.

The report claims that the widespread use of electronics makes us more vulnerable than ever before to a nuclear attack. The reason is the little-remarked phenomenon of electromagnetic pulse (EMP) which occurs when a nuclear bomb is detonated at high altitudes. The EMP is a microsecond burst of electromagnetic energy, a hundred times more powerful than a lightning bolt, which can incapacitate solid-state electronic equipment (vacuum tubes are less vulnerable). Two years ago, the Office of Technology Assessment, in a nuclear war scenario, postulated that in a "limited" strike the Soviets could wipe out the American petroleum industry with 80 MIRV'd missiles. Now, says Clark's report, it appears that "one or two well-placed nuclear warheads detonated in the upper atmosphere could cause failure in the entire national power grid, including destroying the sensitive control facilities at modern electric power plants."—CONSTANCE HOLDEN

SCIENCE, VOL. 211, 13 FEBRUARY 1981 0036-8075/81/0213-0683$00.50/0 Copyright © 1981 AAAS

(29) 3/31/81 25

Mr. Langley,

Save us. Call Alan Quist to

Support Plant Here -

Bill Mc. -

Lewisburg, Pa.

MAR 0 - 1980

James A. Cafaro Co.

My family live on the east end of Trumbull Co. but we do not need or want another cancer producing industry in this area! We can smell the paper mill up the road every morning, as it is, and do not need more smog & pollution in our air and river.

We are mostly concerned about our health, not - how many jobs it will create.

Our vote is NO.

Bring us a cleaner industry to this county.

Anne & Steve Hudson

27

February 27, 1981

Marty Rogowsky
Mail Stop 5A-114
Forrestal Building
1000 Independence Ave., S.W.
Washington, DC 20581

Dear Marty:

As a follow-up to our conversation after the SRC-I DEIS hearing, February 23, 1981, I am writing to provide you with the sources from which several existing government documents can be obtained. By using the data and information in these studies, DOE could (with very little expenditure of time and resources) address the cumulative impacts and the degree to which the proposed Newman plant would contribute to them, and could evaluate the alternatives within the context of cumulative impacts.

1. The Ohio River Basin Energy Study (ORBES) studied the impacts of existing and proposed power plants:
   Lowell Smith, Project Officer
   U.S.E.P.A., Environmental Engineering & Technology
   Office of R & D, Washington

2. Since ORBES did not consider synfuels development, the cumulative impacts specified in "Coal Conversion-Briefing Paper-Environmental Assessment of Coal Conversion Industry in Western Kentucky" must be added. This study, prepared by Russell Barnett, December, 1980, is available from:
   Don Beavers, Assistant Administrator
   Office of Special Projects
   Kentucky DNREP
   (502) 564-7320

3. Socio-economic impacts for the project area have been and are being studied through federally-funded studies by the:
   Green river Area Development District
   Owensboro, Kentucky

4. Data necessary to quantify impacts on the agricultural sector (including loss of farmlands due to transportation corridors, "impermanence syndrome" etc.) should be available through the DOE representatives for the National Agricultural Lands Study (NALS) and/or
   Bob Gray, NALS Executive Director
   Washington, DC

Since government funds, (i.e., tax dollars) have been used to do these studies, it seems irresponsible, at best, to expend more government funds on the SRC-I project without first utilizing the existing information to analyze the wisdom of proceeding.

I realize that the preparation of the FEIS will be a major task, but also feel strongly about its importance. Please contact me if I can help in any way.

Sincerely,

Karen Hollweg

Karen Hollweg
Assistant Regional Representative

cc: Jim Roafsnyder

28

WEST KENTUCKY COAL OPERATORS' ASSOCIATION, INC.
Ramada Square - P.O. Box 771
Madisonville, Kentucky 42431
(502) 825-3898

PRESIDENT
STEPHEN JONES

BOARD CHAIRMAN
DON BOWLES

February 27, 1981

Mr. James Reafsnyder
Research and Development Manager
SRC Projects Office
U.S. Department of Energy
SRC-I Public Hearing
P.O. Box E
Oak Ridge, TN 37830

Dear Mr. Reafsnyder:

I wish to formally submit information concerning the ozone monitoring and assessment at the Newman SRC-I plant. While the Draft Environmental Impact Statement does discuss possible effects to the ozone due to construction and operation of the demonstration plant, clarification is apparently needed given recent statements presented at the DEIS hearings this week.

There have been charges that the SRC-I plant would clearly violate federal and state standards governing ozone concentrations at the Newman site and the surrounding areas. I was concerned when I first heard and read about these violations. I spoke with several friends and contacted executives associated with the SRC-I project to hear their view. What I have learned is worth putting into the DEIS record.

It seems the first air quality monitoring efforts were conducted four years ago to collect the baseline data of air quality in our area. Data was gathered in connection with an SRC-I project designed for a 2000 TPD plant. The monitoring was conducted according to the specifications of the Kentucky Department of Natural Resources and Environmental Protection. An entire year of data on emissions was collected in 1974 including data collected for the ozone. Now, I should note that International Coal Refining Company explained to me that data specifically on the ozone was collected only during the summer months as is customary seeing that the highest ambient ozone concentrations can be expected in the summer. It seems that there was at that time a 0.08 PPM one hour average standard not to be exceeded more than once per year. The area was listed "non-attainment" based on the data collected in 1974 and the ozone standard that was in effect at that time.

Soon after this monitoring program was completed, plans for the SRC-I demonstration design changed to a 6000-ton-per-day plant. It was clear that the air quality data would no longer be current by the time conceptual engineering and preliminary design work on the 6000-ton-per-day plant reached an advanced stage to start preparing for air quality permits. Therefore, plans were made early in 1979 to collect information based on additional one-year ambient monitoring program. The monitoring program included information on a number of pollutants including sulfur dioxide and carbon monoxide. However, the Kentucky Department of Natural Resources and Environmental Protection agreed that there was no need for additional monitoring for ozone because all the available data clearly demonstrated violations of the 0.08 PPM standard.

Not long afterwards, the ozone standard was changed to 0.12 PPM one year average, not to be exceeded more than one day per year. Presumably, based on this new standard Daviess County was reclassified as an attainment area. At this time, both the Environmental Protection Agency and the Kentucky Department of Natural Resouces and Environmental Protection officials agreed to re-evaluate SRC-I data based on the new standards. It was also agreed to carefully review the acceptability of ozone monitoring equipment, maintenance and calibration procedures.

This review of equipment and procedures resulted in a re-evaluation of information concerning the correct scale on which to obtain proper values. This re-evaluation also resulted in revised facts, based on the correct scale, which coincided almost exactly with data obtained by the Kentucky Department of Natural Resources and Environmental Protection in their ozone monitoring program. These corrected values are the values included in the DEIS and in the PSD permit application.

Based on all this information, all parties involved agreed that the ozone non-attainment was moot.

I shall note one thing further. All of these facts notwithstanding, there was a decision on the part of the DOE and ICRC in late 1978 to define the best possible control technology for emissions that would affect the ozone in our atmosphere. This technology, called "Lowest Achievable Emission Rate," will be employed to minimize the potential environmental and health risks that will be associated with some of the organic compounds associated with the process. This is reassuring to all of us. It will, no doubt, be effective in continued areawide ozone attainment as it pertains to the SRC-I plant in our area.

I appreciate this opportunity to comment on the Draft Environmental Impact Statement.

Sincerely,

Stephen Jones
President

VALLEY WATCH, Inc.
P.O. Box 2262 Evansville, IN 47714 812 · 464 · 5663

March 1, 1981

BOARD OF DIRECTORS

Dr. Hugh Spencer
Principal Investigator
ORBES Study

H. Joel Deckard
Member of Congress

John Blair
Pulitzer Prize
News Photography

Dr. Andrew Jorgensen
Chemist
ISU- Evansville

Dr. Richard Wham, M.D.
Radiologist- Henderson
Community Hospital

Fred Hauck
President
Save the Valley, Inc.

Tom Zeller
President
Valley Watch, Inc.

Mr. James A. Reafsnyder
Research and Development Manager
SRC Project Office
U.S. Department of Energy
SRC-I Public Hearing
P.O. Box E
Oak Ridge, TN 37830

Dear Mr. Reafsnyder:

Enclosed are my comments regarding the draft environmental impact statement for the SRC-I project in Daviess County, Kentucky (DOE EIS-0073-D). I presented a synopsis of these remarks at the Stanley Kentucky hearing on February 25, 1981. Both presentations are made on behalf of Valley Watch, Inc., an environmental education and research corporation serving the Lower Ohio River Valley.

It is our feeling that the SRC-I plant as described in the aforementioned EIS should not be built at this time at any location. Our primary objections center on the use of unproven technology ("conceptual design") in an industry with such great potential for environmental damage especially when a scale-up of 120 times is suggested. There does appear to be more promise to this method in comparison to that of the proposed SASOL plant - but 6000 tons per day is too large a gamble at this time. Our other general objection is the continued use of the Ohio Valley as a heavy industry alley so that the rest of the country can continue in its wasteful ways.

Your thoughtful consideration of these comments are appreciated. If further clarification is needed my business phone is 812-464-1716 (Chemistry Department, Indiana State University Evansville).

Sincerely,

Andrew D. Jorgensen

Andrew D. Jorgensen, Ph. D.
Executive Board Member
Valley Watch, Inc.

BOARD OF DIRECTORS

Dr. Hugh Spencer
Principal Investigator
ORBES Study

H. Joel Deckard
Member of Congress

John Blair
Pulitzer Prize
News Photography

Dr. Andrew Jorgensen
Chemist
ISU- Evansville

Dr. Richard Wham, M.D.
Radiologist- Henderson
Community Hospital

Fred Hauck
President
Save the Valley, Inc.

Tom Zeller
President
Valley Watch, Inc.

VALLEY WATCH, Inc.
P.O. Box 2262 Evansville, IN 47714 812 · 464 · 5663

COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED SRC-I PROJECT IN NEWMAN KENTUCKY

Presented by Andrew D. Jorgensen, Ph. D., on behalf of Valley Watch, Inc.

As a research chemist I have been involved in a study of synethic fuels from coal under the auspices of the Department of Energy for the last two years. (I recently reviewed part of this draft environmental impact statement with particular attention to potential air quality impacts. My conclusion is that this plant should not be built at this time at any location. In general there are too many missing answers and too many wrong answers. My objections are in four general areas:

1.) This process will produce many tons per day of material contaminated with very hazardous chemicals (carcinogens, mutagens). This situation is not comparable to the crude oil industry whose liquid products seem to be less hazardous (eg. much weaker mutagens in the Ames test). This is consistent with the difference between the structure of coal and crude oil. It has been shown that liquid coal products can cause tumors in animals with a single application. Excerbating this problem is the lack of proven control technology in what will be a very demanding environment. Although recent news reports suggest more strict controls than discussed in the dEIS, this was not presented in the formal document and relies on advances not yet tested on a large scale. The combination of thousands of valves and the realities of human nature suggests that seal aging and accidents might well cause the release of significant amounts of hazardous materials. The major spill at the SRC pilot plant reinforces this concern.

2.) Ozone levels have exceeded ambient health standards in Evansville during 1980 and in Henderson and Owensboro in past years. Because this plant will have liquid hydrocarbons as one of its major products and since compounds of this type are involved in the formation of ozone, an already bad situation may get worse. The very large size of the plant coupled with the newness of the controls again combines to give a troublesome situation.

The topic of ozone brings up another question - that of the ability of this contractor (ICRC) to handle the project: Although not mentioned in the dEIS, background documents indicated very high ozone readings on the proposed site during 1978. I understand that this data was in the preliminary draft EIS. This was not a trivial concern since the reported levels would mean LAER controls and hydrocarbon trade-offs to meet federal law. It was later stated that an error had been made during the days of highest ozone concentrations and this data was twice as high as it should have been. However, this was not realized until two years after the fact! This either indicates tampering with the results, which I have no reason to believe, or incompetence. In either case it raises significant questions. If we are to believe state-of-the-art controls and "directed Maintenance" how much confidence can we have when this error of great impact went unnoticed for so long? Monitoring is of little value without careful and intelligent interpretation.

3.) Total suspended particulates (TSP) are a regional problem in this area with, for example, Evansville presently in violation of the secondary ambient air quality standards. Construction and operation of this plant will significantly add to the problem. The dEIS states that the "demonstration" plant will use up 73% of the allowable PSD increment. The commercialization scale-up of five times will obviously present difficulties with TSP levels. The dEIS suggests new controls and perhaps the purchase of farms with subsequent cessation of farming. I question the prudence of this action. In addition, dust particles can act as efficient vectors of the very hazardous chemicals that will be produced in the process.

A general air quality concern is the suggested location of this plant within 50 miles of almost a quarter of a million people and within 20 miles of about 100,000 people.

Finally, while I agree with the role of the federal government in synthetic fuel research, I strongly oppose 93% funding from tax dollars. Using the GAO estimate for plant costs the "Demonstration" plant only would cost every family of four in the U.S. more than $40. For a venture that is 120 times as large as its predecessor, this is just too large a gamble. I don't accept the "inflation will make it too expensive if we slow down" argument. The logic of that implies we should always spend money as fast as possible - clearly not a good idea in many cases. If it were a reasonable gamble, private industry would be willing to support it to a greater extent.

In conclusion, it should be remembered that machines don't perform the way that they are designed to work for 100% of the time so you must have a margin of safety. I don't think that we have it in this case.

I believe that the proposed plant is unacceptable with regard to environmental problems and unacceptable with regard to cost. If we want to cut down on imported oil, and this seems to be a very prudent objective, we should work on conservation of our present sources. I suggest putting billions of dollars to work on that problem not this rushed effort to grab our tax dollars.

Kentucky Heritage Commission
104 Bridge Street
Frankfort, Kentucky 40601

MEMORANDUM

TO: Environmental Review
Office of Policy and Program Analysis

FROM: Anne Armstrong Thompson, Executive Director
Kentucky Heritage Commission

SUBJECT: Draft Environmental Impact Statement - Solvent Refined Coal - I Demonstration Project

DATE: January 29, 1981

The Kentucky Heritage Commission has reviewed the Draft Environmental Impact Statement for the Solvent Refined Coal-I Demonstration Project (SRC-I). Our review of the statement indicates the applicant is in complicance with the Advisory Council's Regulations for the Protection of Historic and Cultural Properties (36 CFR, Part 800) pursuant to the National Historic Preservation Act of 1966, National Environmental Policy Act 1969 and Executive Order 11593.

AAT/pb

RECEIVED
FEB 6 1981
DEPT. NATURAL RES. & ENV. PROT.
POLICY & PROGRAM ANALYSIS

Request for
EIS, 1 own review
pub. 1, & copies

CRD, 2-25-81

FEB 18 1981
@7:30AM

31

653 Rand Rd
Owensboro, Ky 42301
2/10/81

James A. Reafsnyder
Research + Development Manager
SRC Projects
Oak Ridge, TN 37830

Dear Sir,

I would like to make public comment on the Newman SRC-I project, however due to some of my wife's relatives being land owners in the proposed site area, I think it would be best just to make comment in writing in order to avoid excessive friction with these relatives. My understanding is that the private comments are just as important as those made at the public hearings.

I am definitely in favor of the SRC-I demonstration plant at Newman, Ky.

I could probably write several pages on why the U.S. should encourage the coal-synthetic fuels concept, but I won't for your sake. If my written comment doesn't have as much weight as the public comment let me know. If you want more explanation as to why I'm for the SRC-1 plant at Newman then let me know.

Sincerely

Gregory A. McCarty

Phone 502-683-5249
Address 653 Rand Rd
Owensboro, Ky 42301

P.S. Could you also send me 2 more copies of the environmental impact statement for the SRC-1 at Newman. Two of my chemistry professors would like to have a copy, Dr. John Reasoner and Dr. John Riley both professors involved with coal chemistry research at Bowling Green (Western Ky. Univ. Grad. School)

Sent 2/18/81

Sam McDowell
2967A McAlister Place
Owensboro, KY 42301

MAR 0 4 1981

32

James A. Reafsnyder (615/576-1055)
Research and Development Manager
SRC-1 Project Office, U.S. Department of Energy
P.O. Box E
Oak Ridge, Tennessee 37830

1 March 1981

Dear Sir:

I would like to comment on the DEIS on SRC-1. There are a number of apparent contradictions, many of which have been addressed by others.

The DEIS, in one place, indicates that all coal will be shipped by barge. Another place indicates that it will be shipped by rail. How it is to be shipped is certainly important. Other obvious questions are: How will it be loaded? What environmental impact will occur due to loading and shipping? What stockpiling will occur at the loading sites?

The DEIS, in one place, indicates that dust suppression of the active stockpile will be chemically accomplished. Another place indicates that it will be done with water. What effects will result from the chemical treatment and from the polymer used for dust suppression in the two fifteen day stockpiles? How much acreage will be used for the entire stockpile of coal? How will it be kept from smoldering and giving off noxious and toxic smoke? How much of the manufactured product will be stockpiled? Will it smolder also?

The DEIS indicates that current pollution of the Green River is due in part to area coal mining. Will increased coal mining due to SRC-1 further degrade the river water to unacceptable quality?

Many comments from organized labor were apparently organized and orchestrated by outside sources. Their struggles in delivering their speeches indicated that they may have been too unfamiliar with the content of their speeches to read them smoothly. Coordination of subject material also indicated the presence of a master plan. An investigation should be conducted to determine if ICRC, DOE and/or other government agencies conspired to unduly influence a public hearing. The practice of allowing ICRC to make opening remarks at the hearings was certainly improper. Many government agencies attempted to influence the hearings by making speeches. If this use of tax dollars is not illegal, it certainly should be. It has been rumored that union members were paid to attend. This charade was a flagrant attempt to convey the inaccurate impression to the media and to the public that local support for SRC-1 is overwhelming. I object to my tax dollars being used to perpertrate a fraud. I insist that this affair be thoroughly investigated.

Sincerely,

Sam McDowell

Sam McDowell

MAR 0 4 1981

WILLIAM A. McMANUS, M.D.
2009 OLD CABIN ROAD
OWENSBORO, KY 42301

33

Feb. 28, 1981

Mr. James A. Reafsnyder,
Research and Development Manager,
SRC-I Projects Office,
U.S. Department of Energy,
P.O. Box E,
Oak ridge, Tenn., 37830

Dear Mr. Reafsnyder,

Please let me register my objections to the proposed synfuels plant at Newman, Ky.

The temporary benefits of the jobs provided during construction are not going to offset the continuing problems of pollution which will remain for generations to come.

We allready have evidence of lack of controls with persistant pollution from aluminium plants to th e NOrth and South. "Watch for Fog" signs are the controls. Now you want to put oneto the west, or upwind. No thanks.

Please list me as objecting to the plant.

Sincerely,

Wm McManus MD

A-85

FEB 2 6 1981

Mrs. William Allen McManus
2009 Old Cabin Road
Owensboro, Kentucky 42301

MAR 3 1981

February 23

34

Mr. James A. Reafsnyder
SR-1 Projects Office
P.O. Box E, Oak Ridge, Tennessee

Dear Sir;

Because of my concern for our environment now and in the future, I wish to register my strong opposition to the Newman synfuel plant.

The benefits to the construction industry are self-limiting, but the discharge from the plant is an on going problem to the entire population.

Thank you for giving me this opportunity to express my opinion, as I am unable to attend the public hearings.

Sincerely,

Mrs. William McManus

FEB 2 6 1981

Feb 23 - 1981
Rt. 4 Iron Tree Tri. Ct.
Beaver Dam, Ky. 42320

Mr. James A Rispaugher
Research and Development Manager
SRC-I Projects Office
U. S. Department of Energy
P.O. Box E
Oak Ridge, Tenn. 37830

35

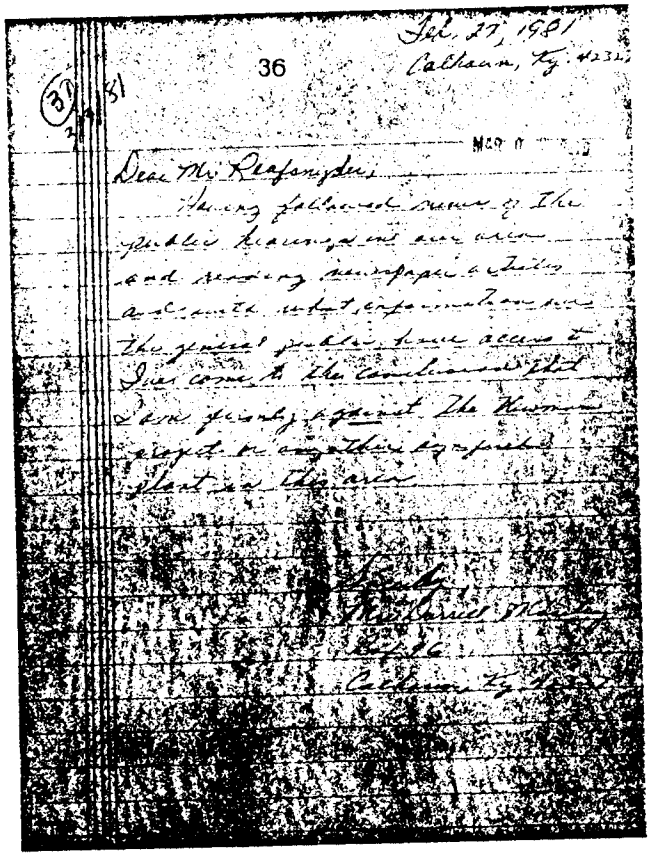
Dear Sir:

As an underground coal miner for thirty four years, an Ordained Minister for over thirty years with Sunday Radio Broadcast and Church Pastoral and Evangelist work I believe I know our people and their needs well enough to speak out.

Our place of work to supply the needs of our families is a lot more important to us than The Snail Darter or some Rat that might become extinct. Many species have since Zoo more this Earth and anything that therein is but we get along fine without them. Without our jobs and a way to get free of foreign fuel supplies you me I may be the next to become extinct. Each job at the Newman Coal to clean energy plant will generate many more jobs supplying coal and goods and services to these workers and their families.

I could write all night without covering all the reasons this facility will help but I'm sure you get my point so I rest my case.

Respectfully Yours,
Rev. James F. Wisner



Feb. 27, 1981
Calhoun, Ky. 42327

36

(31) 31

Dear Mr. Reasonover,

Having followed news of the public hearings on our area and reading newspaper & Utility advertising, what information can the general public have access to. Is it true the Commission did not permit any protest to anything by public present at the area

Sincerely,

Mrs. Grace [illegible]

Box 16

Calhoun, Ky. 42327

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

January 26, 1981 37

nsf

OFFICE OF THE
ASSISTANT DIRECTOR
FOR ASTRONOMICAL,
ATMOSPHERIC, EARTH,
AND OCEAN SCIENCES

Rec'd
JAN 30 1981

Mr. James A. Reafsnyder
Research and Development Manager
SRC Projects Office
U.S. Department of Energy
SRC-I Public Hearing
P.O. Box E
Oak Ridge, Tennessee 37830

Dear Mr. Reafsnyder:

The Director of the National Science Foundation has asked me to respond to your invitation to attend public hearings on the SRC-I Demonstration Project.

The Foundation will not send a representative to the hearings in Kentucky from 23-25 February 1981. However, we will review the draft environmental impact statement on the project and send any comments directly to you.

Sincerely,

Adair F. Montgomery

Adair F. Montgomery
Chairman
Committee on Environmental
Matters

NATIONAL WILDLIFE FEDERATION
1412 Sixteenth Street, N.W., Washington, D.C. 20036 202—797-6800

March 2, 1981

38

Mr. James A. Reafsnyder
Research and Development Manager
SRC-I Project Office
United States Department of Energy
P.O. Box E
Oak Ridge, Tennessee 37830

Re: Comments on SRC-I DEIS

Dear Mr. Reafsnyder:

Enclosed please find the comments of the National Wildlife Federation and the Indiana Conservation Council, Inc., on the Draft Environmental Impact Statement for the Solvent Refined Coal-I Demonstration Project proposed for construction in Newman, Kentucky (DOE/EIS-0073-D). The Natural Resources Defense Council joins in these comments as well.

We hope you will find the comments helpful.

Sincerely,

Norman L. Dean, Jr.
Counsel

Enclosure

Comments on the Draft EIS
For the Proposed SRC-I
Demonstration Plant
Newman, Kentucky
(DOE/EIS-0073-D/VI)

100% reclaimed paper

NATIONAL WILDLIFE FEDERATION
1412 Sixteenth Street, N.W., Washington, D.C. 20036 202—797-6800

38

Comments on the Draft EIS
For the Proposed SRC-I
Demonstration Plant
Newman, Kentucky
(DOE/EIS-0073-D/VI)

Submitted on Behalf of

National Wildlife Federation
Indiana Conservation Council, Inc.

Joined by

Natural Resources Defense Council

Norman L. Dean, Jr.
Judith S. Cox
National Wildlife Federation
1412 Sixteenth Street, N.W.
Washington, D.C. 20036

(202) 797-6817

March 2, 1981

100% reclaimed paper

Table of Contents

INTRODUCTION..... 1

I. DOE and Other Relevant Federal Agencies Must Prepare A Programmatic Impact Statement on Synthetic Fuels Development..... 3

II. The DEIS Does Not Adequately Justify the Need for the Proposed Demonstration Project..... 9

III. The DEIS Fails to Consider Energy Conservation and Renewable Energy Resources As An Alternative.....10

IV. The DEIS Does Not Consider Possible Construction of a Smaller SRC-I Demonstration Plant.....16

V. Preparation of the Environmental Impact Statement For the SRC-I Demonstration Project is Premature.....18

VI. The DEIS Fails to Provide a Full and Candid Appraisal of the Experience at the SRC Pilot Plants.....27

VII. The DEIS Does Not Contain An Adequate Justification For Locating the SRC-I Plant at the Newman, Kentucky Site.....31

VIII. The DEIS Does Not Present a Plan for Collecting Baseline Environmental Data Nor Does It Outline An Environmental Monitoring Plan.....36

IX. The DEIS Does Not Contain A Discussion of Project Financing.....38

X. The DEIS's Discussion of Key Environmental Impacts is Inadequate.....39

A. The DEIS's Treatment of Occupational and Health Hazards is Incomplete and Misleading.....41

1. The DEIS Does Not Enumerate the Harmful Substances Likely to Be Present At the Plant or Their Risks.....42

2. The DEIS Does Not Contain Any Data on the Harmful Substances Found to Be Present at the Pilot Plant and PDU.....49

3. The DEIS Improperly Discounts the Health and Occupational Hazards Associated with the Proposed Plant.....50

4. The DEIS Fails to Contain a Worst Case Analysis of Occupational and Health Hazards.....53

5. The DEIS Fails to Provide for the Funding of Health Research and Implementation of Health Research Results.....55

B. The DEIS's Treatment of Socioeconomic Impacts is Inadequate.....36

1. Projected Population Increases are Highly Questionable.....57

2. The Discussion of Cumulative Effects is Too Vague 59

C. The Problem of the Loss of Prime Farmland is Not Adequately Discussed in the DEIS.....61

D. The DEIS Does Not Adequately Analyze the Impact on Fish and Wildlife Resources.....64

1. Inadequate Analysis of Resources.....65

2. The DEIS's Treatment of Floodplain Encroachment is Inadequate.....66

XI. DOE Must Prepare An Adequate Environmental Impact Statement or Statements Before Making Any Commitments Involving the Construction of the SRC-I Demonstration Plant.....69

CONCLUSION.....71

NOTES.....73

INTRODUCTION

The National Wildlife Federation (NWF) and the Indiana Conservation Council, Inc. are pleased to submit the following comments on the draft environmental impact statement (DEIS) for the Solvent Refined Coal-I (SRC-I) demonstration project proposed for construction in Newman, Kentucky. We are joined in these comments by the Natural Resources Defense Council.

With over 4.6 million members and supporters the National Wildlife Federation is the nation's largest non-governmental conservation organization. The Federation is dedicated to the intelligent management of the life sustaining resources of the earth and to the promotion and encouragement of the knowledge and appreciation of those resources. A central concern of the Federation's energy program is to minimize the impact of synthetic fuels on the environment.

The Indiana Conservation Council, Inc., is an affiliate of the National Wildlife Federation. The Council has over 5,000 members in Indiana who are dedicated to the wise use, conservation, aesthetic appreciation, and restoration of wildlife and other natural resources.

The Natural Resources Defense Council (NRDC) is a private, non-profit organization dedicated to the protection and enhancement of the human environment and the conservation and sensible use of the earth's natural resources. The Council has 45,000 members.

All three organizations have members living in the vicinity of the proposed SRC-I plant.

This is the third draft environmental impact statement issued by the Department of Energy (DOE) on a coal-based synthetic fuel plant. Unfortunately, DOE has repeated many of the mistakes made in the two earlier EISs. This DEIS is technically better than its two predecessors. It contains much useful information. However, this DEIS--like its two predecessors--is virtually useless as a decision-making document. Few actual impacts, and consequently few alternative plant configurations, are outlined by the DEIS since the document was prepared before completion of an actual design for the plant. Programmatic issues are dealt with summarily and superficially. Key issues such as occupational and health hazards, impacts on wetlands, impacts on agricultural lands, and social and economic impacts are poorly handled. Less damaging sources of energy are not considered as an alternative to the project. The need for the project is not adequately justified. And, DOE fails to explain why the goals of the proposed project cannot be met with a smaller demonstration project. In short, this DEIS does not enable the public or the relevant federal decision-makers to assess the full environmental costs and benefits of the proposed facility. Consequently, the DEIS does not comply with the requirements of the National Environmental Policy Act.

In the pages that follow, we outline our major concerns with the DEIS. In addition, we share the numerous concerns that have been raised by various local organizations such as Synfuel Inquiry, the League of Women Voters, the National Audubon Society Central Midwest Regional Office, and the Audubon Coalition; the various comments submitted by individuals such as Dr Richard Wham and Mr. Ted Grannan; and the criticisms of the Environmental Protection Agency and other federal, state and local agencies. We reserve the right to submit additional comments on the DEIS based on documents that we have been unable to obtain from DOE during the comment period. Among other things, both NWF and NRDC have pending Freedom of Information Act requests before DOE that are relevant to this DEIS.

I.
DOE and Other Relevant Federal Agencies Must Prepare A Programmatic Impact Statement on Synthetic Fuels Development

The inadequacy of the SRC-I DEIS is symptomatic of a major problem facing not only DOE but all other federal agencies involved in synthetic fuels development: the failure to prepare a comprehensive environmental plan for dealing with the growing synfuels industry. At the present time, DOE, the Office of Management and Budget, the Department of the Interior, the Environmental Protection Agency, and the U. S. Synthetic Fuels Corporation are making their synthetic fuels decisions largely in a haphazard fashion--without any overall

view of the broad environmental, safety, and health questions involved. In our view, this disorganized decisionmaking is not only bad public policy but violates the National Environmental Policy Act. We believe that the various federal agencies involved in synthetic fuels production must prepare a comprehensive programmatic impact statement on synthetic fuels development. As the Council on Environmental Quality's NEPA regulations state:

> (b) Environmental impact statements may be prepared, and are sometimes required for broad Federal actions such as the adoption of new agency programs or regulations (§ 1508.18). Agencies shall prepare statements on broad actions so that they are relevant to policy and are timed to coincide with meaningful points in agency planning and decisionmaking.
>
> (c) When preparing statements on broad actions (including proposals by more than one agency), agencies may find it useful to evaluate the proposal(s) in one of the following ways:
>
> (1) Geographically, including actions occurring in the same general location, such as body of water, region, or metropolitan area.
>
> (2) Generically, including actions which have relevant similarities, such as common timing, impacts, alternatives, methods of implementation, media, or subject matter.
>
> (3) By stage of technological development including federal or federally assisted research, development or demonstration programs for new technologies which, if applied, could significantly affect the quality of the human environment. Statements shall be prepared on such programs and shall be available before the program has reach a stage of investment or commitment to implementation likely to determine subsequent development or restrict later alternatives.

40 C.F.R. 1502.4(b) and (c).

The SRC-I DEIS contains a section that is labeled a "programmatic overview." DEIS, pp. 1-1 to 1-23. That label is clearly a misnomer. The section is superficial to the point of being meaningless. The purpose behind a programmatic EIS is to enable the public and relevant decision-makers to make reasoned choices involving such issues as the selection of technologies, sites, project sponsors, and environmental controls. The programmatic section in this DEIS plainly does not aid in making such choices. Among other things, the section is limited to liquefaction and does not include the other synthetic fuel technologies, it does not provide a complete list of available liquefaction technologies, it does not contain a listing of the emissions considered likely from each of the available technologies, and it fails to include any analysis regarding siting, project sponsors or detailed environmental control technologies. A brief comparison of this DEIS's programmatic analysis with almost any previous programmatic EIS prepared by DOE or its predecessors will demonstrate how ridiculously inadequate this DEIS's analysis is. Compare e.g., ERDA, EIS on Coal Research, Development and Demonstration Program (ERDA-1557); DOE, Management of Commercially Generated Radioactive Waste (DOE/EIS-0046-D); and ERDA, Alternative Fuels Demonstration Program (ERDA-1547). At a minimum, a programmatic EIS on synthetic fuels must present a

detailed analysis of the following key questions:

Technologies

- What type of fuel is produced? How can it be used? For utilities? Transportation? Petrochemical feedstocks? Industrial boiler fuel? Where is the demand for the fuel? At what price? Does the fuel meet environmental requirements for the regions where it might be used?

- Is the technology restricted to certain geographical regions by resource availability (e.g., water, specific types of coal, clean air increments, or, for specific technologies, shale, waste, or grain)?

- How close is the technology to commercial readiness from a purely technological viewpoint?

- What are the known environmental, safety, and health problems associated with the technology? What are the available control technologies and their relative merits? What are the known residual impacts after application of control technology?

- What are the unanswered environmental, safety, and health questions? What are the alternative means to provide the data necessary to answer the questions? How long will it take? How significant are the risks associated with the questions and what is the affected area or population? Are the questions uniquely associated with production or use of the fuel? Are certain uses more problematic than others? Are the questions unique to the technology? How much previous research has been done and by whom?

Site Selection

- Which geographic regions are suitable for which technologies? Which are uniquely suitable? What are the controlling factors?

- What is the likely timetable for development of different technologies in each region absent federal restraints?

- What is the capacity of the region to absorb the cumulative impacts of multiple synfuels development, in terms of infrastructure, environment, and socieconomic dislocations? Which competing uses--other industries, agriculture, recreation, etc.--will be adversely affected and to what degree by multiple plant development?

- What are the applicable regulatory requirements in each region? Which requirements are likely to change or develop?

Sponsors

- What types of sponsors have expressed interest in synthetic fuels development?

- Are there significant differences among sponsors relative to their ability and willingness to resolve environmental, safety, health, and socioeconomic issues? Is it significant if a sponsor already owns a site? A resource supply? A specific process?

- Are there important differences in approach among sponsors that are primarily energy producers and those that seek feedstock or a captive fuel supply?

- What factors can be used to determine a sponsor's capacity and willingness to promptly identify and resolve environmental, safety, health, and socioeconomic problems? Commitment of resources in project preparation? Regulatory record? Commitment of resources to environmental, safety, health, and socioeconomic problems in other activities? Early consulation with the public?

The interaction of these factors cannot be assessed or managed proposal-by-proposal. It requires generic programmatic analysis and planning. That is precisely the function of a programmatic EIS. In the absence of such an analysis, DOE and other federal entities will inevitably proceed ad hoc and will thereby foreclose both environmental and technological options. Each failure to resolve problems early before going forward to the next step will simply increase the cost of later rectification of previous errors, and may well impose a cost in lives and illness.

While various federal agencies have commendably commissioned a variety of studies on specific aspects of the

program, they remain essentially useless because they have not been integrated into a coherent whole and made a basis of action. Each of the studies is like a sentence out of context. It is impossible to read them and determine what steps should be taken by the relevant decisionmakers as a result.

The failure to insist upon effective coordination of research, regulatory, promotional and industrial activities may enable faster action now, but it will ultimately injure the synthetic fuels industry. Sites that should have been reserved for site-limited proposals will be used by plants that could have been sited elsewhere. Environmental monitoring and late-concluded health studies will reveal the need for expensive modifications that could have been avoided through early resolution of critical questions. The failure to address cumulative local impacts will lead to levels of degradation and rates of growth unacceptable to the local population, in turn resulting in litigation and legislative action. Haste now will create all the necessary preconditions for debilitating regulatory uncertainty later.

DOE and all other agencies involved with synthetic fuels should write a programmatic impact statement and treat it not as an inconvenience, but as a vehicle for developing a comprehensive strategy that establishes standards and criteria for environmentally responsible management of the program. In

the absence of such a document, the federal government will continue to make the kind of shortsighted decisions NEPA was enacted to prevent.

II.
The DEIS Does Not Adequately Justify the Need for the Proposed Demonstration Project

The initial and perhaps most striking question raised by this DEIS is: why build the SRC-I plant at all? The DEIS never adequately addresses itself to this question. The question contains several important aspects that should be addressed in the final EIS:

- o Why should DOE support a plant whose primary product will be solid fuel? Much of the nation's energy problem is a "liquids" problem. We consume too much oil--much of it from foreign sources of supply. Why should the federal government invest enormous amounts of taxpayers' money supporting a plant designed to convert domestic coal into another solid fuel?

- o Why do we need two SRC demonstration plants? This plant is one of two proposed SRC demonstration plants; the other is proposed for construction near Morgantown, West Virginia. Why isn't it possible to demonstrate the SRC technology with only one plant?

- o Why don't we invest the funds earmarked for the SRC-I project in less expensive, environmentally less damaging energy sources? According to a recent study by the General Accounting Office (GAO), the total cost for the SRC project may exceed $3 billion. Numerous recent studies indicate that DOE could produce far more energy, reduce our consumption of foreign oil, and inflict less damage on the environment by spending this $3 billion on

> solar energy and other renewable energy sources and energy conservation. We expand on this point in the section below on energy conservation alternatives.

The final environmental impact statement must present detailed answers to these questions.

The federal Office of Management and Budget has itself raised the first two of the above questions. In comments on the DOE FY1982 Budget, OMB stated that:

> The OMB recommendation also would terminate the SRC-I project....Originally, SRC-I was distinguished from the SRC-II product on the basis that it produced a solid product. Now, however, project sponsors are proposing to also produce liquids after hydro-processing of the primary solid product. As the product slate for SRC-I approaches that for the SRC-II project there is less of a justification for proceeding. With the advent of the SFC [Synthetic Fuels Corporation] it is likely that the commercial adoption of SRC technology would not be delayed if this project were terminated. Although there are important differences between SRC-I and SRC-II, the processes have many common steps. The differences are not judged to be so significant that the private sector could not commercialize the SRC-I approach given a successful demonstration of SRC-II and the existence of the SFC. Also, given the high technical risks of scaling up two processes from a less than 60 tons-per-day pilot plant to a 6000 ton-per-day demo plant and the substantial Federal cost, at least $1.4 billion, the fiscal and risk savings produced by termination of the SRC-I project are significant [emphasis added].

III.

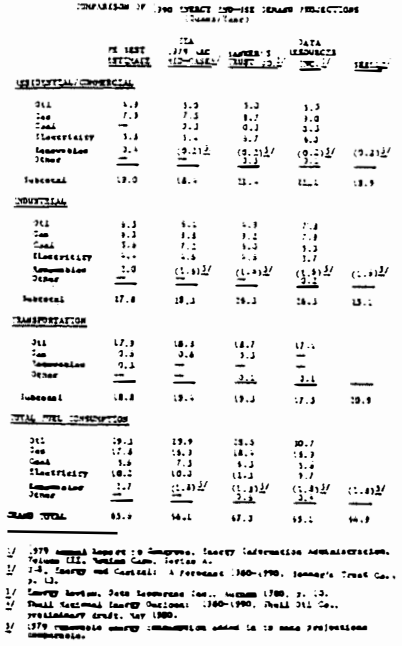
The DEIS Fails to Consider Energy Conservation and Renewable Energy Resources As An Alternative

The DEIS gives cursory and inadequate attention to the

possibility of the development of conservation and renewable energy sources as an alternative to the current proposal despite the fact that the CEQ NEPA regulations require an EIS to include detailed discussions of "[e]nergy requirements and conservation potential of various alternatives and mitigation measures." (emphasis added) 40 C.F.R. 1502.16(e). Although the DEIS admits possible savings from energy conservation as an immediate and cost effective way to deal with the energy problem and that solar and other renewable sources may make a contribution, the conclusion seems to be that these contributions are either insignificant or that they need to be augmented by the potential contribution of the SRC-I. This conclusion is not borne out by the facts. If we accept as given the notion that there is a limited amount of Federal money to be spent, then choices must be made. The most cost-effective and environmentally sound alternatives must be implemented.

Higher prices and the conservation impacts of Federal programs have resulted in significantly lower projected end-use demands than those quoted in Table 1.1 of the DEIS. The attached Table I compares several recent projections, all of which conclude that the DEIS figures overstate the case for end-use demand by more than 19 Quads. Recent deregulation of oil prices and proposed deregulation of natural gas prices are not considered in these tables and will probably reduce demand even further.

Table I



Source: Reducing U.S. Oil Vulnerability: Energy Policy for the 1980's (Washington, D.C.: U.S. Department of Energy, November 10, 1980), p. IV-H-5.

The imputed contribution of the solar and conservation options to total energy use by the year 2000 (25.9 Quads) and to oil savings specifically(8.3 Quads) are not noted in the DEIS. The attached Table II indicates the expected impacts of current federal programs for conservation and solar energy by program area. Table III describes 1990 energy savings by specific program and projects OPEC price increases (but not increases due to recent and proposed deregulation). Given the dramatic potential indicated for conservation and solar energy use stimulated by existing federal programs alone, it is incumbent on the DEIS to determine whether additional programs would not provide the most cost effective alternative to the proposed plant.

Further, there is no discussion whatsoever of the comparative environmental impacts of the proposed plant with the possible solar and conservation options.

This method of analysis, which merely states that the solar and conservation options exist but fails to compare them to the proposed plant on the basis of cost or environmental degradation, is seriously flawed. As an example of a more appropriate analytical technique, see the Allen-Warner Valley Energy System Environmental Impact Statement. Although not perfect by any means, that final EIS addresses the potentials for energy conservation programs and possible use of renewable energy sources in sufficient detail to allow for comparison to

Table II

Expected Impacts of Current DOE Conservation Programs on Energy and Oil Savings (Quads)[1]

	Energy Savings		Oil Savings	
	1985	2000	1985	2000
Residential/commercial	1.4	4.6	.2	.6
Industrial	1.0	6.2	.2	1.7
Transportation	.1	1.3	.2	3.6
Utilities	0	.8	.02	.3
Cross-Sectoral[2]	.1	1.0	-	.2
Aggregate Savings	2.6	13.9	.6	6.4

[1]These incremental impacts are measured with respect to baseline energy use projections (38 Quads in 1985 and 107 Quads in 2000) which reflect all existing legislation as of Jan. 1980 (e.g., tax credits, Corporate Average Fuel Economy standards, phased decontrol of oil, and phased deregulation of natural gas).

[2]The savings shown are associated only with the Community Systems program. No estimates have been calculated at this time for the following programs: Municipal Waste, Non-Utility Storage, Energy Extension Service, State Energy Conservation Program, Appropriate Technology, Energy Conversion and Utilization Technology, Energy Related Inventions Program.

Expected Total Solar Contributions and Oil Displacement with Current DOE Solar Programs (Quads)[1]

	Energy Displacement			Oil Displacement	
	Current	1985	2000	1985	2000
Residential/commercial	.3	.5	2.7	.05	.2
Industrial	1.5	1.7	3.8	.1	.8
Transportation	0	.04	.9	.04	.9
Utilities	3.05	3.2	4.35	.02	.03
Aggregate Savings	4.85	5.4	12.0	.1	1.9

[1]Expected energy contribution refers to the projected conventional energy displacement by solar with the basic level of funding for DOE solar programs.

Source: Office of the Assistant Secretary for Conservation and Solar Energy, Conservation and Solar Strategy (Washington, D.C.: United States Department of Energy, January, 1981), p. 30, 31.

Table III

1990 DIRECT SAVINGS IN THE BEST ESTIMATE CASE
(Quads/year)

	PROJECTED 1990
END-USE DEMAND WITHOUT SAVINGS[1]	96.6
SAVINGS FROM CONSERVATION PROGRAMS	
Energy Policy and Conservation Act (EPCA)	
Federal Energy Management Program	-.09
Schools and Hospital Weatherization Program	-.39
Subtotal	-.2
National Energy Act of 1978 (NEA)	
Conservation	
Building Conservation Programs/Appliances	-.87
Automobile and Truck Standards	-.56
Utility Rate Reform	-.19
Energy Taxes	
Residential Tax Credits	-.48
Gas Guzzler Tax	-.34
Business Energy Credits	-.23
Subtotal	-2.7
Energy Security Act of 1980	
Residential and Commercial Conservation Measures	-1.06
TOTAL SAVINGS FROM CONSERVATION	-3.9
SAVINGS FROM ENERGY PRICE IMPACTS	
1973 OPEC Oil Price Increase Savings	-9.6
1979 OPEC Oil Price Increase Savings	-6.9
Post-1979 OPEC Oil Price Increase Savings (2.4%/Year real increase)	-1.6
TOTAL ENERGY PRICE SAVINGS	-17.1
PROJECTED END-USE CONSUMPTION	65.6

1/ Projected end-use demand at 1972 world oil prices, and with no conservation savings from the above energy policies.

Source: Reducing Oil Vulnerability: Energy Policy for the 1980's (Washington, D.C.: U.S. Department of Energy, November 10, 1980), p. 11-H-5.

the proposed project. Bureau of Land Management, Final Environmental Impact Statement on Allen-Warner Valley Energy System (December 17, 1980), pp. 2-41 to 2-50, 4-145 to 4-161. This DEIS must present a comparably detailed analysis.

IV.
The DEIS Does Not Consider Possible Construction of a Smaller SRC-I Demonstration Plant

The SRC-I facility described in the DEIS will process 6,000 tons per stream day (tpsd) of high sulfur coal during its demonstration phase. This represents a scale-up of 120 times from the largest SRC facility--the Fort Lewis, Washington pilot plant. The DEIS offers no discussion of the technical, environmental, or financial risks associated with expanding a small-scale pilot plant to a facility of this size, nor does it consider the alternative of constructing a smaller demonstration plant.

This is a disturbing omission considering the earlier resistance of the contractor and the Kentucky Department of Energy to a plant larger than 2,000 tons per day. In its original proposal to DOE, submitted March 28, 1978, Wheelabrator CleanFuel Corporation contended that a 2,000 tpsd plant would adequately achieve the objective of demonstrating the viability of commercially sized equipment; and it specifically rejected a 6,000 tpsd module as presenting significantly greater risks while offering only marginal advantages. Proposal, p. 2-3; see also, Status Report, Feb.

1978, p. 10. The 2,000 tpsd plant, according to Wheelabrator,

> has been selected as the largest size for which commercially available equipment can be practically employed, yet is sufficiently large to permit extrapolation to full commercial size with reasonable technical confidence.

Latter to John O'Leary, DOE, March 27, 1978.

Studies recently completed on the SRC-I's sister plant proposed for construction in Morgantown, West Virginia also demonstrate the need for considering construction of a smaller facility. One 1979 report to Gulf Mineral Resources by the Stearns-Rogers Engineering Co. on the SRC-II demonstration plant recommended a 1,500 tpsd facility as the "most reasonable selection," while another report prepared by Badger Energy, Inc. stressed the "technical and schedule advantages in limiting the size and number of trains in the demonstration plant." In fact, the chairman of Gulf recently stated in an interview that:

> Now if we had our 'druthers, we wouldn't do it this way. This is too much of a jump in an orderly technical development--to go from a 50 ton a day plant to a 6,000 ton a day plant.

Wheelabrator CleanFuel Corporation, in a status report on the solvent refined coal process, stated that even a 600 ton per day demonstration plant would be "of sufficient size to allow a mechanical demonstration." February 1978 Status Report, p. 10. Similarly, a study of coal liquefaction prepared for the National Academy of Sciences concluded that:

> Demonstration of a process to obtain data for the design of a commercial plant can be carried out in a properly designed and operated unit utilizing 250 to 600 tons per day. The first commercial (pioneer) plants can then be designed from the information obtained.

National Academy of Sciences, Assessment of Technology for the Liquefaction of Coal (Washington, D.C., 1977), p. 4.

Even the 2,000 tpsd plant, which represents a scale-up of 40 times from the pilot plant, is acknowledged by the company's original proposal to present considerable risk. DOE, however, has inexplicably decided to ignore the early advice of its private investors by proposing a facility three times the original recommended size. As Wheelabrator demonstrated in its 1978 proposal, the 6,000 tpsd plant is not only unnecessary to achieve the project goals but needlessly multiplies the many potential risks and uncertainties inherent in the SRC-I project. It is imperative that the impact statement for this project consider in detail the construction of a smaller demonstration unit. The consideration of alternatives for lessening of the impact of a project on the environment constitutes the "heart of the environmental impact statement." 40 C.F.R. 1502.14. Hence, it seems obvious that a smaller demonstration unit would inflict less damage on the environment without compromising DOE's programmatic goals.

V.
Preparation of the Environmental Impact Statement For the SRC-I Demonstration Project is Premature

The Draft Environmental Impact Statement on SRC-I was prepared on the basis of a preliminary conceptual design. DOE

concedes that the conceptual nature of the current design limits any evaluation of process alternatives. NEPA requires that an environmental impact statement be detailed and contain a "full and fair" discussion of impacts and alternatives. While the DEIS identifies innumerable and substantial problems in the current plans for the SRC-I facility, it cannot present an adequate discussion of potential environmental harm or alternative courses of action without a more complete and detailed design.

There are literally dozens of instances in the DEIS where the lack of essential data regarding the functioning of the plant and its environmental and socioeconomic impacts is attributed to either inadequate research or the conceptual nature of the plant design. We have extracted a sampling of these to illustrate the problem.

Conceptual Design. On the general subject of plant design, for example, the DEIS states:

> The designs of several plant features of of environmental significance are incomplete and will be highlighted for environmental review during detail design. DEIS, p. 2-39.

As the U. S. District Court for the District of Columbia has stated (Environmental Defense Fund v. Hardin, 325 F.Supp. 1401, 1403-04 (D.D.C. 1971):

> [An EIS] must be sufficiently detailed to allow a responsible executive to arrive at a reasonably accurate decision regarding the environmental benefits and detriments to be expected from program implementation.

Such a process of decision-making would be impossible on the basis of the current DEIS, not only because of the lack of a specific design, but also because the "conceptual" design, such as it is, is evidently continually changing. The DEIS recognizes this:

> The proposed design is under continual evaluation by both DOE and the industrial participant and may be further modified. DEIS, p. 2-3.

It would seem that any decision that could be made concerning the current design is likely to be futile at this stage in the development of the project.

Alternative Plant Designs. The Council on Environmental Quality Regulations under NEPA require that the environmental impact statement "shall inform decisionmakers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment...." 40 C.F.R. 1502.1. Yet on the subject of alternative plant designs, the DEIS states:

> Evaluation of alternatives for heat rejection, process hydrocarbon emission control, product solidification, coal drying, and sulfur emission control indicate that further study might reveal an alternative with less environmental impact than the proposed design. It should be noted that this evaluation is limited by the conceptual nature of the current plant design. These alternatives are being further evaluated by both DOE and the industrial participant to determine their technical and economic feasibility and to obtain a more quantitative evaluation of

> their potential for reducing adverse environmental impacts. DEIS, p. 2-39.

Occupational and Public Health Effects. On the subject of public health effects, the DEIS states:

> A program of data collection, research, and assessment for SRC-I demonstration plant is in progress and will continue to be necessary to better quantify impacts. DEIS, p. 4-1.

Many of the properties of SRC products are unknown, and emission standards have not yet been formulated:

> Although current and project environmental quality standards and emission limitations require application of state-of-the-art pollution control techniques, standards and limitations do not yet exist for most of the classes of compounds that are of concern. DEIS, p. 4-2.

Methods for controlling these substances have not yet been devised:

> Pilot plant studies have shown that the qualitative and quantitative compositions of SRC products and wastes vary and are sensitive to changes in coal feedstock and process conditions such as temperature, hydrogen pressure, and residence time. This variability, combined with the fact that only a conceptual SRC plant design exists at this time, reduces the ability to predict the specific compounds and exact concentrations of such compounds that will be present in products, intermediate streams, wastes, and occupational environments. This, in turn, limits the ability to quantitatively predict occupational and public health consequences of altered plant operating conditions. DEIS, p. 4-2.

Impacts on Water Quality. Considerable research is still required to assess the effects of the plant on water quality. For instance, movement of groundwater beneath the site is unknown:

> At the present time, specific natural groundwater movement beneath the site is not known. DEIS, p. 4-28.

This information will only be available in the final EIS:

> Monitoring results to date indicate that groundwater beneath the western third of the site apparently moves in a southwesterly direction while groundwater beneath the eastern portions of the site moves in a southeasterly direction. Additional information on the site groundwater system will be included in the final EIS. DEIS, p. 2-45.

Effectiveness of control technologies is not fully known. For instance, regarding the wastewater treatment system, the DEIS states:

> A comprehensive laboratory study is being conducted to determine how effectively the proposed system can control trace toxic metals and the complex trace organic materials that may be toxic and/or carcinogenic. The laboratory program will characterize the contaminants in the streams expected in the demonstration plant and will determine the treatability of the wastewater expected at the demonstration plant. DEIS, p. 2-45.

* * * *

> Significant degradation of water quality is expected to occur only if wastewater recycling equipment is inoperable during low-flow periods. The probability of this occurrence cannot be predicted, because the

> reliability of the wastewater recycling system is uncertain. DEIS, p. 4-42.

After discussing the problem of water-soluble solid wastes and the ineffectiveness of various control processes, the DEIS states:

> Disposing of these water-soluble salts is recognized as one of the key engineering considerations of the detailed-design phase. DEIS, p. C-24.

Impacts on Air Quality. The effectiveness of equipment to control emissions from the SRC-I facility is highly conjectural. For instance, on page 4-58, the DEIS states:

> Operation of the proposed SRC-I plant will result in small emissions of heavy metals and reduced sulfur compounds. As discussed in Sect. 2.2.1, the types and amount of these emissions will depend on the type of coal processed and the efficiency of pollution control equipment, which will be more accurately analyzed during detailed design of the plant.

With regard to the emission of hydrocarbons during process upsets and emergencies, the DEIS states:

> Some of these combustible materials may contain complex organic compounds including carcinogenic substances, and flaring from an elevated flarestack (a conventional refinery and petrochemical industry practice) may not adequately destroy these compounds....A controlled combustor system could be used to incinerate the heavy hydrocarbons. The design of this system is under evaluation by DOE and the industrial participant and represents one of the major environmental control decisions to be made during the detailed design phase. DEIS, p. 2-39.

On the subject of commercial plant emissions, the DEIS states:

> For purposes of this analysis, the unit plant emissions have been estimated from conceptual design of an SRC-I commercial plant. In the absence of final plant designs, it is difficult to estimate accurately the total emissions arising from a commercial coal liquefaction facility. Existing emissions data are highly conceptual. DEIS, p. 1-34.

Emergencies. Given the preliminary state of the design process, the DEIS can only predict that emergencies will occur; it cannot provide much information as to their frequency or potential hazardous effects.

> Emissions of process materials resulting from such an event cannot be predicted at this time. The safety analysis report will address the likelihood of these events, the impacts that would result from them should they occur, and appropriate design and operating measures to protect employees and the public. DEIS, p. 4-6.

Mitigation. The deficiencies of the DEIS are epitomized in the introduction to the section on mitigation measures:

> The following lists of mitigation measures are intended not to be exhaustive but to highlight some of the site-specific and process-specific control measures that are responsive to environmental concerns. Some mitigation measures cannot be specified in detail at this time. In some cases studies are currently underway or will soon be undertaken to determine the nature and magnitude of potential environmental problems. In other cases the detailed mitigation techniques will be developed along with the final plant design itself. DEIS, p. 4-137.

It is not surprising that the DEIS is unable to devise reasonably comprehensive mitigation alternatives. To do so requires a clearer sense of the actual functioning and likely impacts of the proposed facility than is possible on the basis of the present design. The length and technical complexity of the DEIS is misleading. While it is replete with statistics, diagrams and the appearance of detailed analyses, even a superficial examination reveals that the design is hopelessly vague, the assessment of impacts is shallow and the alternatives for mitigating those impacts is perfunctory.

Not only is the current design inadequate, but many critical studies of the technological processes involved and their environmental effects have not yet been completed. Although the deadline for public comment on the DEIS is March 2, 1981, the SRC-I contract provides that a Demonstration Plant Environmental Plan will not be prepared until July, 1981. Also, socioeconomic studies and plans for obtaining water and power for the plant are not contractually required to be completed until March, 1981. SRC-I Contract, p. A-18. According to the DEIS, the Preliminary Safety Analysis Report is not scheduled to be completed until December, 1981. DEIS, p. AA-5. Pollution Control Guidance Documents, which will identify the best and most cost effective emission and discharge control systems for direct liquefaction, will not be available until October, 1981. DNREP Briefing Paper, p. 97.

Finally, the EPA/DOE/KNREP Joint Work Plan identifies a variety of studies relating to environmental issues that are planned, but have not yet been conducted. These include: an assessment of the effects of floods on the construction and operation of the facility; an evaluation of hazardous and non-hazardous waste disposal sites; selection of pollution control designs; and the development of a program for monitoring system performance, ambient environmental quality and health effects of plant operation.

Obviously, these reports and studies are critical to an informed and thorough appraisal of the environmental acceptability of the plant. We agree with DOE's observation in the DEIS that "comprehensive detailed safety reviews can only be done when detailed design information becomes available." DEIS p. AA-4. We believe that this highlights the need for a more complete design before closing public comment on plans for the proposed facility. Clearly the attempt to finalize the EIS before these essential reports are available precludes fully informed public comment on the proposed project and assures that very basic decisions and irrevocable commitments of resources will be made on the basis of incomplete data. DOE has also stated that "further study might reveal an alternative with less environmental impact than the proposed design." If this is true, and we believe it is, then surely DOE is obligated to conduct those studies before reaching its

decisions of the merits of the proposed project. To do otherwise would frustrate the purpose of the EIS process.

In its recent report on DOE's liquefaction program (PSAD-81-19), the General Accounting Office identified other risks involved in failing to prepare a sufficiently detailed design before proceeding with a project of this sort. GAO concluded that the lack of an adequately detailed design before the commencement of construction on the H-Coal plant in Catlettsburg, Kentucky resulted in serious construction quality problems and immense cost overruns. GAO predicted that a similar experience at a facility of the size of SRC-I would have a "devastating effect" on the project.

VI.
The DEIS Fails to Provide a Full and Candid Appraisal of the Experience at the SRC Pilot Plants

For over 5 years DOE has funded two SRC pilot plants. One would expect the DEIS to be full of data from those facilities. To the contrary, most sections of the DEIS contain no references to those pilot facilities. It is incumbent upon DOE to present a full and candid appraisal of the experience at the SRC pilot plants. How have those plants functioned? What, if any spills, fires, accidents or releases of hazardous substances have occurred? What environmental monitoring has taken place at those plants and what did that monitoring demonstrate? What design changes need to be made in the demonstration plant in the light of experience at the pilot

facilities. These and other similar questions should have been addressed in the DEIS.

The importance of evaluating the pilot plant experience is highlighted by recently released reports of potentially serious environmental problems at those plants. Among those problems that have come to light to-date are the following:

o On November 19, 1980, a crane installing a new nitrogen tank at the Wilsonville pilot plant placed the tank on a concrete pad. The inadequate pad collapsed, tipping the tank into a nearby pipe rack and severing the outlet line at a caustic storage tank. 11,000 gallons of sodium hydroxide solution escaped therough the broken pipe onto the ground. A nitrogen cloud covered part of the plant site for 15 to 20 minutes. The pilot plant was shut down for three weeks and cost of cleaning up the incident was estimated at $75,000 to $100,000.

o On December 27, 1980, 150 to 200 gallons of oil were inadvertantly spilled from a wastewater treatment system at the Fort Lewis pilot plant. A surge of water coming down the wastewater drain apparently forced oil out of the collection tank. The oil flowed downhill, over a road and settled on top of a water-filled depression. 12 inches of soil at the spill site were excavated to clean up after the accident.

o Testing and videotaping of 1800 feet of process sewers at the Fort Lewis pilot plant have indicated failures of the clay pipe in over 1500 feet of the system. As one internal memorandum notes "it is therefore probable that water runoff containing small concentrations of coal-derived materials have seeped into the grounds within the plant area." Memorandum to Anthony L. Liccardi from Ronald H. Fischer, Subject: Ft. Lewis Pilot Plant Sewer Inspection, October 10, 1980.

o On March 23, 1978, there was a significant spill of naptha at the Fort Lewis Plant as the result of an employee's failure to close a bleed valve. The spill produced a 75 foot oil slick.

o In a much more widely publicized spill, on November 19, 1979, over 2,000 gallons of SRC distillate spilled out onto the ground at the Fort Lewis pilot plant. The toxic distillate threatened to contaminate a ground water aquifer and a lake used as a salmon hatchery. A major cleanup effort--involving the excavation of several thousand cubic yards of soil--was required. That cleanup is now estimated to cost over $1.4 million. Despite the seriousness of the spill, we could find only one textual reference to the spill in the DEIS. On page 4-14, the DEIS states that "effects of the spill of SRC-II liquid at the Fort Lewis pilot plant on nearby aquifers exemplify this potential [for groundwater contamination]." This lack of a detailed analysis of the Fort Lewis spill is irresponsible.

o Apparently, there have been other significant spills at the Fort Lewis pilot plant. A recent internal DOE memorandum notes "[a] total of nineteen(19) possible contaminated sites other than the 12/19/79 spill site have been identified as candidates for sealing..." Memorandum to R.M. Hamilton from Project Manager, SRC Pilot Plant, Subject: Oil Spill Update SRC Pilot Plant (September 12, 1980).

o The plant project manager recently summarized some of the environmental problems at Fort Lewis in the following terms: "Both coal and solid wastes are openly stored at the plant site, subject to lixivation during periods of rainfall and uncontrolled discharge of the leach to Hamer Marsh. Also, extensive unpaved areas of the plant have been contaminated by cumulative spills during the plant's five years of operation. Water soluble components of the oil spills are a continuing source of

> contamination for the aquifer, thirty five feet below grade." Memorandum to Liquefaction Project Manager from G. B. Sweeney, Project Manager, Subject: Storm Water Runoff and the Environment at SRC Pilot Plant (September 12, 1980).

These do not appear to be isolated incidents. It appears that the SRC pilot plants have been riddled with problems. DOE must provide a full accounting of all of those problems. In addition, DOE must provide a process by which problems can be corrected when they develop. One of the lessons that must be learned from the major spill at Fort Lewis is that DOE has difficulty responding to major, unexpected developments. This point was forcefully made by the Deputy Director of the State of Washington's Department of Ecology:

> [I]t has become evident that federal procurement procedures are not responsive to the need for timely accomplishment of required environmental goals at this [Fort Lewis] facility.
>
> The nature of the pilot clean-up is such that decisions must be made as more information is obtained and the clean-up progresses. Construction of additional monitoring or production wells for instance could be required at any time and the delays in getting approval for such items through Washington, D.C. are unacceptable.
>
> Excavation of contaminated material from the December 19, 1979 spill was substantially delayed because of the process and currently the construction of a reliable groundwater monitoring well and the investigation and cleanup of the remaining plant are being delayed.
>
> I realize that we are all somewhat constrained by regulation and procedures but we should also be prepared for emergency situations. I suggest that a contingency fund be authorized immediately for use at the P&M plant to avoid further delays.

Letter to Dr. James D. Batcheler from Elmer Vogel, Deputy Director, Department of Ecology, State of Washington, July 11, 1980.

DOE's failure to be candid about its experience at the pilot plants is irresponsible, unjustified and casts doubt on the entire NEPA process for the SRC-I project.

VII.
The DEIS Does Not Contain An Adequate Justification For Locating the SRC-I Plant At the Newman, Kentucky Site

Nowhere in the DEIS, or apparently elsewhere, is there an environmental analysis comparing the Newman, Kentucky site for the plant with other potential alternative sites. The Oak Ridge National Laboratory (ORNL) site analysis described in Appendix B of the DEIS compares alternative sites with each other but not with the Newman site.

The Newman site was orginally selected as the result of an analysis conducted by Rust Engineering Company in 1976. That analysis, as DOE concedes, was based exclusively on engineering, economic and physical criteria, such as ease of acquisition, site preparation, access, and labor availability. There was no consideration of environmental impacts other than a literature search for records of historical or archaeological resources or rare or endangered species at the three most desirable sites. DEIS, p. B-6.

Unlike the Rust study, the ORNL site analysis placed primary emphasis on environmental criteria in selecting

alternatives to the Newman site. Unfortunately, Newman was never subjected to these criteria. This is not surprising given the likelihood that the Newman site would fare extremely poorly in such an analysis. In fact, Newman could not possibly have received a positive rating when evaluated on the basis of the following seven environmental variables employed in the ORNL study:

> o Surface Water Quality: The DEIS states that the Green River has good water quality and is classified "effluent limited." DEIS page 3-19. Should discharge of wastewater occur during a low flow period, degradation of water quality would be significant. DEIS, page 2-20.
>
> o Endangered Species: The endangered Indiana bat was found in the riparian forest areas on the site. The DOE field study was conducted too late in the season to determine whether the site serves as a breeding colony, however additional surveys are planned for the summer of 1981. DEIS, p. K-11. The bald eagle and Arctic peregrine falcon are also "infrequent visitors to the site. DEIS, p. 3-12.
>
> o Wetlands: Wetland resources on the proposed site include six on-site ponds and bottomland forest along Martin Creek that are described as "high-quality wetland areas." The forests along the Green River Shoreline and Bryant Ditch are also wetland habitats. DEIS, page D-14.
>
> o Geologic Hazard: The site is located on the boundary of seismic risk zones 2 and 3. The DEIS attributes this "relatively high risk classification" to the "continued seismic activity" in the region. A zone 3 classification indicates that "major destructive earthquakes may occur with risk of major damage to structures." DEIS, p. 3-6.

> o Prime Agricultural Soils: 91% of the site is classified prime farmland by the U. S. Soil Conservation Service. DEIS, p. 3-2.
>
> o Groundwater Use: Information on groundwater movement is not yet available, but potential consequences include drawdown of the aquifer, contamination of domestic water supplies, and general deterioration of the water resource. DEIS, p. 4-28.
>
> o Air Quality: Monitors in Daviess County show violations of NAAQS for ozone, and Henderson County, which was only recently classified attainment for ozone, is still borderline in meeting those standards. The nearby cities of Henderson and Owensboro, and counties of Muhlenberg and Vanderburgh are currently in non-compliance with air quality standards for TSP. Henderson and Owensboro are in nonattainment with SO_2 standards. KNREP Briefing Paper, p. 37.

In short, it appears likely that Newman would be identified as one of the least desirable sites on which to locate the SRC-I demonstration plant. This point was graphically made by Hittman Associates, a consulting firm retained by EPA to review the preliminary DEIS:

> A considerable part of chapter 2 [of the preliminary DEIS] is devoted to a discussion of the site: the fact that most of it lies in the 100 year floodplain, the presence of endangered species, the existence of 'riparian hardwood forest', the presence of 'prime agricultural soil', and so forth. No discussion of alternatives to this site is given. Only negative factors are identified. After reading chapter two (and other sections of the DEIS) several times, this reviewer is forced to wonder why anyone would want to locate the facility at this site and, further, how anyone could expect to do so without arousing a wave of protest from conservation and environmental groups. Not

> a single strong reason is given <u>for</u> selecting this site, DEIS, p. 2.

Indeed, the only reason the reader is given for the superiority of Newman over the alternative sites analyzed later is that it was selected first:

> "Newman, Kentucky, having been chosen in the 1976 Rust site selection study, was proposed as the site for the SRC-I project." DEIS, p. B-3.

However, the validity of that initial Rust study is itself questionable, not only for its total disregard of environmental factors, but also in light of later design changes in the plant and because of inconsistencies in the original selection process. For instance, the Rust study was premised on a 2,000 tpsd facility, however, the current plan is for a 6,000 tpsd plant with capacity for expansion to a 30,000 tpsd commercial facility. In addition, a major criteria used by Rust to eliminate potential sites was that a large percentage of the land area was located on a floodplain. DEIS, p. B-4. Over 65% of the proposed site is located on a 100 year floodplain and 75% of the area lies below the 500 year flood elevation, yet no explanation is given for why this fact did not bar selection of the Newman site. The Rust Study was also conducted before Executive Orders 11988 and 11990 concerning floodplain and wetland encroachment were issued. Yet, despite significant changes in the design and capacity of the plant, and in applicable environmental regulations, Newman was retained as the preferred location.

On the other hand, the ORNL study, which purports to compare environmental impacts at alternative sites with the proposed location, makes no such comparison and is not even a convincing facsimile of the type of review required by NEPA. The sites selected for comparison are the same locations considered in the SRC-II environmental impact statement. According to the Hittman report, p. 30, "no further characterization of these sites has been conducted since that document was released." The explanation offered by the DEIS is that, "Because of the constraints of time and unavailability of resources, it was not possible to visit each of the remaining sites." DEIS, p. B-9. The DEIS also states that, "a definitive comparison of the environmentally acceptability of alternative sites is severely constrained ... by the availability of consistent and detailed information on each site." DEIS, p. xxvi. It would seem that by duplicating the site selection for SRC-I and SRC-II, there would have been sufficient time for the necessary studies to have been performed.

Unfortunately, the ORNL siting analysis appears to be merely an elaborate post-hoc justification for the original Rust Engineering analysis that did not include environmental factors. The National Environmental Policy Act requires that the DEIS do more than justify a contractor's inadequate analysis.

VIII.

The DEIS Does Not Present a Plan for Collecting Baseline Environmental Data Nor Does It Outline An Environmental Monitoring Plan

The DEIS repeatedly indicates that one of the major purposes of the demonstration project is to "confirm the effectiveness of environmental control systems." E.g. DEIS, p. 1-23. Unfortunately, the DEIS does not provide a detailed plan for assuring that this goal can be accomplished. If the SRC-I plant is to be an environmental demonstration plant, the following four steps must be taken:

First, the DEIS must must identify those substances that are of environmental concern and that, consequently, will be subject to monitoring. This list should include all potentially harmful substances whether regulated or not. As the DEIS admits (DEIS, p. 4-132), many of the substances of primary concern are not presently regulated.

Second, the DEIS must set forth a plan and schedule for collecting environmental baseline data. Data must be collected for all substances of concern and all potential health effects. Without this baseline data, it will be impossible to evaluate the impact of the proposed facility on human health and the environment. The existence of sound environmental baseline data is especially important where, as in this case, the proposed plant will be located in a region with numerous other potential sources of pollution. Early development of a plan and schedule for collection of baseline data is critical

since all the required baseline data must be collected before the demonstration plant commences operation.

Third, the DEIS must set forth a detailed environmental monitoring program. This program must, among other things, provide for the monitoring of fugitive and other emissions both within and outside the plant. A detailed explanation must be provided of the methodology to be employed in selecting monitor locations.

Fourth, the DEIS must provide a detailed plan for evaluating the monitoring data and translating that data into changes in plant design. As we note below, development of such a plan now is especially important in light of the proposed cuts in federal environmental research.

The DEIS provides for the future development of an environmental monitoring plan. DEIS, p. 4-133. Such vague assurances are inadequate and do not comply with NEPA. Unless a monitoring plan is available in the EIS, it will be impossible to assure the collection of the required environmental baseline data before plant construction begins.

Without extensive environmental baseline data and sound monitoring practices it will be impossible to determine in another five or ten years whether regional health and environmental problems are being caused by the SRC-I project or some other industrial facility in the region. In short, the project will have failed in its purpose of serving as an

environmental demonstration facility.

IX.
The DEIS Does Not Contain
A Discussion of Project Financing

The DEIS contains no discussion of project financing. This is troubling in light of the fact that cost estimates developed by DOE and project contractors have more than quadrupled since Wheelabrator CleanFuel Corporation submitted its proposal to DOE in March, 1978. At that time, the total estimated project cost for a 2,000 tpsd facility was $220 million, with private financing providing one-half, or $110 million of the investment. Proposal, Vol. II, p. 3-1. The most recent DOE estimate now places that cost at $1.4 billion. Private participation has remained constant at approximately $110 million. GAO has criticized these latest estimates for failing to provide for contingencies and escalation. When properly adjusted for these factors, GAO believes that total project costs for SRC-I will be $3.1 billion, although this amount would be slightly offset by product revenues. GAO Report, PSAD-81-19, p. iv. A realistic cost estimate is critical to decisions on the viability of these plants. In its review of the coal liquefaction process, the GAO questions whether the enormous costs, when considered with other factors such as the serious environmental effects, technical and economic risks and chances of commercial success, warrant continued government support of this project.

One particularly important aspect of project financing that needs to be addressed by the DEIS is the percentage contribution of the contractor to the project. The DEIS should specifically consider the alternative of increasing the contractors share of costs and cost growth. As GAO noted in its recent study:

> Larger investments by private sponsors and sharing of cost growth provides an incentive to private sponsors to control costs and helps to assure that each party is fully committed to the success of the project. GAO Report, p. v.

In our view, a contractor with a larger share in project costs, cost growth and liability for damages is more likely to take pains to minimize the environmental impacts associated with that project.

X.
The DEIS's Discussion of Key
Environmental Impacts is Inadequate

NEPA has been correctly characterized as "an environmental full disclosure law." Environmental Defense Fund v. Corps. of Engineers, 325 F.2d 749, 759 (E.D.La. 1971). By requiring the preparation of environmental impact statements for major federal actions, Congress was acting to assure that government decision-makers and the public had sufficient information to weigh the environmental costs and benefits of proposed federal actions. As the Council on Environmental Quality's NEPA regulations note (40 C.F.R. 1502.1):

> The primary purpose of an environmental impact statement is to serve as an

> action-forcing device to insurs that the policies and goals defined in the Act are infused into the ongoing programs and actions of the Federal Government. It shall provide full and fair discussion of significant environmental impacts and shall inform decision-makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment....Statements shall be concise, clear, to the point, and shall be supported by evidence that the agency has made the necessary environmental analyses.

NEPA requires that an environmental impact statement's discussion of impacts and alternatives be "detailed." As the United States District Court for the District of Columbia has stated (Environmental Defense Fund v. Hardin, 325 F.Supp. 1401, 1403-04 (D.D.C. 1971):

> [An EIS] must be sufficiently detailed to allow a responsible executive to arrive at a reasonably accurate decision regarding the environmental benefits and detriments to be expected from program implementation.

For all of its length, the DEIS is not "detailed" in the sense required by NEPA, nor does it contain a "full and fair discussion" of alternatives and impacts. The DEIS is certainly not concise and to the point. Since no final plant design is available most of the major work required for the DEIS has not yet even begun. The analysis that is provided is rife with errors, is often irrelevant and confusing, contains may critical omissions, and is generally misleading. No responsible decision-maker could arrive at a reasonably accurate set of decisions concerning the proposed plant based on this DEIS.

In the sections that follow, we detail the failure of the DEIS to adequately analyze impacts in the following selected key areas:

- o Occupational and health effects
- o Socioeconomic impacts
- o Impacts on agricultural lands, and
- o Impacts on fish and wildlife habitat

A. The DEIS's Treatment of Occupational and Health Hazards is Incomplete and Misleading

The SRC process will produce a broad range of materials that can cause serious adverse effects ranging from cancer and mutation to neurological disorders. Although the DEIS recognizes this fact (DEIS, p. ix), it fails to present the detailed analysis of occupational and health hazards required by NEPA. Among other things, the DEIS:

- o Fails to enumerate the many substances likely to be present at the plant and describe the health risks created by those substances.
- o Fails to present any data on the substances found at the SRC pilot plant and plant demonstration unit (PDU).
- o Seriously understates the risks involved in a number of important respects.
- o Fails to perform the risk analysis and worst case analyses required by the Council on Environmental Quality's NEPA regulations.
- o Does not describe how arrangements will be made for assuring that the proposed research will be funded and research results implemented.

o Does not contain a detailed discussion of alternatives for minimizing the health risks of the proposed plant.

1. The DEIS Does Not Enumerate the Harmful Substances Likely to Be Present At the Plant or Their Risks

Shockingly, the DEIS does not provide a detailed enumeration of the potentially harmful substances likely to be present at the SRC-I plant. Given the potential for significant harm this omission is irresponsible. Both the decision-makers at DOE and the public are entitled to DOE's present best estimate of which substances will be found at the proposed plant and what evidence exists concerning the potential harm from exposure to those substances. As we note below, DOE must provide a worst case analysis of release and exposure to those substances.

Both the light and middle distillates as well as the gases generated in the SRC-I plant contain numerous chemicals which are known to be carcinogenic or genotoxic, or to be developmental toxics or potent neurotoxins. Among those substances that can reasonably expected to be present at the plant are:

Benzene. Present in the light distillate, benzene is a known human carcinogen. It has been identified as a cause of leukemia in humans[1] even though it does not cause skin tumors in animal skin-painting experiments, the only type of carcinogenesis bioassay used in the DOE study.

Aniline. Aniline, present in the light and middle distillates, was carcinogenic in rats in a bioassay conducted by the National Cancer Institute.[2]

Indole. Indole is also found in the light fraction of the distillates, and, like benzene, has also been implicated as a cause of leukemia. One study found that subcutaneous injections of 1% indole in 50% propylene glycol produced myeloid leukemia in rats within six months.[3]

Quinoline. Quinoline, found in light and medium distillates, induces liver tumors in rats and in mice.[4] It is mutagenic in the Ames test,[5] and causes chromosonal aberrations in Chinese hamster cells.[6]

Phenol and Cresols. Mixed phenols from shale oils, although not carcinogenic themselves, promoted the carcinogenic activity of benzo[a]pyrene in skin painting experiments in mice.[7] A recent literature review noted that all phenols and cresols tested caused chromosome damage in a variety of *in vitro* test systems,[8] even though at least some were not mutagenic in the specific tests used in the Battelle studies.

Phenol anc cresols are present in the light and medium distillates fractions, and we believe that a more extensive battery of genetic testing than Battelle performed would demonstrate the potential of these fractions to cause chromosome damage.

Thiophene. Thiophenes are present in the light and medium distillates, and their presence raises the possibility of neurotoxicity of these fractions. Daily injections of thiophene have been found to cause degeneration of the cerebellum and other brain areas of dogs.[8] Other investigators have found the same type of brain degeneration when they administered thiophene to rats.[9] Another study has reported that inhalation of thiophene effects the flexor reflexes in rabbits,[10] and one investigator stated that inhalation of only 0.8 mg/m^3 of thiophene caused changes in human electroencephalograms.[11]

Hydrogen sulfide and carbon disulfide. H_2S and CS_2 will be present in the gases generated by the coal liquefaction process. H_2S is partially dangerous, because a single exposure to more than 300 mg/m^3 can cause unconsciousness and death, and those who survive exposure at such levels often experience long-lasting damage to the nervous system.[12] Even currently accepted occupational exposure limits may not provide an adequate margin of safety for the neurotoxic effects of H_2S. The threshhold limit valve-time weighted average (TLV-TWA) standard adopted by the American Conference of Governmental Industrial Hygienists is 15 mg/m^3.[13] One investigator reported that exposure to only 10 mg/m^3 for 12 hours per day over 90 days caused brain damage and abnormal nerve conduction in rats.[14] Carbon disulfide is also a human

neurotoxin. Several human expidemiologic studies reviewed by NIOSH indicate that occupational exposure to carbon disulfide is associated with both psychological disturbances and severe polyneuropathies.

Pregnancy complications and various ovarian and menstrual cycle disorders were also noted in women exposed to carbon disulfide.[15] Mixtures of hydrogen sulfide and carbon disulfide are teratogenic in rats.[16] in addition to the chemicals listed above, there are several metals with known toxicity that are likely to be present in one or more of the fractions during the SRC-I process and possibly also in the end products.

Arsenic. Arsenic is a known human carcinogen.[16] Studies have shown that certain smelter workers who inhaled high levels of arsenic trioxide were at 4 to 12 times the risk of developing lung cancer than unexposed workers.[17] Arsenic pollution in the general environment also appears to be associated with increased risk of lung cancer.[18] Skin cancer in humans is also causally associated with exposure to arsenic.[19]

Mercury. A discussion of the toxic potential of mercury must be based on considerations of the toxicity of mercury and inorganic mercury compounds, as well as that of the alkyl mercury compounds (especially methylmercury). Mercury and inorganic mercury compounds are central nervous system toxins,

producing signs of irritability, excitability, etc. They also accumulate in the kidney, leading to proteinuria, renal failure, etc. Several alkyl mercury compounds are also known to induce central nervous system disorders and renal effects. In addition, methyl mercury is known to be a human teratogen.[20]

Nickel. Several forms of nickel are carcinogenic in animals.[21] Nickel subsulfide produces lung cancer when inhaled by rats. Nickel carbonyl increases the incidence of lung tumors when inhaled by rats. Intra-muscular injection of several other nickel compounds (nickel powder, oxide, carbonate, subsulfide, and nickelocene) has produced local sarcomas in rats, mice and hamsters.[22] Increased incidences of cancer of the nasal cavity, lung, and probably larynx, have been observed in nickel refinery workers. Exposure to nickel also produces dermatitis.

Chromium. Chromium is a human and animal carcinogen.[23] An increased incidence of lung cancer has been observed among chromate workers, chromium plater, and chromium alloy workers.[24] Several forms of chromium have also been found to produce local sarcomas in rats.[25] Chromic acid and the chromates are also skin irritants, and, at lower exposure levels, the chromates are sensitizers.[26]

Lead. Lead is a general metabolic poison, documented in both humans and laboratory animals, that affects the central

and peripheral nervous system, the kidneys, the reproductive system, and behavior.[27] Furthermore, lead acetate induces kidney tumors in mice and rats upon oral administration. Lead acetate, lead subacetate, and lead phosphate are carcinogenic in rats when adminstered by various routes.[28] Limited epidemiological evidence of lead exposure in smelter and lead workers showed increased cancer morality. The excess of tumors was seen in the respiratory, urinary, and digestive systems, although tumors at no site alone were significantly increased.[29]

Cadmium. Exposure to cadmium and/or certain cadmium compounds may result in a wide range of toxic effects. A number of investigators have found that workers exposed to some form of cadmium are at increased risk of developing cancer of the prostate, respiratory system, and kidney.[30] Several forms of cadmium are also carcinogenic in rats and mice following subcutaneous and intramuscular administration.[31] Cadmium is also a mutagen, capable of causing point (gene) mutations and chromosomal damage.[32] Numerous investigators have found cadmium to be a potent teratogen and fetotoxic agent. In a recent review of these studies, the Battelle Memorial Laboratory concluded that a no-observable-effect-level could not be established.[33]

Some of the toxic properties of SRC-I-related chemicals are summarized in Table IV.

Table IV

Summary of Toxic Chemicals and Effects

Chemical	Carcinogenic	Causes Chromosome Damage	Teratogenic	Other Reproductive and Developmental Toxicity	Neurotoxic	Toxic to Other Organ Systems
Polycyclic aromatic hydrocarbons	+	+				
Benzene	+					
Aniline	+					+(interferes with blood's ability to carry oxygen)
Indole	+					
Quinoline	+					+(skin, eye)
Phenols	(promoters)	+				
Cresols		+				
Thiophene					+	+(liver, kidneys heart, blood)
Hydrogen sulfide			+		+	
Carbon disulfide			+	+	+	
Arsenic	+					
Mercury			+		+	+(kidneys)
Nickel	+					+(skin)
Chromium	+					+(skin)
Lead	+			+	+	+(kidneys, blood-forming system)
Cadmium	+	+	+	+		

The foregoing is not an exhaustive list of all the toxic chemicals in the SRC-I process; it is merely intended to illustrate some of the potential human health problems that have not been dealt with in the DEIS. Each of these toxic chemicals may be present in

- o Waste streams
- o Fugitive emissions from the plant
- o End-products

For this reason, we believe that the DEIS should attempt to quantify the amount of possible human exposure to these toxics, and should also address specific measures which will be taken to mitigate exposure.

2. The DEIS Does Not Contain Any Data on the Harmful Substances Found to Be Present at the Pilot Plant and PDU

Perhaps even more suprising that the DEIS's failure to include theoretical estimates of the substances likely to be present at the proposed plant is its failure to provide any monitoring data on the substances actually found to be present at the two SRC pilot plants and the PDU. Surely, after more than 5 years of operating small scale SRC facilities, DOE has actual data on substances present at those plants. Such data should be included and analyzed in the EIS.

For example, documents recently released to the National Wildlife Federation under the Freedom of Information Act reveal that the SRC middle distillate from the Fort Lewis pilot plant contains the following polynuclear aromatics priority pollutants:

Naphthalene

Acenaphthene

Phenanthrene

Anthracene

Fluoranthene

Fluorene

Pyrene

Benz(a)anthracene

Chrysene

Benz(e)pyrene

Benzo(b)fluoranthene

Benzo(k)fluoranthene

Benzo(e)pyrene

Dibenz(a,h)anthracene

Benzo(ghi)perylene

Indeno(1,2,3-cd)pyrene

Any such similar information from the Wilsonville pilot plant or the PDU must be publicly released, included in the DEIS and analyzed.

3. The DEIS Improperly Discounts the Health and Occupational Hazards Associated with the Proposed Plant

Although at one point the DEIS admits that there is a health risk associated with the SRC-I plant, the entire approach of the DEIS is to seriously discount that risk. Given the admitted lack of information and research and the fact that there is presently no commercial or even demonstration scale

SRC plant, such a discounting of risk is entirely improper. As we will note below, rather than discount the risks involved, the DEIS should present a worst case analysis of those risks. The DEIS improperly discounts the health risks in the following fashion:

First, the DEIS contends that:

> Chemical and biological screening analyses of available SRC pilot plant materials by Battelle Pacific Northwest Laboratories indicate that selected materials are active in certain toxicological tests. However, an extensive industrial hygiene program has been in place since startup of the Fort Lewis pilot plant (5 years) and there have been no increases of skin cancer traceable to chemicals found in the workers' environment. This is in distinct contrast to experiences in previous coal hydrogenation plants where equivalent industrial hygiene practices were not employed. DEIS, p. 4-2.

This statement is misleading. The assertion that SRC materials are "active" is a significant understatement of the available data. Moreover, DOE has absolutely no basis to conclude from the Fort Lewis experience that its industrial hygiene practices have been effective and that workers were not subject to serious risks. Most cancers have an average latency period of more than 20 years between the onset of exposure and the diagnosis of disease. Five years experience is simply too short a time to draw any conclusions, especially considering the known hazards of the chemicals involved. The failure of skin tumors to appear during the 5 year test period does not

provide a basis for concluding that cancer will not appear in the future. Although the earlier appearance of tumors can sometimes indicate an increased likelihood of cancer, the converse (i.e. that the absence of tumors indicates a reduced likelihood of cancer) has not been demonstrated. Reliance on the Fort Lewis experience is also misplaced since the Fort Lewis workforce is too small a sample to warrant faith in the observed effects. Effects occurring at very serious rates can escape detection in small studies. Finally, the DEIS provides no details of the methods of industrial hygiene that are followed at Fort Lewis, the kinds of monitoring exposure being done and the kind of medical surveillance being performed. Without such data, there is no basis for evaluating the Fort Lewis experience.

Second, the DEIS indicates that a study of the Institute, West Virginia plant indicates a "fivefold" increase in skin tumors. However, the Sexton study of that plant found a 16 to 37 fold increase in the expected incidence of skin cancer. See Sexton, "The Hazards to Health in the Hydrogenation of Coal: IV. The Control Program and the Clinical Effects," Archives of Environmental Health, vol 1, pp. 208-31 (1960).

Third, the text of the DEIS contains a confusing series of references to the various mechanisms by which cancer may be fostered. The mechanisms by which cancer is encouraged are irrelevant to the design of the SRC-I plant. Whether cancer

comes earlier or later, whether it is encouraged by a "potentiator" or a carcinogin, is largely irrelevant. Preventing exposure to any of these substances is likely to reduce the ultimate risk of cancer.

Fourth, the DEIS implies that whatever risk does exist will be dealt with adequately through plant design changes and reduction in worker exposure through training and protective clothing. Without considerable additional detail on the proposed measures and further research this implication is unsupported and, indeed, unsupportable.

Fifth, the DEIS fails to include some of the existing evidence on the risk of harm from coal hydrogenation plants. Included among the missing evidence is the EPA study of a Yugoslavian hydrogenation facility. See R.K. Patterson, "Ambient Air Downwind of the Kosoco Gasification Complex: A Compendium," unpublished Environmental Protection Agency paper.

4. The DEIS Fails to Contain a Worst Case Analysis of Occupational and Health Hazards

DOE deals with the uncertainties over the risks and methods of control by proposing a massive research effort. See DEIS, appendix Z. The Department, in short, intends to approve the plant and attempt to correct any problems in the future. Even if the DEIS indicated how this research is to be funded and its results implemented--which it does not--the approach to be taken by DOE is unwise and directly contravenes the

requirements of NEPA. The Council on Environmental Quality's NEPA regulations indicate the course to be taken by an agency facing uncertainty over risk:

> When an agency is evaluating significant adverse effects on the human environment in an environmental impact statement and there are gaps in relevant information or scientific uncertainty, the agency shall always make clear that such information is lacking or that uncertainty exists.
>
> (a) If the information relevant to adverse impacts is essential to a reasoned choice among alternatives and is not known and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement.
>
> (b) If (1) the information relevant to adverse impacts is essential to a reasoned choice among alternatives and is not known and the overall costs of obtaining it are exorbitant or (2) the information relevant to adverse impacts is important to the decision and the means to obtain if are not known (e.g. the means for obtaining it are beyond the state of the art) the agency shall weigh the need for the action against the risk and severity of possible adverse impacts were the action to proceed in the face of uncertainty. If the agency proceeds, it shall include a worst case analysis and an indication of the probability or improbability of its occurrence (emphasis added).

40 C.F.R. 1502.22.

It is clear that DOE has not complied with this requirement. Plainly, research on the health and occupational risks from the proposed plant are "essential to a reasoned choice among alternatives." Moreover, the DEIS indicates that it is possible to obtain the necessary information. DEIS,

appendix Z. In these circumstances, DOE's proper course is to complete further studies before approving a large demonstration or commercial plant. Even assuming that the costs of obtaining the necessary information are exorbitant or beyond the state of the art, DOE has failed to comply with the NEPA regulations by including a worst case analysis in the DEIS or weighing the need for the action against its risk.

5. The DEIS Fails to Provide for the Funding of Health Research and Implementation of Health Research Results

The heart of DOE's plan to deal with the admittedly signficant occupational and health hazards of the proposed plant is a four phase research effort. DEIS, Appendix Z. However, the DEIS offers no plan for funding that research. This is a serious omission in light of the DEIS's own admission that "financial constraints may prevent all of the proposed research from being completed." DEIS, p. 4-3. The omission is even more serious in light of President Reagan's recent proposals to trim DOE's funding of environmental studies. President of the United States, America's New Beginning: A Program for Economic Recovery (February 18, 1981), p. 4-18. The final EIS must include a concrete plan for funding the research effort proposed in Appendix Z. In light of the President's proposed budget cuts, that plan will doubtless have to include a binding committment on the part of the private participants in the project to fund most of the proposed research.

Similarly, the final impact statement needs to include a plan for implementing any plant design changes or other methods required as the result of the research effort. Under the present SRC-I contract, the government appears to bear the cost of any environmental changes required as the result of the NEPA process. See e.g., SRC-I Contract, Contract No. DE-AC05-780R03054, Article XXXVII. With the present budget tightening, it appears unlikely that the government will be willing to bear all changes that might be required by the Appendix Z studies. Consequently, DOE needs to make other arrangements for assuring that required changes are fully funded by the project's private participants. In our view, the final EIS must contain a binding committment on the part of the private parties to fund all changes that might be required as the result of the Appendiz Z research effort.

If the government continues to bear responsiblity for the required health studies and implementation of any changes indicated by those studies, some method has to be developed for assuring timely and full response of the DOE to research results.

B. The DEIS's Treatment of Socioeconomic Impacts is Inadequate

The treatment of socioeconomic impacts in the DEIS is inadequate in a number of respects. The discussion of cumulative socioeconomic effects produced by the nine energy projects currently planned for the region is impossibly vague

and incomplete, while impacts of the SRC-I facility alone are seriously underestimated due to the use of inaccurate population projections. In addition, there is virtually no discussion of mitigation strategies.

1. Projected Population Increases are Highly Questionable

An accurate forecast of population increases resulting from the construction and operation of the SRC-I facility is basic to a sound discussion of the socioeconomic effects of the plant. The population increases projected in the DEIS, however, appear to be arbitrarily low. As the DEIS notes, "a critical factor in evaluating the socioeconomic impacts of SRC-I construction is the estimated number of in-migrating workers" to the communities in the site area. DEIS, p. 4-64. The DEIS then predicts that construction of the demonstration plant will require a peak work force of approximately 3500 onsite workers, a figure admitted in the DEIS to be unreasonably low. As the DEIS states, "actual work force requirements for large-scale construction projects often deviate substantially from projections." DEIS, p. 4-65. The DEIS then cites a study of nuclear power plant construction work forces in which all 33 of the subject plants experienced larger manpower requirements than originally projected, and nearly half of the plants exceeded projections by 100 to 300%. On the basis of this information, the DEIS concludes that:

> Given this history of underprojections for a relatively mature technology, it is not

> unreasonable to believe that the projected SRC-I peak work force estimate for an emerging technology may be low. DEIS, p. 4-65.

Incredibly, despite these qualifications, the DEIS does not attempt to develop a more realistic employment projection, nor does it perform a worst case analysis to reflect the anticipated statistical variance. We are told that the final EIS will contain a socioeconomic analysis using a peak labor force of 5000. We are not told why such an analysis was not included in the DEIS, despite the fact that the size and composition of the construction work force is identified as the key factor in determining all other socioeconomic effects. Furthermore, the "worst case" projection of 5000 seems much too conservative considering the evidence that some nuclear power plants exceeded projections by as much as 300%. Nevertheless, the DEIS proceeds to use its original estimate of 3500 workers as the basis "for all subsequent analysis" on the socioeconomic impacts of the SRC-I project. DEIS, p. 4-65.

In determining the size of the work force that will need to be imported to the area, the DEIS uses a 70 mile radius, or 90 minute commuting distance, to define the size of the existing labor market. The availability of labor within a zone of that size is obviously much greater, and the associated socioeconomic impacts proportionately less, than would be the case if the extent of the existing labor market were more narrowly defined. This selection of a 70 mile commuting zone

seems extravagant, particulary in contrast to the otherwise consistently conservative estimates used by the DEIS in discussing socioeconomic impacts. As the DEIS also predicts that transportation to and from the plant will present a considerable hardship, and in light of escalating fuel costs, it would seem that a more conservative estimate of the availability of labor would have been appropriate.

These figures--labor requirements and labor availability--form the cornerstone of any subsequent projections of socioeconomic effects. While there is an inevitable uncertainty in such projections, the figures used in the DEIS are unjustifiably low, and the treatment of socioeconomic impacts is distorted accordingly.

2. The Discussion of Cumulative Effects is Too Vague

Although the DEIS dismisses the isolated effects of the SRC-I project as "minor," the cumulative impact of the nine energy projects under construction or proposed for construction in the vicinity of the Newman site are recognized to be severe. Yet the socioeconomic conditions likely to be produced by this simultaneous development are discussed only in the most general and uninformative manner.

The DEIS posits an estimated regional work force demand of 28,000, requiring the importation of 21,000 workers along with 31,000 family members, and an additional population increase of 3,000 resulting from associated economic development. This

amounts to a total projected population increase of 55,000, or 8% of the 21-county region. DEIS, p. 4-101. The DEIS recognizes that these projections are "very tenuous," but makes no attempt to describe the potential range of population growth. The DEIS then summarily concludes that, based on these statistics, "the region, as a whole, is not in danger of becoming overwhelmed by possible population increases." DEIS, p. 4-101. No explanation is given for this conclusion, except that boomtown conditions are usually defined as an annual population increase of 8%, and the increase projected here is expected to occur over a longer, but unspecified, time frame.

As the DEIS points out, however, the time frame is critical in assessing the impact of the cumulative development in the region. Even the DEIS concedes that, but for the "fortuitous" SRC-I construction schedule, the magnitude of the expected cumulative impacts would be drastically increased. According to the DEIS, "if other synfuels plants and fossil-fuel power plants are constructed during the same time-frame as SRC-I construction, population increases in SRC-I's local and regional impact areas would likely be substantial and disruptive." DEIS, p. 4-71.

The DEIS does note "the very real possibility that particular communities in the region may experience impacts on the order of boomtown proportions," but there is virtually no description of what these impacts will be. DEIS. p. 4-103.

Moreover, the DEIS also states that, "should this situation occur, the public services, housing, transportation, and local economic infrastructures would likely be faced with such adverse impacts that significant mitigation measures would be required." DEIS, p. 4-103. At no point in the DEIS are these mitigation measures discussed.

C. The Problem of the Loss of Prime Farmland Is Not Adequately Discussed in the DEIS

On p. 4-19, the DEIS states:

> An important consideration in evaluating the impact of the change in land use resulting from SRC-I facility construction is the growing local and nationwide concern for the preservation of prime agricultural land.

After making this declaration, the DEIS then proceeds to give deplorably scant treatment to the problem of the loss of prime agricultural lands caused directly and indirectly by the proposed demonstration plant. The DEIS notes briefly that Daviess County and adjoining Henderson County are major agricultural areas, being among the largest producers of corn and soybeans in the state. DEIS, p. 3-2. However, as the DEIS also notes, total farm acreage in both counties is declining. DEIS, p. 3-2. What the DEIS does not discuss is the extent of that decline and the expected contribution of SRC-I and related industries to the critical reduction in valuable prime farmland in the region.

A briefing paper prepared by the Kentucky Department of Natural Resources and Environmental Protection, describes the

anticipated impacts of the synthetic fuel industry on agricultural lands in western Kentucky:

> In the last 10 years Kentucky has lost 1.1 million acres of farmland, of which 123,181 acres were prime farmland. The loss of this invaluable resource will become an increasingly critical issue in the 1980s. The four proposed plants [SRC-I, SASOL, H-Coal and W. R. Grace] are each located on prime farmland and the loss of these lands (9,785 acres) will equal the total amount of prime farmland lost in the Green River Area Development District in the last 10 years. The annual crop production losses associated with the construction of the plants will be approximately $2.25 million (assuming an average of $225/acre). The losses from urban growth and mining activities (assuming 75% of those areas subject to urban growth and only 25% of those areas mined would be farmlands and assuming that the mined areas could be returned to productive cultivation within eight years) would equal approximately $2.75 million. In addition to this annual $5 million loss, the associated agricultural economic sector would be severely impacted by spin-off effects. Western Kentucky is the prime grain producing region of the Commonwealth...[T]he study region accounts for over 25 percent of Kentucky's corn and soybean production. As the area's land resources are converted to industrial, residential or mining uses, the shift will create secondary effects that could adversely effect this important economic sector.

Environmental Assessment of a Coal Conversion Industry in Western Kentucky, p. 58.

The DEIS makes no attempt to calculate the direct and indirect effects of the proposed facility on agricultural production in the region. For instance, there is no discussion of the farm acreage that will be lost to increased coal mining

needed to supply the facility. The DNREP report states that the four synthetic fuels plants currently planned for the region, when operating at commercial capacity, will require 40.8 million tons of coal annually, or 95% of the 1979 Western Kentucky coalfield production. Ibid., p. 54. This increased mining activity would significantly reduce agricultural production in the region through direct conversion of farmlands as well as associated negative environmental impacts, such as degradation of air and water quality.

The DEIS also fails to consider the loss of productivity through crop damage caused by pollution. Presumably, the lack of accurate forecasts of air emissions from the proposed plant accounts for this serious omission.

In its brief treatment of the issue, the DEIS seriously undervalues the direct impact of the proposed plant on the loss of agricultural lands. Ninety percent of the proposed 1,484 acre site is prime farmland currently devoted to agricultural use. The annual value of the loss of agricultural production on the site given in the DEIS was calculated on the basis of an earlier site area of only 1,050 acres. DEIS, p. 4-20. Data on agricultural production for the current proposed site is not given.

In discussing cumulative impacts of the four proposed synfuel facilities in the region, the DEIS states that while

the projects will result in a reduction of prime agricultural land, "it is unlikely that the plants themselves will contribute significantly to this problem. DEIS, p. 4-100. The reader is given no basis for this conclusion. At no point does the DEIS identify the actual farmland acreage to be consumed by these facilities nor does it estimate the value of lost agricultural production. The Kentucky DNREP paper, however, reports that the four plants will directly result in the loss of 9,785 acres of prime farmland and $2.25 million in annual crop production. It is incredible that the DOE could characterize this impact as insignificant.

Most incredible of all, however, is DOE's proposal to purchase farmland in the vicinity of the SRC-I plant and cease agricultural activity on that land in order to offset particulate emissions so that SRC-I could qualify for an air quality permit. DEIS, p. xviii. This statement exposes the apparent indifference of the DOE to the nationally recognized problem of the loss of agricultural lands in our country.

D. The DEIS Does Not Adequately Analyze the Impact on Fish and Wildlife Resources

The DEIS' treatment of the impact of the SRC-I project on fish and wildlife resources is deficient in two broad categories:

- o the analysis of wildlife resources at the site is incomplete, and
- o the treatment of floodplain encroachment is inadequate.

1. Inadequate Analysis of Resources

Before an accurate assessment of the effect of the proposed project on fish and wildlife resources can be attempted, the exact nature of those resources must be investigated. This entails a thorough survey of the proposed site. As yet, however, several important ecological studies have not been conducted.

An endangered species, as well as several rare or uncommon birds listed in the Audubon Society's Blue List of declining species inhabit the hardwood and riparian forests on the site and have been regularly observed. However, as the DEIS states, predictions of impacts on these species and other bird species "is somewhat limited by the fact that field surveys at the site were not done during the main breeding season." DEIS, p. 4-24. Additional surveys are proposed for the summer of 1981 to determine whether the site is a breeding colony for the endangered Indiana bat. There is no indication, however, that further studies are planned to investigate the habitat productivity for other species known to frequent the site. Until such data is collected, an assessment of the impact of construction and operation of the plant remains incomplete.

Another indication in the DEIS that a complete investigation of the fish and wildlife resources at the site has not been conducted is the fact that data is only given for approximately 70% of the site area. Table 4.3 shows land use

classifications for 1,050 acres of the 1,484 acre proposed site. A survey of the missing 434 acres is surely required before the impact of the plant can be fully evaluated.

Finally, since the DEIS cannot identify the full range of possible pollutants produced by the facility (see Part X.A. above), it cannot hope to evaluate the effect of those pollutants on the terrestrial and aquatic ecology on and near the site.

2. The DEIS's Treatment of Floodplain Encroachment Is Inadequate

The DEIS recognizes the "significant national problem of loss of floodplain forests." DEIS, p. 4-23. We are told that 90% of the nation's original riparian or floodplain forests have already been destroyed and that current losses approximate 6% of the remaining area per year. DEIS, p. 4-23. Nevertheless, the DEIS seems to divorce the destruction of floodplain forests caused by construction of SRC-I from that national trend. Just as in its treatment of the loss of prime agricultural lands, the DEIS characterizes the contribution of this facility to the overall losses of floodplain forestlands as "slight" and "minor." This is precisely the attitude that has permitted wholesale destruction of floodplain and wetland resources; and it is because these resources have been critically depleted that Executive Orders 11988 and 11900 were issued.

The treatment of floodplain encroachment in the DEIS is generally misleading. It not only underestimates the direct and indirect impact of the SRC-I plant on floodplain habitat, but also fails to address the very significant cumulative impacts that can be expected from related development.

The DEIS, describes the floodplain habitat on the site as follows:

> [the] riparian hardwood forest along the Green River and the bottomland hardwood forest along Martin Creek represent the most ecologically important communities on the site, as they support a high diversity of both vegetation and wildlife. DEIS, p. 4-23.

In recognition of the value of these forest areas, the DEIS explains that only "a small area of riparian hardwood forest" will be destroyed to accommodate the proposed facility. It is only in Table 4.3 that we discover that 67% of this forest will be cleared during construction of the demonstration plant. While we applaud the intention of the contractors to "destroy as little of this forest as possible," we question whether the full impact of the destruction that is planned has been accurately assessed.

The DEIS also does not fully discuss the indirect impacts that are expected to occur on the site. For instance, what effect will increased barge traffic on the Green River have on wildlife along its bank? How will the destruction of portions of the forest habitat disrupt normal wildlife use patterns? The DEIS states that "the effects of potential vehicular

traffic, noise, and human presence [on terrestrial ecology] would be relatively minor." DEIS p. 4-24. This seems inconsistent with the DEIS's own evaluation of the socioeconomic impact of the facility, which projects considerable commercial development in nearby communities and such massive increases in traffic that additional roads and rail commuter services are contemplated.

Another serious flaw in the DEIS is the failure to analyze the cumulative effects on fish and wildlife resources of the construction of SRC-I and other major projects in the region. Without further elaboration, the DEIS concludes that:

> It is anticipated that effects on land use, geology, soils and terrestial ecology as a result of SRC-I and other energy developments for the most part will be site specific and localized and will produce few cumulative impacts. DEIS, p. 4-100.

This statement seems highly questionable in light of the evidence of project-related development presented elsewhere in the DEIS. For instance, the DEIS contains no discussion of the impact of urbanization on wildlife habitat in the region, although we are told that the immediate tri-county area will probably experience "boomtown" growth during the next decade. DEIS, 4-103. The DEIS presents some evidence that the proposed synthetic fuel facilities will result in major increases in surface mining in the area. However, any discussion of the disturbance of wildlife habitat caused by this increased mining is omitted.

Finally, the loss of prime farmland occasioned by the operation of this and other energy projects, as well as associated regional development, is only briefly discussed. The DEIS states that dislocation of agricultural activities

> may result in added pressures on remaining farmland and on the clearing of more floodplain and riparian forests to compensate for farm losses. DEIS, p. 4-24.

However, the impact of this anticipated development on wildlife habitat is never calculated, nor are mitigation strategies even discussed.

XI.
DOE Must Prepare An Adequate Environmental Impact Statement or Statements Before Making Any Commitments Involving the Construction of the SRC-I Demonstration Plant

A major purpose of the environmental impact statement process is to provide the relevant federal agency decisionmakers with enough information on the environmental costs and benefits of alternative courses of action to enable them to arrive at reasonable decisions. Of course, it necessarily follows that for the EIS to have any actual benefit it must be available before actual decisions are made. In this case, for example, for the NEPA process to have any benefit an adequate site selection analysis must be available before the site is selected, an assessment of competing technologies must

be available before a technology is selected, an analysis of the impacts of plants of various sizes must be available before a commitment is made to a plant of any set size, and detailed analysis of all the impacts and programmatic issues must be available before a commitment is made to funding the plant. As we have seen none of these analyses have been adequately completed on the SRC-I plant.

Until they have been, DOE cannot properly commit itself to funding the SRC-I demonstration. This is in accord with CEQ's NEPA regulations which provide that until an adequate final EIS is issued and a record of decision published

> no action concerning the proposal shall be taken which would:
> (1) Have an adverse environmental impact; or
> (2) Limit the choice of reasonable alternatives.

40 C.F.R. 1506.1(a)

Under the present circumstances, the obligation of DOE is clear: it must complete an actual plant design as well as environmental studies and either prepare an entirely new EIS or circulate a supplemental EIS. As stated in the CEQ NEPA regulations:

> The draft statement must fulfill and satisfy to the fullest extent possible the requirements established for the final statements in Section 102(2)(C) of the Act. If a draft statement is so inadequate as to preclude meaningful analysis, the agency shall prepare and circulate a revised draft of the appropriate portion.

40 C.F.R. 1502.9(a). Unless a supplemental or a new EIS is

prepared in circumstances such as these, the preparation of environmental impact statements will, in the words of the U.S. Court of Appeals for the District of Columbia Circuit, "become a useless ritual, defeating the purposes of NEPA, and rather making a mockery of it." Natural Resources Defense Council v. Callaway, 524 F.2d 70 (D.C. Cir. 1975).

CONCLUSION

As these comments have shown, the DEIS on the proposed SRC-I demonstration project is totally inadequate. No adequate programmatic EIS has been prepared. The DEIS does not justify the need for the project, fails to consider energy conservation and the use of renewable energy sources as an alternative to the project, and does not consider construction of a smaller scale demonstration plant. Moreover, the DEIS does not provide an environmental analysis to support the selection of the proposed site and irresponsibly fails to detail operational and environmental problems at the SRC pilot plants. It inexplicably fails to offer a detailed plan for monitoring or collecting environmental baseline data. There are significant errors of commission and omission in the discussion of key environmental impacts. But the single most telling failure of the DEIS--and the root of most of its other failings--is its lack of an actual plant design. Without such an actual plant design an adequate impact assessment and analysis of alternatives is all but impossible.

No decisionmaker could possibly fairly assess the environmental costs and benefits of the SRC-I plant based on this DEIS. Given the inadequacies of this impact statement, DOE must complete an actual plant design, prepare the necessary environmental studies, and issue a new or supplemental draft EIS. Until a new and adequate impact statement is finalized, DOE cannot lawfully commit itself to the funding of the SRC-I demonstration plant.

NOTES

1. Infante et al, "Leukemia in Benzene Workers," Lancet, July 9, 1977, pp. 76-78 (1977); Ott, et al., "Mortality Among Individuals Occupationally Exposed to Benzene," Exhibit 154, OSHA Benzene Hearings, July 19-August 10, 1977.

2. National Cancer Institute "Bioassay of Aniline Hydrochloride for Possible Carcinogenicity, National Cancer Institute Carcinogenesis Technical Report Series No. 130, Washington, D.C., DHEW Publication No. (NIH) 78-1385 (1978).

3. Ehrhart, & Stich, "Undersuchungen uber Experimentelle Luekamien: II. Die Indol-Leukamie bei der weissen Maus," Klin. Wichenschr. Vol. 35, pp. 504-511 (1957).

4. Hiraro et al., "Carcinogenic Activity of Quinoline on Rat Liver," Cancer Research, vol. 36, pp. 329-335 (1976); Schinohara, et al., "Effects of Various Factors on the Induction of Liver Tumors in Animals by Quinoline," Gann, vol. 68, pp. 785-796 (1977).

5. Hollstein, et al., "Quinoline: Conversion to a Mutagen by Human and Roden Liver," Journal of the National Cancer Institute, vol. 60, pp. 405-410 (1978).

6. Matsuoka, et al., "Chromosomal Aberration Tests on 29 Chemicals Combined with S9 Mix in Vitro," Mutation Research, vol. 66, pp. 277-290 (1979).

7. Bogovski, & Mirme, "Co-carcinogenicity of Phenols from Estonian Shale Tars (Oils), Environmental Health Perspectives, vol. 30, pp. 177-178 (1979).

8. Dean, "Genetic Toxicology of Benzene, Toluene, Xylenes, and Phenols," Mutation Research, vol. 47, pp. 75-97 (1978)

9. Clinton, "Thiophene and Derivatives," API Toxicological Reviews, American Petroleum Institute, Washington, D.C., (1948).

10. Bradley & Berry, "Effects of Thiophene on the Purkinje Cell Dendritic Tree: A Quantitative Golgi Study." Neuropathology and Applied Neurobiology, vol. 5; pp. 9-16 (1979);

Herndon, "Thiophene-Induced Granule Cell Necrosis in the Rat Cerebellum: An Electron Microscopic Study." Experimental Brain Research, vol. 6, pp. 49-68 (1968).

11. Mikhailets, et al., "Toxicology of Thiophene," Gig. Tr. Prof. Zabol. vol. 10, pp. 57-58. Biological Abstracts, vol. 48, p. 23256.

12. Khikmatullaeva, "Data to Substantiate the Maximum Permissible Concentration of Thiophene in the Atmosphere" Gig. Sanit. vol. 32, pp. 3-6 (1977) (Biological Abstracts, vol. 49, p. 63743).

13. National Institute for Occupational Safety and Health, "Criteria for a Recommended Standard...Occupational Exposure to Hydrogen Sulfide," Washington, D.C. DHEW Publication No. (NIOSH) 77-158 (1977).

14. American Conference of Governmental Industrial Hygienists, "Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1978." ACGIH, Cincinnati (1978).

15. Duan, "Data for Determining the Maximum Permissible Concentration of Hydrogen Sulfide in the Atmospheric Air."

16. See NIOSH, note 13 above.

17.. Barilyak et al., "Effects of Small Concentrations of Carbon Disulfide and Hydrogen Sulfide on Intrauterine Development in Rats," Arkh. Anat. Histol. Embriol., vol. 68, pp. 77-81 (Russian with English summary) (1975).

18. Althouse, et al., "An Evaluation of Chemicals and Industrial Processes Associated with Cancer in Humans Based on Human and Animal Data: IARC Monographs 1 to 20," Cancer Research, vol. 40, pp. 1-12 (1980).

19. International Agency for Research on Cancer, IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man, vol. 2, pp. 48-73, World Health Organization, Lyon, France (1973); Kuratsune, et al., "Occupational Lung Cancer Among Copper Smelters," International Journal of Cancer, vol. 13, pp. 552-558 (1974); Tokdome & Kuratsune, "A Cohort Study on Mortality from Cancer and Other Causes Among Workers at a Metal Refinery," International Journal of Cancer, vol. 17, pp. 310-317 (1976).

20. Blot & Fraumeni, "Arsenical Air Pollution and Lung Cancer," Lancet (1975) vol. ii, p. 142.

21. Althouse, et al., note 18, above.

22. National Academy of Sciences, Assessment of Mercury in the Environment, Washington, D. C. (1978)

23. Althouse, et al., note 18 above.

24. International Agency for Research on Cancer, IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man, vol. 11, pp. 75-112, World Health Organization, Lyon, France (1976).

25. Althouse, et al., note 18 above.

26. IARC, vol. 2, note 19 above.

Taylor, "The Relationship of Mortality and Duration of Employment as Reflected by a Cohort of Chromate Workers," American Journal of Public Health, vol. 56, pp. 218-229 (1975);

Davies, "Lung-Cancer Mortality of Workers Making Chrome Pigments," Lancet, (1978) vol. 1, p. 384;

Waterhouse, "Cancer Among Chromium Platers," British Journal of Cancer, vol. 32, p. 262 (1975);

Royle, "Toxicity of Chromic Acid in the Chromium Plating Industry," Environmental Research, vol. 10, pp. 39-53 (1975);

Pokrovskaya & Shabynina, "Carcinogenous Hazards in Production of Chromium Ferroalloys," Gig. Tr. Prof. Zabol., vol. 10, pp. 23-26 (1973).

27. IARC, vol. 2, note 19 above.

28. National Academy of Sciences, Chromium: Medical and Biological Effects of Environmental Pollutants, Washington, D. C. (1974).

29. National Academy of Sciences, Lead in the Environment, Washington, D. C. (1980).

30. International Agency for Research on Cancer, IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man, vol. 1, pp. 40-50 (1972).

31. Althouse, et al., note 18, above.

32. IARC, vol. 11, note 24 above.

Kjellstrom, et al., "Mortality and Cancer Morbidity Among Cadmium-Exposed Workers: A Preliminary Report." Environmental Health Perspectives, vol. 28, pp. 199-204 (1979).

33. Althouse, et al., "An Evaluation of Chemicals and Industrial Processes Associated with Cancer in Humans Based on Human and Animal Data: IARC Monographs 1-20," Cancer Research, vol. 40, pp. 1-13 (1980).

34. Environmental Protection Agency, "Rebuttable Presumption Against Registration and Continued Registration of Pesticide Products Containing Cadmium," 42 Fed. Reg. 56574. (1977).

35. See EPA, note 34, above.

February 22, 1981

Mr. James A. Reafsnyder
Research and Development Manager
SRC-I Project Office
U.S. Department of Energy
P.O. Box E
Oak Ridge, Tennessee 37830

39

Dear Mr. Reafsnyder:

I have reviewed the Draft Environmental Impact Statement - Volumes I and II for the Solvent Refined Coal - I Demonstration Project proposed for construction at Newman, Kentucky. I submit the following comments for consideration in future planning regarding this project:

1. This proposed plant will produce a broad range of materials that are carcinogenic and mutagenic compounds, including aromatic amines, aromatic and heterocyclic compounds, phenols, and other compounds. There is considerable doubt in my mind that control technologies for these compounds are adequate. The control of these compounds is a must. The public deserves this. We cannot and should not tolerate an industry that poses hazardous health problems for the populace.

2. Point-source emissions of hazardous substances can be controlled with proper control equipment. Fugitive emission sources cannot be adequately controlled, such as those from valves, joints, etc. I do not believe that the DEIS adequately treated this problem.

3. It is reasonable to assume that the wastewater recycling equipment might cease to function properly from time to time. The DEIS stated that during such times quantities of manganese, iron, phenol, and cadmium would need to be discharged into nearby Green River. This river already has quantities of these and other heavy metals that exceed water quality standards at times. There should be no discharge of these metals into Green River by this SRC-I plant.

4. It is my understanding that very high quantities of water will be drawn into the plant operation from Green River. Much of this water will be consumed on site. I do not believe that the DEIS adequately addressed this problem from the standpoint of the SRC-I project and other synthetic fuel plants and power plants operating and planned for Green River.

5. I do not think that the siting of this plant and others planned for this area was given adequate attention. The siting of this plant and three additional synfuel plants within a small radius, along with all of the fossil-fueled power plants that we have and those planned or being built would seem to violate all of the standards of good logic The added concentrations of pollutants cannot help but add to the health hazards for the people of this area.

6. Going back to the water intake from Green River. The water taken in contains large amounts of micro-aquatic organisms that are important to the Green River ecosystem. This aquatic material will be lost and the fertility of the River and its' ability to support life will be continuously diminished. This problem was not addressed in the DEIS and it deserves adequate consideration. The impact of this plant on the aquatic ecology of Green River was treated very, very lightly. A thorough study of the impact on the aquatic ecology is needed and should be done.

7. The DEIS treated the impact on the terrestrial ecology at somewhat greater length. However, most of the discussion centered around the Indiana bat - an endangered species found on the plant site. I have no problem at all with the treatment of this species. This was good. However, I have a real problem with the treatment of the many other wildlife species found at the plant site. They were briefly referred to in statements like - "Wildlife populations would be permanently reduced because of habitat loss". (Volume I - I-47). And - "most animal species should be able to relocate in adjacent areas." The latte is a misstatement of the facts. Most of the wildlife affected by the plant and its' operation will be simply eliminated or their numbers will be significantly reduced. Surrounding habitat has its' own carrying capacity and cannot permanently support influx from the plant site. The DEIS also contains the statement - (Volume I - 4-23) - "Because most of the site is presently cleared for agriculture and represents poor wildlife habitat, most wildlife species would not be significantly affected." May I point out that the Kentucky Department of Fish and Wildlife Resource, along with most state game and fish organizations, incorporate agricultural cropping into the wildlife management plan of state wildlife areas. Farm crops produce significant amounts of food for wildlife on these areas. The clearing of riparian and bottomland forests is a significant national problem. The DEIS correctl states that as much as 90% of the nation's original riparian or floodplain forests may have already been lost, and current losses approximate 6% of the remaining area per year. This wetland forest habitat is extremely valuable habitat to a wide variety and large numbers of wildlife. To some, like the very rare Swamp Rabbit - that is still present in some sections of the Ohio and Green River bottoms - it represents their only habitat. The national problem was caused by local habitat destruction in "bits and pieces". The Newman "bit" is a contribution to this problem.

According to the DEIS, a portion of the riparian habitat will be destroyed and altered for the construction of barge unloading facilities. A suggested mitigation measure is to establish a wide strip of streambank woodland along the company property bordering Green River. This would do three things: (1) control streambank erosion, (2) mitigate some of the wildlife habitat losses, and (3) serve as a model of streambank management for all landowners up and down the river where good streambank management has been sadly lacking for many years.

The DEIS indicated that a 40-acre waste pond would be necessary during the plant demonstration phase and an additional 180-acre waste pond during 14 years of operation of the commercial facility. Unsuspecting wildlife has a habit of getting into such ponds - waterfowl in particular. This problem was not addressed in the DEIS. It should be addressed and measures instigated to forstall the problem of wildlife coming into contact with toxic wastes.

The idea set forth in the DEIS of acquiring title to or the surface rights of the woodland area along Martin Creek is commendable. Other statements indicating the planting of wildlife food and cover on plant property were also commendable. Incorporation of these intentions into the project plans is recommended.

8. There was no mention in the DEIS of the impact of this project on the commercial and sport fishery in Green River. This problem needs to be addressed. Certainly these activities will be impacted by the lowered water quality brought about by the destruction of aquatic organisms lost in the plant intake waters, by possible toxic materials discharged into the river in wastewater, and by the increased barge traffic caused by the large amount of coal used in the plant operation.

9. It is most unfortunate that the decision was made to locate the Newman SRC-1 plant in a flood plain on prime farm land when the public was just coming to understand the importance of protecting both. It will be necessary for the ICRC to go before the Owensboro Metropolitan Planning Commission and request a zoning change from an agricultural use of the land to heavy industrial use. The Planning Commission will be under tremendous pressure to make this change even though it violates the very essence and spirit of the Commission's land-use plan - "Community Directions". By every aspect of good planning, this proposal should be denied. Should the change in zoning be made, how does an individual commissioner approach the next proposal of a small developer whose case, to him, is just as compelling? This problem was not addressed in the DEIS and I am requesting that it be addressed in the Final EIS.

10. Ground-level fogging and icing are two local problems that were mentioned in the DEIS, but there was no solution given and there were no plans given for finding a solution. Both can be safety hazards - especially for local traffic. These problems need to be addressed and solutions worked out.

11. The ponds that will contain the toxic wastes that I referred to earlier are of great concern. As I understand the situation, there are no processes known to neutralize some of these substances and therefore they will remain in these repositories for possibly very long periods of time. We would seem to have a parallel situation here as in the nuclear industry. Rather than going ahead producing quantities of these wastes without proper disposal technology - which is the cart before the horse philosophy - we should rather solve the problem now and then proceed. I urge the ICRC and DOE to assume this approach to the problem. With the present plan - who is to assume the responsibility and liability for these wastes should the plant ever be closed?

12. I know from experience that the cost of relocating families from the project area can be extremely expensive. These costs for the 24 affected families were not projected in the DEIS. These should be stated in the Final EIS.

13. The DEIS states that 526 acres of land will be affected by power transmission lines serving the SRC-1 facility. Where it is possible to do so, I would recommend that wildlife benefitting plants be established on this corridor. This would be one mitigation measure to compensate for wildlife habitat destroyed or altered.

14. The hazards of sulfur dioxide emissions on plant life and crops was stated in Section K of Volume II of the DEIS. I need not go into them, but there are many serious consequences involved. Since immense damages are already occurring, it does not seem logical to continue to add sources for the problem. Each plant facility appears to justify it by saying that their emissions add very little to the problem - but the problem is the result of these compounded little bits. This point needs to be treated more adequately in the Final EIS.

15. There is a great need right here at the start of this SRC-1 project to assess the expected net gain in energy units to be brought about by the construction of the proposed facility. I have personally attended 11 meetings concerning this project. I have flown over the proposed plant site in a plane and have toured it on the ground. Energy units (in this case gallons of gasoline) were consumed. Others have attended meetings - some coming from out-of-state. Hundreds have come to the three hearings on the DEIS. Landowners on the proposed site have expended energy units, so have government planners at all levels, company planners and engineers, environmental consultants. The list goes on and on. Then there would be energy units consumed in the construction of the facility and the operation of it, the mining and transporting of coal, the provision of electrical power, the building of a power plant to supply the electricity (the Big Rivers new plant near Livermore, Kentucky), the transporting of the end products to far-off destinations..... I urge the ICRC and DOE to initiat a sound computer-assisted study to assess the total energy units consumed in the planning and operation of this proposed facility (utilizing those listed above and all others that are relavent that are not listed). These should be projected over the expected life of the plant The projected production of the plant over its' life span should be presented and the two figures compared. All costs should also be stated, using best estimates. These data should then be presented to the public via news media for evaluation. I urge that this suggested study be included in the Final EIS.

******

I request that all of the points listed in this letter be given consideration in the Final EIS.

Sincerely,

Lee K. Nelson

Lee K. Nelson
Route 3
Owensboro, Kentucky 42301

University of Evansville
C. Prendergast
Sociology
Post Office Box 329
Evansville, Indiana 47702

40

March 2, 1981

James A. Reafsnyder
Research and Development Manager
SRC-1 Project Office, U.S. D.O.E.
P.O. Box E
Oak Ridge, TN. 37830

Dear Mr. Reafsynder,

I recently had occasion to read and respond to the Draft Environmental Impact Statement for the SRC-1 facility proposed for Newman, Ky. My responses can be found in the 71-page document submitted by Synfuels Inquiry, Inc.

In going over the DEIS, I had special difficulty with the primary and secondary work force projections, especially those aspects dealing with the size of the total in-migrating population. Never was I able to replicate the numbers, in part, I think, because two methods were used to calculate them. But even when I dismissed one method as a mistake, there were still differences in our projections.

The DEIS projections were based on a study by L. Blair and W. Stevenson entitled, The Construction Labor Force Model (Oak Ridge, 1980). I would like to receive a copy of the study, if possible, in order to gain a better understanding of the model and to check the validity of my criticisms. If it has now been published, I would also like to see Robert B. Braid's Chronic Underprojecting of Work Forces at Nuclear Power Plants (Oak Ridge, 1980). Any other documents which would shed light on cumulative work force and migration estimates would be warmly appreciated.

I am presuming these documents can be obtained free of charge. If I am mistaken, please inform me of the cost before mailing them.

Thank you very much.

Yours respectfully,

Christopher Prendergast

Christopher Prendergast

February 24, 1981

James A. Reafsnyder
Research and Development Manager
SRC Projects Office
U.S. Department of Energy
P.O. Box E
Oak Ridge, TN 37830

41

Dear Mr. Reafsnyder:

Enclosed is my rhetorical assessment of the DEIS(DOE EIS-0073-D) for SRC-1 Davies County, Newman, Kentucky. As a member of the organization Synfuel Inquiry, Inc., it was my responsibility to prepare a rhetorical evaluation of the DEIS and to make suggestions that could improve the DEIS as a communication aimed at disclosure for adequate public assessment of environmental impact.

My response contains an overall assessment of the report, a specific question that summarizes that assessment, and a sample summary intended primarily for illustrative purposes.

As a concerned citizen, I appreciate theopportunity to participate in all efforts that ensure maximum public participation.

Sincerely,

Thomas M. Rivers

MAR 0 2 RECD

Title: Response to Draft Environmental Impact Statement
SRC-1 Davies County, Newman, Kentucky
January 1981 (DOE EIS-0073-D); Rhetorical Evaluation
by Dr. Thomas M. Rivers
Associate Professor of English
Indiana State University Evansville

The purpose of this response is not to question the accuracy of data in DEIS, or the appropriateness of investigation methods, or the interpretation of data. That objective is the concern of others. The purpose of this response is to evaluate the DEIS as a communication document, purportedly a document charged by the EPA with the "disclosure" of information adequate for the public's careful assessment of the environmental impact of the proposed SRC-1 demonstration plant. It is my conclusion that a number of things should be done in the final statement that more clearly meet the requirement for adequate disclosure. If the present document were prepared with disclosure as the goal a number of rhetorical decisions would have been made differently, and would I believe have suggested to a prudent public a less than optimistic response to the SRC-1 plant. Perhaps that may have been a reason for the inadequacies of this document.

Length

First of all the document is unnecessarily redundant and therefore excessively long. Disclosure to the public can only be possible if there is a reasonable assumption on the part of any lay reader that the document can be read in a reasonable amount of time and that such time is necessary. Besides the usual wordiness that could be eliminated by revision work -- excessive nominalizing of verbs, weak coordination, excessive passive voice construction, dummy subjects, and excessive prepositional phrases -- the major source of redundancy comes from the decision to add little of substance to the Appendices section Volume II. For the most part very little if any new information is included in the Appendices (other than tables and figures that are properly Appendix material) that is not either already in the body of the discussion section or could have been added to the discussion section. Furthermore, I believe the summary section itself, which is the bottom line section of this report, could also be significantly shortened, particularly if it avoids excessive repetition of discussion material located in the body of the work. Summary: Shorten the appendices, revise the discussion section, and shorten the summary section.

Structure and Disclosure Philosophy

Of most concern is the failure to structure this document with disclosure about impacts of DOE action on the quality of the environment as the primary goal. First and foremost this intent should govern the structure of this document. With this in mind I make the following observations and suggestions. Most notable of these observations is based on an analysis of the table of contents. The table of contents run from pp. XXXI-XXXVII. Environmental Impact Assessments of the actual site are first of all scattered throughout the document 1.4.3, 1.4.4, and 4.2. And given the assumption that

disclosure of environmental impact of actual site is the priority item there is little to suggest a sequencing of items that promote such disclosure. The Newman site itself and its impact is arbitrarily imbedded in the document as one small part of a larger structure that does not promote disclosure of priority items. Furthermore, since the summary section is based on the discussion section of the report it too suffers from an unmanageable sequencing and prioritizing of items. I recommend that in the final draft the present structure be abandoned in favor of one that puts priority on the actual environmental impact of the Newman site, instead of priority being placed on the political and energy implication. These areas are certainly critical to an overall decision about synfuels but are not properly the center of concern for this report. A change, of course, in the structure of the document will necessarily result in a more useful and informative summary. At the end of this statement I have written a sample of how the summary would read if disclosure were the real intent of this document and if restructuring, as I've suggested, occurred.

Question: How can the Final EIS be written so it meets the requirement of disclosure for adequate public assessment?

SAMPLE SUMMARY

The following sample is intended to suggest the possible direction the final report ought to take in terms of rhetorical implications. The summary is written with the assumption that the body of the discussion would in fact prioritize the actual environmental impact of the proposed Newman demonstration plant. If this were done then in fact this is how the summary would be developed. I also use clearly marked headings in the summary making for quick and easy reference by the public. Certainly the numbering of the summary, if actually needed, would give first place to the summative findings of environmental impact of Newman demonstration plant. As much as possible I've used the exact language of the draft. My main objective was the restructuring and reprioritizing of the various units of the original document.

SUMMARY

NON-CUMULATIVE SRC-1 ENVIRONMENTAL IMPACTS

Occupational and Public Health Impact

Since only a conceptual SRC plant design exists there is no way to predict the specific compounds and exact concentrations of such compounds that will be present in products, intermediate streams, water, and occupational environments. This limits the ability to quantitatively predict occupational and public health consequences. Furthermore, no epidemiological studies have been done at the comparable SRC plant at Fort Lewis. Because there has been no significant population of workers employed in direct coal liquification technologies little is known at this time about health consequences to workers of long term work in such plants or for that matter to the general public.

The only way to reasonably gather and evaluate such data is to build the demonstration plant first and conduct study afterwards. It is certain however that the SRC process will produce a broad range of materials that contain carcinogenic and mutagenic organic compounds. DOE recognizes the health risk of operating a plant of this nature and will do all that is technologically feasible to limit the unknown affects of the demonstration plant on the workers and the general public. It should be kept in mind there is no known acceptable limit for many of the carcinogens produced in the SRC process and that essential testing has not been done on dermal and inhalation carcinogenesis, teratogenesis, and male reproductive effects.

Water

At present, the Green River's maximum concentrations of manganese, iron, cadmium, mercury, and probably phenol exceed the water quality standards. Because of this potential toxicity to humans and acquatic organisms, the SRC-1 discharges of cyanide, chlorine, phenol, and cadmium during low-flow conditions is considered a significant degradation of water quality. Furthermore, it is uncertain whether there is a small possibility that waste water discharges would be necessary during low-flow periods. If periods of low stream flow do correspond with periods when zero discharge cannot be achieved then plant shutdown might be required. Presently, there are no effluent limitations for the plant and such a worse case plant shutdown would be purely voluntary.

Air

Operation of the proposed facility will increase ground-level concentration of EPA-regulated pollutants and other airborne pollutants.

TSP -- Total Suspended Particulates exhibit the greatest levels of impact. It should be noted that the emission factors for fugitive TSP are not very reliable. Only onsite monitoring, after the plant is on-stream, can conclusively determine actual TSP concentration.

CO -- The impact on CO standards will be small.

Ozone -- The air quality models that are currently available to predict ozone concentration, limit predicting ambient ozone concentration. Insofar as hydrocarbon emissions are thought to be the most important precursor pollutant in ozone formation the best available control technology will be used to limit routine hydrocarbon emissions. Nevertheless, the only accurate measurement of the impact of heavy fugitive hydrocarbon emissions will be to monitor emissions during plant operations. No extensive operating data on fugitive hydrocarbons from plant valves, flanges, and other fittings exists for a coal conversion facility the size of the proposed demonstration plant. SO_2, sulphur dioxide, emitted from the proposed SRC-1 plant will oxidize to form suspended sulfate aerosols. The rates are dependent on ambient relative humidity, temperatures, and ozone concentration. It is possible that, under certain conditions, the cooling towers' plume and SO_2 from the proposed plant will interact to cause higher sulfate formation rates. Precipitation passing through the SO_2 will also absorb it and form acidic sulfates in the rainwater. Furthermore, data are not available to (1) define existing levels of acidity or precipitation near the proposed plant site; (2) to model adequately acid rain or the formation of sulfite aerosol and (3) to evaluate the chemical reaction processes and to relate these with resultant rainfall acidity or aerosol concentration. However, the SO_2 emissions from the proposed SRC-1 facility represents less than 1% of the SO_2 emitted from all sources within 30 miles of the site. As such, the incremental impact of the SRC-1 facility upon acid rain is likely to be small. This does not presuppose that the present levels are safe or acceptable.

CUMULATIVE SRC-1 ENVIRONMENTAL IMPACTS

The proposed SRC-1 facility will contribute to cumulative impacts associated with other projects proposed, planned, or under construction in the area. Since some of these projects are just beginning, their designs are uncertain, and data is limited, quantitative assessments on cumulative impacts are limited. It is possible that, acting together, significant impacts may occur in the region or in particular subregions as a consequence of multiple sitings.

Water

Aggolomeration of plants along the Green River will have potentially significant cumulative impacts on water quantity particularly when competing domestic, industrial, and other project related consumption is considered. Ten percent of the the 7-D, 10-year low flow for energy was specified by ORBC as the qualitative criterion for identifying potential negative impacts. The possibility of 30% cumulative consumption by energy facilities from the Green is estimated, three times more than the ORBC guideline. Impacts to the Green and Wabash Rivers are assumed to be limited to plants located on these tributaries, but water quality and quantity impacts of all new plants could have a cumulative impact on the Ohio downstream of points of confluence. Furthermore, the potential cumulative impacts to the entire Ohio River basin does not include unforeseen problems resulting from breaks in waste containment systems.

Air

In the absence of sufficient data on exact plant locations, pollutant emission rates, physical stack parameters, and other data necessary for dispersion modeling, simplifying assumptions were required for assessment of probable cumulative impacts on air quality. These simplifying assumptions show that the cumulative impact will add to problems of nonattainment for either TSP, or ozone and sulphur dioxide in the Owensboro, Henderson and Evansville areas.

FEB 3 0 1981

Mrs. Donald Roberts
2311 Crescent Hill Drive
Owensboro, Kentucky 42301

42

1981

Dear Sir,

Please do not permit the surface
plant at Newman to be built.

The disadvantages to our environment
our economy and future generations
far out weigh any temporary benefits.

The people who I come in contact
with on a daily basis feel the same
although they may not take the
time to write.

I repeat again please do not
permit it as once they start
in our beautiful Green River Valley we
won't remain beautiful for very long.

Sincerely
Linda Roberts

A-137

Oct 1981 43

507 E 25th St
Owensboro, Ky
Feb. 22- 1981

Dear Sir:-

I am writing to strongly protest the building of this Synfuel Plant in Newman, Ky.

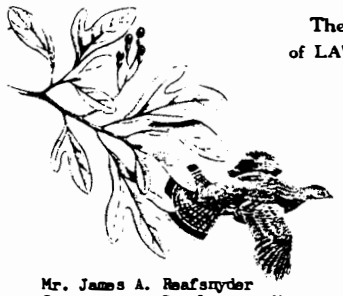
Already the Government has spent millions of dollars without knowing that it will be successful.

This wild scheme is doing away with over 1500 acres of farm land that produces the food we all eat, including the wealthy that stand to make a mint of money. Not us Tax payers and Unbiased Going to be that many jobs.

Have you considered the damage this will do to our City and County? Our air will be polluted. Our schools, roads, transportation facilities, everything all over extended. Big - Cities moved in and we are left holding the bag.

Please reconsider these plans. I shall write my Government Officials to let them know how and many more feel.

Thank you - Mrs J N. Kinsaul



The SASSAFRAS AUDUBON SOCIETY
of LAWRENCE - GREENE - MONROE - BROWN -
MORGAN & OWEN COUNTIES

February 28, 1981

44

Mr. James A. Reafsnyder
Research and Development Manager
SRC-I Project Office, U.S. Department of Energy
P.O. Box E
Oak Ridge, Tennessee 37830

Dear Mr. Reafsnyder:

Enclosed are the initial comments of the Sassafras Audubon Society on the Draft Environmental Impact Statement (DEIS), Solvent Refined Coal-I Demonstration Project, Newman Kentucky (DOE/EIS-0073-D).

We have been unable to complete our comments on the DEIS, however, in the allotted time and would appreciate a 10-day extension. There are extenuating circumstances for Sassafras Audubon requested a copy from DOE Wash. D.C. on December 5, 1980, but did not receive a copy when it was issued. We secured a copy by calling your office in Oak Ridge, but the delay in receiving it, as well as schedule conflicts among SAS members, has prevented our meeting the March 2, 1981 deadline.

Thank you for this consideration.

Yours sincerely,

Mary Kay Moody per DGF

Mary Kay Moody, President
Sassafras Audubon Society
6620 East State Road 45
Bloomington, Indiana 47401

NO ENCLOSURE RECEIVED WITH
THIS LETTER. tfk, 3/4/81



The SASSAFRAS AUDUBON SOCIETY
of LAWRENCE - GREENE - MONROE - BROWN -
MORGAN & OWEN COUNTIES
March 14, 1981

COMMENTS ON THE
DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE
PROPOSED SOLVENT REFINED COAL-I DEMONSTRATION PROJECT,
NEWMAN, KENTUCKY (DOE/EIS-0073-D)

I

The use of coal in greatly increasing amounts presents a significant threat to the environment and human health, if the vast quantities of wastes generated are not disposed of in an environmentally acceptable manner. It is estimated that a coal conversion plant will use 8 million tons of coal per year and, in the process generate about two million tons of solid wastes and lesser amounts of liquid and airborne wastes. When this is multiplied by the expected life of a coal-conversion plant (20-30 years) and the scope of the projected Synfuel Program, not only are the quantities of wastes staggering, but it is completely questionable, given the accessory elements and compounds associated with them, that they can be disposed of in an economical and environmentally acceptable manner.

All indications point to the generation of an unprecedented spectrum of pollutants of all phases and types, organic, inorganic, metallic, and organo-metallic, from coal-conversion. This is confirmed in the Summary of the Draft Environmental Impact Statement (DEIS) of the Proposed Solvent Refined Coal-I Demonstration Project (SRC-I DP) Newman,Kentucky, (page ix):

> "Through chemical reactions involving coal, the SRC process will produce a broad range of materials that contain carcinogenic and mutagenic organic compounds, including aromatic amines, aromatic and heterocyclic compounds, highly substituted phenols, and other compounds."

The Committee on Accessory Elements in Coal and Oil Shale, National Research Council, stressed in their central findings and observations, that our geologic and chemical knowledge of coal needs to be greatly expanded, and that:

> "Of special importance are studies of the composition and disposition of wastes, effluents, and emissions associated with coal-conversion processes. These processes, inadequately understood at present, are likely to become highly significant in future exploitation of coal resources. Baseline studies should be made now so that future coal conversion problems will not suddenly appear without a sound basis for resolution." (pages43, 44)

The Committee on Accessory Elements also found that "Knowledge of the physical and chemical characteristics of accessory elements in coal-cleaning wastes is likewise limited and inadequate to assess refuse disposal problems, such as ground-or surface -water pollution". (page 43). About 400 million tons of raw coal have been treated annually in recent years in Coal-Preparation-Plants, producing 300 million tons of clean coal and approximately 100 million tons of refuse. This refuse may contain high concentrations of accessory elements whose escape into the environment must be prevented.

II

LAND CONSUMED AND/OR DISTURBED TO CONSTRUCT AND SUPPORT THE NEWMAN SRC-I PLANT

The Newman SRC-I Plant Facility will consume approximately 1350 acres of prime farmland on the Green River floodplain, but in addition, vast quantities of land will be consumed or disturbed in support of the plant.

The DEIS mentions that specific mines to feed the plant have not been identified (1-1) but an estimate is given (Table 1.13, page 1-42), that 1630 acres/year will be disturbed to provide coal for the plant. Given a life expectancy of 20/30 years for the commercial plant, that would amount to the "disturbance" of 32,600 to 48,900 acres. How much of this will be forest, pasture, crop land?

Will the land stripped of coal for the Newman STC-I Plant be restored to a beneficial use similar to the original use? The coal industry is challenging the Surface Mining Control and Reclamation Act of 1977, including the provisions which would require coal companies to remove the top soil and reserve it for the reclamation process; to build large settling ponds to control erosion; to restore mined land to its original contour; and to restore prime farmlands to their original use. The cost-effectiveness of synfuel production cannot be properly evaluated without including the costs of land restoration and assessing the quality of the restoration.

The western Kentucky #9 coal will be "washed" before being converted to synfuels by the Newman Plant. How much waste will be generated during the washing of the coal over the life of the plant? How much gob? How much tailings? How much land will be consumed in storing these wastes? What will be the final disposition of these wastes? Can these coal-preparation-plant sites be effectively reclaimed? Will the costs of "final" waste disposal and site-reclamation be figured in the costs of synfuel production?

41 coal-preparation-plant sites have been identified in southwestern Indiana. The Indiana Geological Survey has indicated that some tailings in the slurry ponds might be reclaimed for boiler fuel with little further preparation but very little recovery of tailings has occurred. Some firms are recovering coal from gob piles but most gob has low calorific value and recovery is impractical. Very few former coal-preparation-plant sites in Indiana have been reclaimed and walls of some of the slurry ponds have been breached with wastes escaping into the drainage systems. Is this occurring in Kentucky?

Of the nearly 1500 acres of the SRC-I site area, 91% or about 1350 acres is prime farmland, with soybeans the principal crop. This land is likely to be removed "permanently" from agricultural production through severe alteration and contamination of the site from wastes associated with synfuel production.

A recent Federal study has revealed that in the past decade, three million acres of agricultural lands have been converted to non-agricultural uses each year. If the present trend continues, our Nation will be producing only enough food to feed itself by the turn of the century. Eventually the United States could become a food-importing, rather than a food-exporting country. But whom would we export food from?

The Federal Government has been a major offendar in the trend toward development of farmland through its grants and loans program and Federal Highway Construction Program, and the SYNFUEL PROGRAM WOULD ADD A SIGNIFICANT NEW DIMENSION TO THE TREND.

The riparian forest along the Green River comprises 17.3 acres and the bottomland hardwoods along Martin Creek comprises 42 acres of a highly diverse overstory and

understory. Two waterfowl areas. the Sloughs Wildlife Management Area, and the Richland Slough, are only about ¼ mile from the Newman Synfuel Site, and represent together 441 acres of high-quality wildlife habitat.

The potential effect of the Newman Plant on the riparian woodland wildlife habitats of the site and nearby sloughs should not be minimized, both during construction and operation, for the impact could be severe. As with agricultural land, good wildlife habitat is diminishing at an alarming rate, with the current loss nationwide approximating 4,000 acres a day of wetlands, forests, old fields, and fencerows which support a rich and diverse assemblage of animals. A wide-range of "unplanned" noxious emissions, effluents, leachates, barge spills, etc could seriously harm wildlife and the wildlife habitats, withincreased noise levels certain to have adverse impacts.

Additional land will be consumed by new transportation corridors for handling increased traffic in the area.

Newman

The fact that over one-half of the site is below the elevation of the 100-year floodplain, and over 75% of the site is below the elevation of the 500-year floodplain illustrates again the Federal Government's failure to practice what it preaches, to prohibit new development in the floodways to the greatest extent possible.

The middle third of the site will require flood proofing and runoff water control for the liquid storage, ash ponds, SRC product storage, coal storage, and the Administration Building which will result in floodplain encroachment and impacts. The barge docking facility for the demonstration phase of the project will necessitate the removal of 700 feet of riparian habitat, but the docking facility may be greatly increased with commercial expansion since "It is estimated that almost 100% of the commercial plant's feed coal will be supplied by barge." (page d-5).

In addition to the encroachment of the barge-docking facility on the floodplain, other site facilities will encroach on and adversely impact the floodplain and the river:

1) the raw water intake located immediately downstream of the barge facility will require 2,000 yd^3 of dredging for a channel inlet, and elimination of 312 m^2 of riparian-river bottom habitat, and floodproofing to above the 500-year flood elevation;

2) the wastewater diffuaion system elluent line will require disturbance of 120 m2 riparian and 192 m^2 river bottom habitat;

3) the location of the ash ponds represents an encroachment on the Green River flood-plain of about 5 acres, with the base of the landfill below the 100-year flood level, and the top of the embankment above the 500-year flood elevation;

4) the liquid product storage and associated spill containment reservoirs will be surrounded by a dike system raised above the 500-year flood elevation;

5) the SRC solid product storage will be stored in an open-diked area, diked to above the 500-year flood elevation;

6) the open coal storage area will encroach on the flood plain and diked to provide floodwater protection from the 500-year flood event.

The construction, operation, and maintenance of the site facilities in the floodplain can be expected to cause significant adverse environmental effects in the area affected by them, for all excess of those created by existing uses. The barge-docking facility will seriously impact a large riparian-river bottom area and water-quality of the stream during construction, expansion to the commercial phase, and during normal

docking and maintenance activities. A Project of this dimension is never without spills, leakages, noxious air emissions, and even severe accidents in the loading, unloading, and docking processes, whose consequences deserve a degree of speculation.

The water intake channel will require periodic dredging, and all of the structures that are flood-proofed for a 500-year flood may not be fool-proof. It is highly questionable whether the ash ponds and liquid product storage and associated spill containment reservoirs should be located in the flood plain, because of our lack of knowledge of the composition of these wastes and how they should be disposed. Clay liners leak with regularity and this appears to be recognized in the DEIS for leachate collection removal is to be provided above and below the "impervious" liners. Other built-in protection systems may not function under the stresses of a 500-year flood, OR EVEN A HUNDRED-YEAR FLOOD.

WATER QUALITY AND WATER QUANTITY

Coal-conversion facilities consume vast quantities of water. Substantial amounts of water are also consumed in mining and preparing coal for conversion. The SRC-I Demonstration Plant is expected to consume approximately 2,520 gallons/ minute, while the estimated water use during commercial operation is estimated to be 16,500 gallons/per minute withdrawn, and 12,000 gallons/minute consumed, or approximately 7% of the 7-day, 10-year low-flow of the Green River. The DEIS acknowledges that "Because of the large water requirements of each facility, and the existing water requirements, competition for water use may develop. The navigable waterways cannot afford to have their flow significantly reduced if this would affect navigation."

Water quality of the Green River will be affected by this rate of water withdrawal and consumption with significant adverse impacts particularly in periods of low-flow during drought. The Green River receives a wide variety of municipal, domestic, industrial and agricultural discharges, with major impacts in form of cooling water from a power station, and high-sediment load from strip-mining operations. Heavy sediment loads, coupled with continual barge traffic, have produced severe turbidity in the river. The heavy barge traffic expected to support the Newman Plant will add significantly to an already serious situation with regards turbidity and the SRC-I Plant consumption of Green River water will raise concentrations of hazardous substances and trace elements which have been reported in amounts exceeding the criterion for the protection of aquatic life, to still higher levels.

The DEIS tries to minimize the expected impact of SRC-I on the water quality of the Green River by noting that zero-wastewater discharge plant designs are being developed that will contain all water effluents, but such a system is not only far from perfected, it is not likely to attain such perfect operation. Polynuclear aromatic compounds (PNA) are expected to be emitted during the operational phase of coal conversion processes and will be monitored along with trace elements in the wastewater discharge. The fact that current and projected standards do not yet exist for the possible chemical compounds that could be generated within such a facility, make synfuel plants a high-risk venture. The SRC-I facility has the added potential of seriously impacting groundwater quality through the escape of leachates from coal storage and handling areas, solid waste storage areas, solid SRC product storage and handling areas, liquid product storage areas, wastewater collection and retention facilities, etc.

AIR QUALITY AND COAL-CONVERSION PLANTS

The experimental nature of the coal-conversion process is clearly evident in the DEIS attempt to characterize emissions and emission rates and the conclusions that "Because planning for the commercial plant is still in an early stage, the emission

rates cannot be estimated with a high degree of certainty." (page xvii), and "Accurate fugitive particulate emission predictions cannot be made at this time; only monitoring during demonstration plant operation can give a reliable estimate from which to scale."

Since the coal hydrogenation step may produce unique emissions and health effects the public is genuinely concerned about long-range transport of pollutants, particularly because many elements and organic compounds are concentrated on particles too small to be trapped by conventional stack-gas cleaning methods. The extent of potential worker exposure to carcinogenic compounds has also to be determined.

> Considerable discussion is devoted in the DEIS to environmental and health effects monitoring but the question must be asked as to how rigorous this assessment will be, and whether, when health hazards are identified, will they be given proper recognition, with adequate controls instituted?
>
> How efficient are "coal scrubbers" and electrostatic precipitators over time? Can the monitoring systems detect "unique emissions"? Will these systems be conscientiously operated and maintained over time?

The Clean Air Act is under attack as are the Clean Water and Strip-Mining Acts. This is a time of weakening environmental controls, lowering of environmental standards, and poor enforcement of environmental regulations. Present day attitudes and the level of the art of abatement techniques, casts doubt on adequate monitoring, identification, control, treatment, storage and disposal of the vast array of pollutants associated with and engendered by the mining and preparation of coal, and the coal conversion process.

A MATTER OF PRIORITIES

Should Synfuels be developed given the serious environmental problems (acid rain, increasing levels of CO_2 etc) associated with their production, and the need for enormous government subsidy to determine the feasibility of a commercial synfuel industry under appropriate environmental controls?

The DEIS on SRC-I mentions that:

> "Conservation is an immediate and cost-effective way to deal with the energy problem.", and that,
>
> "Solar and other renewable energy resources offer the nation some of its best opportunities to become self-sufficient in energy over the long-term" (page 1-4).

Yet the DEIS does not give them credibility as benign alternatives capable of achieving if supported and promoted (given a free market) energy self-sufficiency for this country within a short period of time. The Report of the Energy Project at the Harvard Business School, ENERGY FUTURE, points out that CONSERVATION ENERGY is no less an energy alternative than oil, gas, coal, or nuclear, and that:

> "If the United States were to make a serious committment to conservation, it might well consume 30 to 40 percent less energy than it now does, and still enjoy the same or an even higher standard of living. That saving would not hinge on a major technological breakthrough, and it would require only modest adjustments in the way people live. Moreover, the cost of conservation energy is very competitive with other energy sources. The possible energy savings would be the equivalent of the elimination of all imported oil--- and then some."

The Harvard energy study also noted that it is entirely possible for solar energy to meet as much as a fifth of the country's energy needs by the year 2000 without a technological breakthrough, for the kind of solar technology at hand can effect a 20% contribution.

A more responsive public policy is required to overcome the obstacles to near-term solar energy. We ask that serious consideration be given Conservation Energy and Solar Energy as alternatives to the synfuel program.

Mary Kay Moody, President
Sassafras Audubon Society
6620 East State Road 45
Bloomington, Indiana 47401

James A. Reefsnyder
Research & Development Manager
SRC I Project Office
U.S. Dept. of Energy

FEB 2 7 1981

45

Dear Mr Reefsnyder;

Please accept these comments-questions concerning the Draft Environmental Impact Statement on the SRC I Demonstration Project in Newman, Kentucky.

(1) Was the possibility of expanding the pilot plants at Ft Lewis, Wash. and Wilsonville, Ala. considered?

(2) How could the Newman site be selected when it fails to meet some of the requirements which eliminated other sites eg: land under multiple ownership, large percentage of land in a floodplain, and it is in seismic zone 3?

(3) From the DEIS "the loss of prime agricultural land to more intensive development contributes to a nationwide trend of recent years which may have adverse effects on agricultural productivity... Protecting our established farmlands would appear a better position than the intensive development of the synfuels industry.

Sincerely

Stephen M Sanner

Stephen M Sanner
408 D Tennessee St
Evansville, In 47710

A-143

46

SIERRA CLUB

CUMBERLAND CHAPTER

February 27, 1981

Comments on the Draft Environmental Impact Statement
Solvent Refined Coal--I Demonstration Project, Newman, Kentucky
DOE/EIS-0073-D/VI

The document under consideration is certainly amazing. At better than eight hundred pages, it easily passes the "weight test." Yet, for all its size, it contains little information. An environmental impact statement should

> provide full and fair discussion of significant environmental impacts and shall inform decision-makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment. . . . Statements shall be concise, clear, to the point, and shall be supported by evidence that the agency has made the necessary environmental analyses.
>
> (Council on Environmental Quality's NEPA Regulations: 40 C.F.R. & 1502.1)

This DEIS is a smokescreen of words.

The vagueness combined with the length of the document appears to result in part from a desire on the port of DOE to "sell" SRC-I by concealing significant points against it. The consideration of alternatives is not even-handed. The one-sidedness of the point of view is clear in the treatment of electric power, for instance, which will be discussed later. The lack of clarity, however, also comes from an actual lack of information. Time and again there are confessions that facts are unknown. The following statements are typical:

> One of the primary problems in predicting water quality impacts is that the impacts of individual effluent components are not yet fully understood. This problem is greatly aggravated at the programmatic level of consideration because of the chemical variation in the effluent receiving media and differences in coal feed characteristics.
>
> (p. 1-42)

> Of the proposed "Demonstration Plant" materials that could potentially impact human health and/or the environment, only process solvent has been screened to date. . . . Results also show the Wilsonville process solvent to be less mutagenic than the For Lewis process solvent. Further chemical analyses of these materials will be conducted to determine why the observed difference is so great. (p. Z-41)

A reader of the DEIS can only conclude that no one knows what the impacts of a synfuels plant will be and that people living near the plant will be used as human guinea pigs. The apparent concealment and the lack of facts are equally frightening.

No valid reason for constructing a synfuels industry--or even a single synfuels plant--is given in the DEIS. Supposedly the first section of the main body outlines the "Purpose and Need for the Coal Liquefaction Program" but one wonders why this section was written at all. It recites various possibilities for solving the energy crisis without comparing them in any meaningful way. What would be helpful is facts about net energy production for each approach and about cost effectiveness (how many dollars does it cost to produce a barrel of oil by coal liquefaction compared to the cost of securing the equivalent of a barrel of oil by conservation, for instance?).

If the goal of the United States is to produce the quickest, cheapest barrel of new oil, we would not rush down the synfuels path. As Robert Stobaugh and Daniel Yergin indicated in their widely acclaimed book, Energy Future, "If the United States were to make a serious commitment to conservation, it might well consume 30 to 40 percent less energy than it now does, and still enjoy the same or an even higher standard of living. . . . The possible energy savings would be the equivalent of the elimination of all imported oil--and then some" (New York: Ballantine, 1979, p. 167). Why does the DOE choose to push the synfuels technology, about which absurdly little is yet known, when the billions of dollars to be spent on this technology would buy a sure return in the future, if invested in soft paths, such as hydropower and biomass and conservation? This question demands careful consideration in the final EIS, since, unless it can be answered in favor of synfuels, there is no reason to build a 6,000 ton per day coal liquefaction plant at this time.

Whatever one thinks about the advisability of a large-scale synfuels program now, the draft DEIS does not justify the building of SRC-I, if SRC-II is constructed. Through admitting lack of knowledge of many of the impacts of synfuels technology, the DOE tacitly recognizes that it is putting at risk the workers in the plants and the people living near them. The DEIS does briefly compare SRC-I and SRC-II (pp. xxviii-xxix). In this comparison the only features unique to one plant which are cited are "solid-liquid separation" and "wastewater treatment." Are these sufficient to justify risking the health of two populations? If it is found to be essential to build a 6,000 ton per day demonstration plant now, would it not make better sense to build one plant, monitor it, and then later build a second plant using results gathered from the first? This matter should be considered in adequate detail in the final EIS.

The waste generated by just one synfuel plant will be horrendous. One commercial plant alone will produce approximately 3,000 tons per day of ash, gasifier slag, and flue gas sludge. Over the course of twenty-five years, each of these plants could be expected to produce enough solid waste to cover 250 acres to the depth of 50 feet. This volume of waste production is roughly equivalent to what would be produced by a city of one million population.

The volume of waste produced by coal liquefaction has apparently been played down in the DEIS for SRC-I. According to the Phase Zero Deliverables the site of the plant was 1050 acres. This site would have room for storage of five-years of gasifier slag from a commercial plant. Plans had been made to acquire an additional 400 acres, which would result in a site of 1450 acres allowing for storage of 14 years of slag (the original 5 plus 9 more) (Tasks 1 and 2, p. 444). In the DEIS there is, as far as I noted, little reference to the size of the site. I assumed that it was still 1050 acres until I happened across a page sandwiched between the title page and the table of contents for appendix C. This page lists changes from the Phase Zero design that are "being evaluated" and that "have been incorporated in the data presented." The first change is "The site acreage is now extended to 1484 acres rather than 1050 acres" (p. C-3). Then I discovered footnotes on two tables about land use, the first of which runs, "The site area to be removed by the SRC-1 facility is correct as shown in this table; however, the total site area has been increased to 600 ha (1484 acres). The land use classification of the additional site area has not been determined" (p. 4-20). The discussion of the storage space for gasifier slag is bland but confusing:

> Because of large quantities, the gasifier slag and flyash will occupy a large land area. For example, during the operation of the demonstration plant, a 16-ha (40-acre) area will be required for ash disposal and storage. During a 14-year period of commercial operation, 72 ha (180) acres would be required for ash storage. Additional offsite storage areas may be required during commercial operation of the facility. Precise area requirements will depend on landfill configuration. (p. 2-26)

There is no mention here that the site has recently been enlarged by over 400 acres, apparently to store slag, and it is not stated that, according to the Phase Zero Deliverables, a 1450 acre site would <u>not</u> be adequate to hold the slag for more than 14 years of commercial operation. The final EIS should be more explicit on the waste problem. Can 1484 acres contain the slag from the entire period expected for commercial operation? If so, how? If not, where will it be put?

Spin-off questions from the matter of site enlargement are what is the land use classification and what is the agricultural value of the extra 434 acres slipped into the site? The final EIS should not ignore this matter.

The final DEIS should also consider another aspect of waste disposal. In D-15 the DEIS considers raising the waste disposal site above the 500-year floodplain via the importing of 11 million yards^3 of soil at a cost of $33 million. This alternative is dismissed in the DEIS as too expensive and as causing too big a delay, ie two years, in the project. What is not discussed is the possibility of raising the site above the 100-year floodplain. Since the byproducts from this process should not end up in streams in the area, DOE should strongly consider raising the waste disposal site above the 100 year floodplain. DOE is requested to report on the results of this analysis in the final EIS.

Electric power, like the size of the site, is an issue on which DOE knows more than it appears to care to tell in the DEIS. There is no discussion of the availability of electric power in the section on "Description of the Existing Environment" at Newman, although the availability of water, coal, and transportation are considered (pp. 1-34 to 1-36). On p. 3-45 under Electricity there is a glib statement that "The current electrical transmission and distribution system at the site is not adequate to supply all of the power needed by the SRC-I project. A proposed Baskett and Newman 161-kV transmission line and switching stations will be adequate to serve the SRC-I project" (p. 3-45). "Project" here, though it may not be immediately apparent to the reader, refers only to the demonstration plant. According to the Phase Zero Deliverables, the commercial plant will require 375,000 KW. This would have to come from a not-yet-constructed source. It is expected that the projected D. B. Wilson commercial facility will be this source. The D. B. Wilson site will have two units of 395,000 KW each. In other words, the commercial plant will use most of the energy produced by half of the Wilson plant (Tasks 1 and 2, p. 59). Furthermore, according to the Phase Zero Deliverables, the supply of electricity is guaranteed neither for the demonstration plant nor for the commercial plant. The Big River Electric Corporation will have to renew a contract with the Southeastern Power Administration to obtain enough capacity to supply the 75,000 KW needed by the demonstration plant, and it will sell this extra power on a first come first served basis (Tasks 1 and 2, pp. 57-58). The electricity from the Wilson plat, if built, could also go elsewhere (Tasks 1 and 2, p. 59). Obviously the question of electric power has to be dealt with in detail before the operation of SRC-I can be considered to be even feasible. Furthermore, the cumulative impact of SRC-I and the Wilson plant should be adequately conaidered.

Another area in which the DEIS is strikingly incomplete is transportation. Something is written about roads and railways; little about barges. Tasks 1 and 2 of the Phase Zero Deliverables (pp. iii and 444) produce the impression that trains will be the major form of transportation for coal. At the 29,400 tons per day level of operation, 750 railway cars will go through per day, we are told. The DEIS is not so sure: "Coal will be transported to the demonstration plant in an 80-car unit-train. . . . In the event that the coal is purchased from a mine that does not have rail

access, coal will be barged to the demonstration plant" (p. 4-93); "All coal for the commercial plant will be transported by barge" (p. 4-96); and, under changes from Phase Zero, "A barge dock includes capability for construction equipment and possibly coal delivery" (p. C-3). Why is there a change from trains to barges for coal transporation and is barge transportation for 29,400 tons per day feasible? The final EIS should say.

Water availability is not adequately discussed in the DEIS, particularly in light of the new emphasis on barges and the need for the Wilson plant. The summary notes:

> The cumulative water consumption for the SRC-I commercial plant, the W. R. Grace synfuel plant, and the D. B. Wilson and Paradise generating plants could exceed 30% of the Green River's 7-d, 10-year low flow. The Ohio River Basin Commission has adopted 10% of the 7-d, 10-year low flow as the guideline criterion for identifying potential adverse impacts from water consumption for energy. Water consumption from the Green River is a potentially serious cumulative effect.
> (p. xxiv)

Would this effect actually be tolerable? Would even the effect of the commercial SRC-I plant and the Wilson plant, which seems to be essential to SRC-I, be tolerable? Concentrations of pollutants would increase, for instance, as the volume of water in the river decreases. According to the Environmental Report, which circulated with the Phase Zero Deliverables (Appendix G-153), SRC-I is expected not to be in compliance with proposed state and federal criteria, not only for cyanide and dissolved oxygen , but also for mercury, phenol, and possibly chlorine. Also, what will be the effect of the decrease in the water on the transportation of coal by barge? The DEIS states: "Because of the large water requirements of each facility (coal conversion), and the existing water requirements, competition for water use may develop. The navigable waterways cannot afford to have their flow significantly reduced if this would affect navigation" (p. 1-34). Would it? This should be answered.

There is also incompleteness in the discussion of impacts on wildlife. To make only one point, the Environmental Report circulated with the Phase Zero Deliverables (Appendix D-78 to 79) noted that the SRC-I plant is located in a pathway of bird migration. The plant will have stacks and a cooling tower producing clouds of condensed steam. Migrating birds are attracted by the lights of buildings and towers during hazy and foggy periods. When they knock high towers "resulting casualties and injuries may be in the thousands." The DEIS is strangely silent on bird migration (see p. 3-12, which mentions birds in other ways). The EIS should at least explain why this point in the Environmental Report is now considered to be worthless (or is it?).

Among the many, many further questions which the DEIS does not cover but which should be dealt with in the final EIS are the

following:

If you assume that biologicals in the wastewater treatment system are destroyed by an upset (pp. C-25 and 26), how long would it take to reestablish the biologicals; how and from what source would biologicals be replenished; what would be the effect on plant operation, particularly wastewater discharge?

Why will only some of the hydrocarbon storage tanks have floating roofs? (p. C-29)

What measures will be taken to prevent the bottoms of the various landfills from being bulged up by high groundwater during floods? Since these landfills must serve as long term containment facilities, absolute care must be used in their design. (p. C-34).

Who serves as an independent judge of the safety of propietary catalysts? (p. C-18)

Current plans call for polymer coatings to be sprayed on coal reserves to reduce fugitive emissions. I assume this spray will be similar to what is sprayed on coal hopper cars to reduce transport shrinkage. If this is true, I recommend your figures be reconsidered, because at least one recent study in Railway Age found the sprays to be ineffective.

A number of sections in the DEIS (particularly section C) indicate that many important decisions regarding emission controls have yet to be made. When will these decisions be reached and what opportunity will the public have to participate in these decisions?

What is the approach velocity for water intake, since this effects the impact on fish and plankton?

What will be the role of blowdown tanks in controlling emergency upsets?

Rough calculations indicate that enough waste heat will be generated to heat more than 17,000 houses (1.7×10^9 BTU/hour--p. C-14). Can some constructive use be made of this heat?

In conclusion, if, as seems likely, DOE decides to go ahead with this project, it should keep in mind its statement on pages 2-18 & 19 which begins: "Through chemical reactions involving coal, the SRC process will produce a broad range of material that contains carcinogenic and mutagenic organic compounds . . . ." This statement is a blanket commitment by DOE to do everything possible to minimize the risks associated with these plants and to conduct ongoing research projects to insure that impacts are kept to an absolute minimum.

For a variety of reasons the citizenry of this country have very little trust in government, and yet DOE is asking us to trust it in this matter. Will DOE be willing to come forward and say that

a certain technology appears to pose too great a threat or perhaps would cost too much? The consequences of not doing so would include the loss of public support and further delays in meeting our energy needs. Time will provide the answer.

Mary B. Davis
Synthetic Fuels Chairman

Are the products produced by this plant and others going to benefit directly Lawrence, Kentucky, Lawrence County, Ohio and above? Or, are they going to the shipper / processor for foreign use at our health and financial risk?

"Big bucks" are distorting and corrupting our public officials (state and city) and misleading labor. (Which we will soon learn when we get to the polls!)

We do not want our area to become another "Love Canal" with the landfills the ICRC says must create. ("synfuels alley")

We have always prided ourselves in the fact that our water, air, and land has remained fairly free from contamination.

Maybe the synfuels plant contamination wouldn't cheat some of us out of many years of life, but what about the quality of life of our children, causing mutagenic malformations in their bodies and those of their offsprings!

We have one life to live.

Sincerely,

Mary Ann Snyder
and many family

1849 Woodfill Way
Louisville, KY 40205
February 28, 1981

James A. Reafsnyder
Research and Development Manager
SRC Projects Office
U. S. Department of Energy
SRC-I Public Hearing
Post Office Box E
Oak Ridge, TN 37830

48

Dear Mr. Reafsnyder:

I have reviewed the DOE/EIS-0073/VI and VII for the Solvent Refined Coal-I Demonstration Project at Newman, Kentucky from cover to cover, and I have visited the proposed site as well. My special interest is in the area of water quality, aquatic habitat impacts and groundwater pollution and, so far as I am concerned, these subjects are poorly treated in this DEIS. Indeed, I find the document to be so totally inadequate as to make it completely useless as an instrument of evaluation. My reasons for this conclusion are many, but for the sake of your time and mine, I will cite only one.

Turn to page 4-32 of Volume I and read the last paragraph. This is the beginning of a description of the "simple model" used in developing the analysis presented in Table 4.7. Major decisions are to be based on this work which, when given a closer look, turns out to be the design equation for effluents entering streams which are rapidly flowing and completely mixed. The Newman plant effluents will enter Green River backwaters held by an Ohio River mainstem high-lift dam. This reach forms a long, narrow lake, not the bubbling, flowing stream upon which the DEIS calculations are based. The assumption of complete mixing, as applied to this system, is without a semblance of scientific credibility. How can anyone base an honest decision on this document?

I request that the Administrator deny the applicant's permit.

Sincerely,

Hugh T. Spencer, Sc. D.
Board Chairman, Valley Watch, Inc.

js

MAR 0

Jan 25, 1981

49

R.R.6
Owensboro, Ky 42301

Dear Mr Reafsnyder,

I definetely oppose the Synfuels plant that has been proposed for Newman Ky.

I feel that it is a great detriment to this community A Plant such as this located here in Our Great Ohio Valley Farmland, a plant with all the contaminants etc! Ky, does, you know have much waste land!

Now please explain with Concise, Condensed answers

How do farmers in a large surrounding area ever expect to harvest a decent crop? If so able to harvest a crop will it be at a loss or profit caused by the smog contaminants etc – Who plans to re-imburse them for this losses. How do you propose to remove the Contaminants from foods that need be sold. How do you propose to replace health that is lost from this plant due to its Contaminants etc?

I merely mention a few health problems as lung diseases, sinus, allergies, bone diseases and blood dyscrasias. Don't you believe these health problems are far more important than a few years the Synfuels Plant will sustain itself? Which is most important? Health or Pleasure? Which is most important? "Money for a few or Health for all"?

Sincerely - Lorna Stephens
Taxpayer & farmer

Dear Mr. Chairperson, 50

I am against the opening of a
type face plant on Watson Island
Either you work on small type business
owners - I just wanted you to know I am
against these type face projects

Thank you

Mrs Camilla Lyles

P.S. Please remind Arthur you owe me a lunch
to talk today.

Comments on Solid Waste Disposal and Wastewater Management

51

Concerning the Solvent Refined Coal-1 Demonstration Project Draft Environmental Impact Statement (DOE/EIS 0073-D/VII), henceforth known as DEIS.

A) DEIS 1.4.4.4 (1-47) lists, among what are referred to as "unavoidable adverse impacts,""the disposal of ash from the facilities and mining wastes could cover large areas of topsoil making these areas permanently useless for productive purposes."

We wish to know how great this impact will be and how unavoidable it is.

Section C.2.3.2 (C-33 & 34) states that "the gasifier wastes will be pumped . . . as a slurry" to the landfill disposal site, which it refers to as a "pond". It is apparent from the DEIS that disposing of gasifier wastes this way raises a number of unresolved issues. There seems to be a great likelihood that these "landfills" or "ponds" will end up being permanent sinkholes of potentially toxic muck. The DEIS raises the possibility that storing the wastes in this semi-liquid form will eventually lead to the liquefaction of the clay insulating layer, complicating the problems of ultimate decommissioning and making the landfill considerably less safe. The DEIS also gives no indication of how closure of these landfills could ultimately occur. It suggests no technology for dewatering the wastes and states that, if it were necessary to remove them there would be a danger of rupturing the protective container and contaminating groundwater (4.2.2.2). The clear implication is that there are no real plans to do anything about them.

The DEIS does state that "if waste storage areas are to be left intact and covered, wastes will have to be dewatered, leachates treated, and the landfills covered in a manner approved by State or Federal regulatory agencies." (4.2.2.2) Nonetheless, section C.2.3, which deals with solid waste disposal, is vague on this issue and does nothing to address, say, RCRA closure requirements as stated in the May 19, 1980 Federal Register.

Although the DEIS gives specific estimates of the volume of solid wastes to be generated during the demonstration and commercial phases of the plants projected operation, it gives no indication of how much land would be affected except that this waste would take "large areas" permanently out of production. The DEIS also gives no information on the water content of the wastes or on their ultimate possibility of solidifying.

We ask the Department of Energy to tell us:

MAR 0 2 RECD

1) How much land these wastes will remove from productive use during the projected commercial life of the plant.

2) How this land can be returned to productive use, and what guarantees we have that this will be done.

3) If there is no known procedure for decommissioning these landfills, why it is necessary to store gasifier wastes in liquid form.

B The DEIS states (4.1.3.1, similarly 2.2.1.2 and C.2.1.2) that: "The system will be designed to operate with total water recycle and zero discharge, but have the flexibility to treat and discharge all wastewater when process operating conditions do not allow recycle."

According to the DEIS such conditions would be expected to obtain during a prolonged plant shutdown (C.2.1.5, C-25). The statement that the system will be flexible implies that it will achieve tolerable effluent discharge levels at such times. The report, however, does not indicate what these levels would be, saying that "EPA, Kentucky, and DOE will jointly develop effluent limitations for the plant." Presumably, these will be developed by April, 1983, the dated given in Table 1.17 (1-49) as the date when an application for an NPDES permit will be required.

We have reason for concern about this since, although the DEIS repeatedly stresses the flexibility of the system, it cites as an advantage of a zero-discharge system "simplified waste-water treatment" (C.2.1.2, C-34). Presumably this means that such a system is preferable because wastewater that is recycled in this manner will not have to be as clean as it would have to be if it were discharged into the Green River. Nonetheless, this is the system that will be discharging effluents when operating conditions make it necessary. What positive assurances do we have that wastewater treatment engineering will meet acceptable levels for such discharge when the system is not designed for that purpose?

RR#2 Box 166
Henderson, Ky. 42420

George Trigg, Jr.

FEB 2 7 1981

Concerning the Solvent Refined Coal-1 Demonstration Project Draft Environmental Impact Statement (DOE/EIS 0073-D/Vii)

Comments at the public hearing in Henderson Ky. February 24, 1981, by Mrs. Jean W. Trigg, Box 166, RFD 2, Henderson, Kentucky, on behalf of the Citizens for Responsible Growth.

52

Comments on Impacts related to Commercialization

Our decision today has far wider implications than approving a demonstration plant. No one here can doubt that, if the Newman Plant performs for specifications and there is a market for its product, it will be expanded to a commercial-sized plant. Potential plant sites have been chosen and plans for the plant have been made with this eventuality in mind. Therefore, we aren't just talking about a demonstration-size plant, we are talking today about a commercial-size plant. This really is a decision on whether we are ready to face the disruption a commercial plant will bring.

We submit that the draft statement before us does not provide us sufficient data to make such a decision responsibly.

The introduction to the section on commercialization at an an expanded capacity, p. 4-94, reads as follows?

"At present the unavailability of sufficiently reliable information regarding construction and operations in the commercialization phase precludes an independent analysis similar to that developed for the demonstration phase."

Thus DOE claims that needed data are not available, then uses this as a justification for failing to address the problem in realistic terms.

Examples of this failure will be shown in the section designated Public Services and Finances, p. 4-95. Here is a quote from paragraph 1:

"Commercialization would provide a significant economic benefit to Daviess County in the form of a large increase to the local tax base, because ownership of the facility would be transferred from the Federal government to private industry at the end of the demonstration phase."

Words like "significant economic benefit" tell us nothing. Yet the DOE is willing to use them without being willing to talk about what the cost will be to the community.

We wish to know what the specific economic benefits to be derived by commercialization are? /We want a list of them with details and supporting data. We want a reasonable estimate of what the "large increase" to the local tax base will amount to.

We want to know how long it will be before property taxes from SRC-1 will be paid to Daviess County.

We want to know what tax money, if any, Daviess County will receive from SRC-1 during the construction and demonstration phases. We want to know where needed money for extra services resulting from the construction and demonstration phases will come from.

We also want to know if there is a possibility that Daviess County will receive no local tax money at all from the SRC-1 plant. On p. 4-95 we found this paragraph?

"Currently, Kentucky legislation exists for alcohol production plants that reduces the tax rate from the present rate of $0.66 per $100 of market value to $0.10 of market value within four years. It is expected that as of July 1, 1981, this exemption will be expanded to include coal plants, as well as other synfuel projects. If passage on July 1, 1981, of tax exclusions to energy production facilities is initiated, the land and buildings will not be subject to property taxes."

We want a full explanation of this. We want to know if synfuel plants will be exempt from property taxes altogether.

We also have questions about the following statemnt DEIS makes about Henderson County (p. 4-96)

...to the extent that expenses are incurred by Henderson County or the cities of Henderson or Owensboro as a result of workers' migration to these areas, there could be negative financial impacts, because these jurisdictions would not receive direct tax payments from the plant."

Is there any doubt that Henderson County and the cities of Henderson and Owensboro will experience additional needs for public services as a result of workers' migration? We want to know how these additional needs will be financed? We want a reasonable estimate of what they will cost.

We also want some reasonable estimates of the amount of money that will be lost to county government because prime farm land is being taken out of production by this plant. DOE has shown in a chart on p. 1-42 that 1630 additional acres of farm land in Kentucky will be disturbed every year by the need to support a synfual plant of 1100 acres with coal from strip mining.

We want to know what will happen to the county tax base as this land goes out of production? We want to know how much tax money will be lost By confiscation of farm land for roads and railroads?

We also want to know about state taxes these plants will pay? What exemptions will be given to synfuel plants at the state level? Whaelabrator-Fryer says that office furniture and equipment at the Newman plant will not be subject to state sales tax. What loss to state revenue would this represent? Will SRC-1 be exempt from other state taxes?

Comments on Cumulative Impacts

DOE admits, page 4-101 that "significant adverse socio-economic impacts could occur" in the event all proposed synfuel plants are built in this area. On the same page, there is an estimate that the construction of these plants will bring a population growth of 55,000. This is a specific figure to work with. Yet, how accurate is it? Dr. Harry Enoch, of the Kentucky Department of Energy in a paper entitled Environmental Consequences of a Coal Conversion Industry in Western Kentucky has estimated that the total population increase due to synfuels in 1985-86 is estimated to be 93,000, almost twice the U.S. DOE's figure.

We want this discrepancy explained.

We also want to know what basis DOE has for assuming that the population increase will be spread evenly over a 21-county impact area. By assuming the population increase will be spread evenly over this 21-county area, DOE has given us a meaningless figure of population increase of only 8%.

But it is not the average increase that will bring the crunch. It is the concentration in small areas that will bring vast socio-economic and financial problems to our area. Henderson County will be the place where the heaviest concentration occurs if two synfuel plants are built within it and one just over the county line. Most of the workers will want to live as close as possible to their place of work.

We would like to have a reasonable, realistic estimate of the population increase in Henderson County.

We want to know what reasonable expectations we can have of how many new people Henderson will have to furnish with schools, hospital rooms, medical services, police and fire protection, gas, water, sewage, garbage disposal, police and fire protection, social services, recreational facilities, housing and food services. We want to know where Henderson can expect to get the extra tax money to pay for these services.

We want data on other places where similar boomtown conditions have occurred.

We want to know what reasonable expectations we can have, based on these data, of increase in problems such as crime, drug abuse, alcoholism, and like problems. The Impact Statement we are examining today does not mention these when it discusses cumulative effects.

We want data presented on the effects of boomtown conditions on people with fixed incomes as costs of housing, food, and other necessities rise to meet increased demand.

We want data on what has happendd to other areas after the boom was over.

Respectfully submitted,

Jan W. Trigg

UNIVERSITY OF KENTUCKY
LEXINGTON, KENTUCKY 40506

COLLEGE OF ARTS AND SCIENCES
DEPARTMENT OF ANTHROPOLOGY

53

February 13, 1981

Environmental Review
Office of Policy and Programs Analysis
Department for Natural Resources
and Environmental Protection
4th Floor, Capital Plaza Tower
Frankfort, Kentucky 40601

Re: Solvent Refined Coal - I (SRC -I) Demonstration Project
Newman, Daviess County, Kentucky No. 81-2.

Gentlemen:

A cultural resource assessment of the Newman Industrial Plant project area resulted in the discovery of eight prehistoric archaeological sites (15 Da 67 - 74). Additional evaluation of two of these sites (Da 73 -74) failed to reveal any substantial archaeological deposits. Consequently, none of the archaeological sites within the project area were considered elgible for nomination to the National Register of Historic Places and no further work is necessary. However, the Office of State Archaeology should be notified immediately if archaeological materials such pottery, chipped-stone tools, or bone are exposed during construction activities.

If this office can be of further assistance in this project, please don't hesitate to contact us.

RECEIVED
FEB 19 1981
DEPT. NATURAL RES. & ENV. PROT.
POLICY & PROGRAM ANALYSIS

Sincerely,

Robert L. Brooks
Office of State Archaeology

AN EQUAL OPPORTUNITY UNIVERSITY

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON, D.C. 20330

54

Mr. James A. Reafsnyder
Research and Development Manager
SRC Projects Office
U.S. Department of Energy
SRC-I Public Hearing
Post Office Box E
Oak Ridge, Tennessee 37830

Dear Mr. Reafsnyder

We appreciate the opportunity to review the Draft Environmental Impact Statement on Solvent Refined Coal-I Demonstration Project, and have completed our review. Due to the low level of Air Force activity within the area, implementation of any of the proposed alternatives will not adversely impact the Air Force.

Sincerely

ROBERT L. KLINGENSMITH, COL, USAF
Chief, Environmental Division
Directorate of Engineering
and Services

DEPARTMENT OF THE ARMY
LOUISVILLE DISTRICT CORPS OF ENGINEERS
P O BOX 59
LOUISVILLE KENTUCKY 40201

ORLPD-R

11 March 1981

55

Mr. J. A. Reafsnyder
Research And Development Manager
Solvent Refined Coal Projects Office
U.S. Department of Energy
P.O. Box E
Oak Ridge, TN 37380

Dear Mr. Reafsnyder:

The Louisville District, U.S. Army Corps of Engineers, has reviewed the Draft Environmental Impact Statement (EIS) for the proposed Solvent Refined Coal Demonstration Plant (SRC-I) at Newman, Kentucky. It should be noted that the Corps of Engineers was lead Federal agency for this proposal prior to Department of Energy (DOE) assumption of lead agency responsibility. On 2 October 1978, by letter from Mr. W. N. Whitlock, Chief, Operations Division of the Louisville District, to Mr. John F. Pearson, Jr., Assistant Manager, Solvent Refined Coal Projects, Department of Energy, it was indicated that the Louisville District concurred that lead agency responsibility should be transferred to DOE. It was further indicated in that letter that the Corps of Engineers should be included as a cooperating Federal agency for the preparation of the necessary EIS for this proposal so that the National Environmental Policy Act (NEPA) responsibilities of the Corps of Engineers could be fulfilled along with the NEPA responsibilities of the DOE and other Federal agencies. With the coordination and information transfer that is appropriate between lead and cooperating agencies, the concerns expressed in this letter can likely be resolved.

While the Draft EIS discusses proposed river facilities that would be constructed in the Green River within the jurisdiction of the Corps of Engineers, no application for such facilities has been received by this District as of this date. The discussion presented in the Draft EIS regarding these facilities has received only minor modifications from the preliminary Draft EIS which we have previously reviewed and provided comments to your office on 7 October 1980. Clarification of our concerns was subsequently provided on 6 November 1980 in a meeting with members of my staff, DOE staff, and representatives of International Coal Refining Company. Your letter of 20 February 1981 includes a portion of the information we had requested but our request

was for this information to appear in the Draft EIS rather than in separate correspondence. This information should be incorporated into the final EIS for this project.

The status of permits for the proposed SRC-I project indicated in the Draft EIS (Table 1.17 and Appendix W) that application for necessary Department of Army permits would be made in January 1981, but as noted above, no application has been received by this office as of this date.

The discussion of cumulative effects (pages 2-30 through 2-32) omits the proposed A. B. Brown Generating Station addition which has a construction schedule parallel to the schedule for the proposed SRC-I project.

Our letter of 7 October 1980 requested that a discussion of alternate types of intake structures be included in the Draft EIS. While this has not been addressed in the Draft EIS, your letter of 20 February 1981 indicated that the selection of a type of intake structure will not be finalized until later in 1981. If a perforated pipe/wedgewire screen intake structure is under consideration, a brief discussion of this type of system should be presented in the alternative narrative and could also be incorporated into the discussion of mitigative measures. Our concern is that a conventional intake structure, as proposed in the Draft EIS, can cause greater entrainment and impingement impacts when compared to a submerged intake structure. The Draft EIS points out that water consumption by the proposed SRC-I project would be minimal as compared to normal flow of the Green River and, therefore, impacts to the aquatic ecology would be minimal. This contention is not supported, as the narrative description of the Newman site's aquatic ecology indicates that ichthyoplankton concentrations are highest in near-shore areas. This indicates that the amount of ichthyoplankton that would be entrained could be, depending on local conditions, a substantial amount. If the purpose of the discussion of a conventional intake is to present a worst case analysis, the unequal distribution of ichthyoplankton should be addressed.

Our letter of 7 October 1980 asked for clarification of the potential for barge transportation of SRC solid and liquid products and potential impacts if this transportation mode would be used. The discussion of transportation impacts (accidents) in the Draft EIS addresses only rail transportation of SRC products. Appendix Y of the Draft EIS still contains a discussion of SRC products being moved by barge. This conflict should be resolved and if barge

ORLPD-R 11 March 1981
Mr. J. A. Reafsnyder

transportation of SRC products is proposed, an analysis similar to that provided for a rail scenario should be provided in the final EIS.

Questions regarding our review should be forwarded to Mr. Terry Siemsen of my staff (FTS 352-6475).

Sincerely

NEAL E. JENKINS
Chief, Planning Division

Thank you for extending the deadline for comments. Even so, it was difficult getting them in within the extension.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
345 COURTLAND STREET
ATLANTA GEORGIA 30365

March 2, 1981

4SA-EIS

56

Mr. James A. Reafsnyder
Research & Development Manager
SRC Project Office
U. S. Department of Energy
P. O. Box E
Oak Ridge, Tennessee 37830

Dear Mr. Reafsnyder:

We have reviewed the Draft Environmental Impact Statement (DEIS) on the SRC-I Demonstration Project in Newman (Daviess County), Kentucky.

DOE has adequately addressed most of our environmental concerns. For those issues or concerns which remain outstanding we believe the negotiated work plan between DOE/EPA/Kentucky DNREP provides the best mechanism for resolution. Our attached technical comments were developed with this in mind.

As a matter of NEPA policy, we still have concerns with DOE's site selection process. A project solicitation process which required a site specific proposal significantly limits DOE's ability to factor environmental considerations in its siting decision(s). Specifically, we have reservations about the Newman site because of its apparent inconsistency with Executive Order 11988, its taking of a large tract of prime farmland, and the possible cumulative socio-economic and environmental impacts on the western Kentucky area from the siting of SRC-I and other energy related projects proposed.

The Draft EIS states that the demonstration plant will consume 73% of the 3-Hr PSD increment for particulates. We understand that these estimates were based on emission factors under worst case conditions and that emissions will not rise in direct proportion to increased plant capacity. Nevertheless, we believe that the emission factors are reasonably accurate and that this problem may be a significant limitation to commercialization at the scale presently envisioned.

An NPDES permit may not be issued for a discharge which violates water quality criteria. It appears that the discharges into the Green River will either violate criteria or aggravate already excessive amounts of toxic materials. In this regard, DOE should consider additional treatment for control of phenol, silver, zinc, chlorine and cyanide. However, procedures have been established by the Kentucky Department of Natural Resources and Environmental Protection by which a variance may be sought for certain pollutants for which the ambient concentration already exceeds water quality criteria standards.

EPA is committed to working with DOE to demonstrate whether synthetic fuel technology can be made environmentally acceptable. To that end, we are involved in a wide range of environmental impact evaluations and technology assessments for the industry. We understand and appreciate that the demonstration scale project is intended to facilitate these assessments. For DOE and EPA to discharge this responsibility, a comprehensive monitoring program during demonstration and subsequent evaluation in a NEPA-related public forum prior to a final decision on future operation is essential. The Final EIS should discuss how this evaluation will be conducted.

Based on the above and our enclosed technical comments, a rating of ER-2 was assigned, i.e., we have environmental reservations about the proposal and are requesting additional specified information to be included in the Final EIS.

Sincerely yours,

for John A. Little, Deputy
Rebecca W. Hanmer
Regional Administrator

Enclosure:
Technical Comments

cc: Dr. Robert Stern
NEPA Affairs Division, DOE

GENERAL COMMENTS

WATER QUALITY

1. Page 2-18, Second Complete Paragraph
The "effluent limited" classification refers only to dissolved oxygen and is not applicable to the discharge of toxics. Treatment requirements for toxics may be more stringent than those defined by "Best Practicable Technology". This should be clarified in the FEIS.

2. Page 2-20, Sixth Paragraph
Our analysis shows that the Green River's average ambient concentrations of copper and silver, in addition to those chemical parameters discussed in the DEIS, exceed water quality standards formulated by the State of Kentucky or Federal water quality criteria. In addition, zinc was found to exceed the criteria at maximum ambient concentration. In determining criteria for the above parameters, the data base from the 1980 EPA Water Quality Criteria Documents would be helpful. This data base is much more extensive than the one used in the DEIS (Table 4.12). We suggest the FEIS use this data base and the discussions in the FEIS be modified accordingly.

3. Page 3.22, Table 3.6
This table should state which parameters violated the Kentucky toxic criteria. In the absence of numerical standards the criteria are:

   a. For noncumulative and nonpersistent toxics, .1 times 96 $HRLC_{50}$ of a representative indigenous aquatic organism.

   b. For all others, .01 times 96 $HRLC_{50}$.

   Where possible, the Fathead Minnow, Bluegill, or other indigenous species should be used as the representative aquatic organism and the 1980 Water Quality Criteria Documents used as a data base.

4. Page 4-34, Table 4.7
The Kentucky standard for cadmium is 0.012 mg/l.

5. Page 4-41, Table 4.12
The 1980 Water Quality Criteria Documents should be used as a data base for determining compliance with mixing zone criteria.

The NPDES Permit for this facility must also comply with these criteria. If a high velocity discharge (greater than 2 FPS) is used, the .44 factor applies at the point where the velocity is reduced to 2 FPS.

6. Page 4.42, General Comment (Table 4.13)
The 1980 Water Quality Criteria, together with the Fathead Minnow or other indigenous species, should be used to determine toxicity criteria.

   Our preliminary analysis has shown that for manganese, mercury and iron, the discharge will not significantly increase concentrations over current maximum or average instream concentrations. Therefore, EPA would likely approve a variance for these parameters. However, the proposed discharge of cyanide, phenol, zinc, and silver would significantly increase current maximum and/or average instream concentrations. Additional treatment may be required for these parameters.

   Any discharge by this facility must comply with the Kentucky Water Quality Standards. In cases where the ambient concentrations exceed standards, a variance must be obtained from the Commonwealth of Kentucky and approved by EPA.

7. Page 4-43, Table 4.14
Same comment as for Table 4.13

AIR QUALITY

1. Page 3-31, Table 3.11
The table shows a summary of monitored air quality values at several sites within the project area. Ozone values given for the Henderson station and on-site ozone data for the period 10/77-10/78 do not agree with values presented in the PDEIS. These discrepancies should be fully explained in the FEIS since on-site data in the PDEIS show violations of the ozone standard. Also, on-site data for carbon monoxide and reduced sulfur for the most recent sampling time period do not agree with the PDEIS. This discrepancy should also be corrected in the FEIS.

2. Page 4-48, Table 4.16
Table 4.16 presents baseline air quality data which do not agree with that presented in Table 3.11 (page 3-31) for 24-hour and 3-hour SO_2 time averages and for the 24-hour TSP time average. This should be corrected in the FEIS.

3. Page 4-46, General Comment
As the DEIS very frankly points out, there may be some future problems at the commercialization phase in respect to particulate consumption of the available PSD increment. We realize that the primary cause of this problem is due to fugitive emissions from coal handling facilities and that air quality modeling in this area is suspect. This may present a permitting problem at the commercialization phase.

RESIDUALS WASTE MANAGEMENT

1. Page 4-2, Second Complete Paragraph
In this section and throughout the DEIS, the ash ponds and the residual disposal areas were described as having a clay liner with a depth of three feet. However, in Appendix R the design parameters for the clay liner on the ash and waste disposal area were given as 6 inches. The FEIS should eliminate this apparent inconsistency in design of the ash ponds and residuals disposal area.

2. Page 2-16, Fifth Paragraph
This section implies that a discrete system will be utilized to manage the raw water treatment sludge. However, the DEIS does not discuss the system.

General Comment (No DEIS Page Number)
Since the DEIS was published, regulations have been published in the Federal Register (January 12 and February 5) formalizing EPA's groundwater protection strategy in respect to location and performance standards for hazardous waste disposal facilities. In this regard, the FEIS should discuss the potential for leachate and other subsurface discharges from the residual disposal area and their potential impact on the future domestic, agricultural, industrial, and commercial groundwater uses in the area.

Page 4-28, Fourth Paragraph
In the event groundwater contamination from leachate is detected, what measures could be taken to eliminate the source of contamination and mitigate potential impacts to nearby water supply wells?

TOXIC SUBSTANCES

The comments and/or concerns below were provided by the Office of Toxic Substances (OTS) Health and Environmental Review Division. It is OTS's opinion that Appendix FF has a number of procedural and substantive errors and needs an extensive revision. In coordination with other EPA programs, OTS's primary responsibility involves evaluating health and environmental hazards associated with the end use of synthetic fuel products. To this end, OTS has set up the Synfuel/Toxic Work Group, a committee comprised of OTS representatives and technical experts on synthetic fuel processes. This committee provides a forum for the exchange and review of information during the premanufacture notice development process, and will serve as a source of guidance for the synfuel industry. The intent is to minimize the potential for unnecessary regulatory constraints and delays. We suggest DOE work closely with the group in revising Appendix FF in the FEIS. Their specific comments on the DEIS include:

1. Page FF-3, Second Paragraph
The inventory is a list of chemicals which were manufactured for commercial purposes between January 1, 1975 and June 1, 1979.

2. Page FF-3, Third Paragraph
The Interagency Testing Committee has little to do with new chemical substances.

3. Page FF-4, First Complete Paragraph
This position is not correct. During the review period, if EPA determines that a substance <u>may</u> present an unreasonable risk (or that the substance will be produced in substantial quantities and may lead to significant human or environmental exposure), additional data may be required by EPA to determine the risks presented. The ITC has nothing to do with the requirement of additional data.

4. Page FF, Last Paragraph
We are not aware of any proposal for a "model rule" in this regard.

5. Page FF-7, First Paragraph
EPA has determined that synthetic fuels are "new" chemical substances and are subject to the provisions of Section 5 of TSCA. The inventory information is incorrect. The Synfuels/Toxic Work Group will work with synfuel developers in developing their premanufacture notices. This interaction should eliminate the uncertainty TSCA imposes on the synfuel developer.

TECHNOLOGY

The following comments address the proposed pollution control strategies presented in the DEIS. This evaluation assesses whether these controls could be considered "Best Available Control Technology" (BACT). In essence, this is the first iteration of the process established in Issue D of the DOE/EPA/Kentucky DNREP Work Plan (Appendix EE) for permitting the demonstration plant. The comments are structured by media control technology and waste stream (i.e., Air Pollution Control - Coal Handling). The time schedules for deficiencies identified in the DEIS are consistent with the categories established in the work plan: first, items that should be resolved or addressed in a time frame so they can be included in the FEIS; and second, items identified requiring resolution after the FEIS. The BACT evaluation was provided by EPA's Industrial Environmental Research Laboratory and consequently are technology based and may not satisfy Commonwealth of Kentucky's permitting requirements.

A. Air Pollution Control

1. The proposed coal handling system includes: rail car unloading with dust suppression (water/chemical) in an open-ended enclosure, discharging coal to underground hoppers; conveyors underground are open (prior to coal crushing); exhaust from underground tunnels controlled using fabric filters; conveyors above ground partially enclosed (top and sides) prior to coal pulverization, totally enclosed after pulverization; enclosed transfer points, with outlets vented to filter; emissions during load-on to coal storage piles reduced by reducing coal free-fall; chemical wetting agent used on active coal pile, polymer crusting agent on reserve piles; coal pile reclaim via underground hoppers, with wetting agent used during reclaim; intermediate hoppers enclosed with vent to filter; pulverizer/hot gas drier off-gases controlled using fabric filter. Most fabric filters are stated (in PSD application) as being designed for 99.5% particulate removal efficiency, or to achieve 0.01 gr/scf.

While additional steps might be postulated to further reduce particulate emissions from this coal handling system (e.g., totally enclosing conveyors before pulverization, greater baghouse efficiency), the system as proposed now reflects such a substantial particulate control effort that the system can realistically be considered BACT as it stands. The proposed controls are identical to those employed for coal handling in, e.g., conventional power plants; there should be no difference between emissions/control performance for the coal piles in direct liquefaction and similiar piles in other industries. Accordingly, the proposed system appears basically acceptable as BACT, with only a few minor action items suggested below.

Prior to the FEIS:

a. Page C-37, Second Paragraph from bottom and elsewhere in the DEIS.
The DEIS indicates baghouse collection efficiency (99+%) only for one baghouse in the coal handling system, viz., the baghouse on the coal drier/pulverizer. The PSD application states a control efficiency of 99.5% or greater for this and the other baghouse in the system. The FEIS should clearly state the performance goal for all of the baghouses. If this goal is at least 99.5% for each, this performance would be considered BACT, although slightly higher efficiencies would theoretically be possible.

b. Page C-7, Third Paragraph
The DEIS mentions that coal might also be received by barge, although the design envisions a unit train. The coal unloading emissions control discussion (e.g., on DEIS page C-36, and in the PSD application, area 11) addresses only the unit train case. The FEIS should discuss, at least briefly, the controls that would be utilized in coal receiving if coal were delivered by barge.

Following the FEIS Page C-49 - General Comment

a. DOE/ICRC should advise EPA regarding the tests for hydrocarbon and acid gas emissions from the coal drier/pulverizer, and regarding any planned adjustments to drier temperature/residence time in order to reduce these emissions. Also, hydrocarbon emissions from this source should then be added to Table C.7.

2. Sulfur Recovery/Claus Tail Gas Cleanup

The proposed system includes: DEA and Selexol for acid gas removal from process gas streams; a three-stage ammonia-burning Claus plant (with a 100% spare) for sulfur recovery; a Beavon-Stretford unit (no redundancy) to remove unrecovered sulfur species from the Claus off-gas (reducing emissions to about 5 ppm H_2S and 50-100 ppm total sulfur); and no incineration of the H_2S is expected to be below 10 ppm if the Beavon unit operates properly). The Beavon unit will be custom-designed for this plant, although this is not clearly stated in the DEIS.

In terms of sulfur removal performance, this system is BACT. DEA and Selexol systems for acid gas removal are widely accepted, and Claus plant technology for sulfur recovery is almost universal. The Beavon tail gas cleanup system offers manufacturer guarantees of sulfur removal superior to any other available system. However, some early Beavon units encountered operating difficulties (e.g., plugging of Stretford tower with sulfur), which the developer indicates have now been sucessfully overcome. The acid gases from a direct liquefaction plant should be similar to acid gases from, e.g., conventional refineries and chemical plants, so that the DEA/Selexol/Claus/Beavon technology should be directly transferable to liquefaction plants; liquefaction plant sulfur recovery performance would be significantly different from conventional applications only in the remote possibility that liquefaction acid gases contained unique trace sulfur species not effectively handled by the sulfur recovery system, or other trace species that somehow impaired the performance of the system. Accordingly, the items indicated below mainly address the contingency of the sulfur recovery plant encountering performance difficulties, either due to Beavon operational difficulties, or due to differences in liquefaction acid gases.

Prior to the FEIS:

a. Page C-34, Last Paragraph
The DEIS indicated that Claus tail gas will be incinerated (oxidizing H_2S to SO_2 prior to emission) if the Beavon unit goes off-line. DOE/ICRC should indicate in the FEIS whether they would be willing to incinerate the tail gases, even when the Beavon unit is operating, if the H_2S concentration exceeds 10 ppm. (Ten ppm H_2S is a level considered in connection with NSPS for conventional refinery sulfur recovery plants).

b. Page C-52, Last Paragraph
The DEIS addresses emissions of SO_2 during upsets. One "upset" has not been considered, i.e., the contingency that the Beavon unit might go down. The FEIS should estimate the increased sulfur emissions (from sulfur recovery tail gas and from heaters fired with plant gas) that might result if the Beavon unit goes off-line.

c. Page 2-9, First Paragraph
The DEIS indicates that an ammonia-burning Claus plant will be employed. How will the ammonia oxidation be conducted in a manner which will not disrupt the H_2S/SO_2 ratio (through simultaneous oxidation of H_2S)? Also, will ammonia-sulfur salts be formed which could impact Claus plant operation?

Following the FEIS:

a. EPA will need to assess the worst-case sulfur emissions that might result if the Beavon unit is not operating properly. If these potential emissions are considered too high, some appropriate course of action should be agreed upon with DOE in the event that these worst-case levels are indeed observed during operation.

b. The plan for monitoring sulfur recovery plant tail gas -- including extended-term monitoring, and also more frequent monitoring during the first year or two of plant operation -- should be provided, if such a plan cannot be provided prior to the FEIS.

3. Fugitive Organics

The fugitive organics control techniques proposed in the DEIS include, e.g., double mechanical seals, with a barrier fluid, on pumps; an improved seal system for pumps where slurry abrasiveness may cause extensive seal wear; enclosure of reciprocating compressors; double valving on sampling connections; enclosure of drains; minimization of the number of flanges; vapor recovery systems on tanks; covering the oil/water separator in the wastewater treatment system; and bottom loading with vapor recovery on tank trucks. The directed maintenance program will include: quarterly or semiannual inspection of valves; "regular" inspection of flanges; "visual" inspection of pumps and compressors; a 10,000 ppm trigger concentration for repair of fittings in gaseous and light-liquid service; a 1,000 ppm trigger for heavy-liquid fittings; repair of leaks within 15 days, where feasible, with monitoring during and after repair in order to assure that repair is adequate; and redundancy in components most subject to leaks, so that these components can be taken off-line and repaired promptly.

The control technologies proposed (double mechanical seals, etc.) are BACT; EPA's studies of the conventional refinery and chemical industries have not defined fugitive organics control techniques superior to those proposed in the DEIS. The estimate of the number of individual fugitive emission sources, the emission factors, and the anticipated control efficiencies -- shown in Table C.5, page C-41 of the DEIS, and also shown in more detail in the PSD application -- have not yet been rigorously confirmed by EPA through independent calculations; however, such independent confirmation will be conducted as part of the PSD review, and there is no reason to doubt that DOE/ICRC have correctly applied the emission factors and control efficiencies from EPA's most recent report from Radian on refinery emissions (EPA-600/2-80-075c).

The proposed directed maintenance protocol -- which is the key to maintaining the performance of the proposed controls -- might also be considered BACT, in the sense that the proposed protocol is generally equivalent to -- or slightly more strict than -- the 1978 EPA refinery VOC leak guidelines (EPA-450/2-78-036). These EPA VOC guidelines

require: annual or quarterly monitoring, and weekly visual checks, depending on the type of source; a 10,000 ppm trigger concentration (zero cm from the source); and a 15-day repair period. These guidelines are considered "reasonably available control technology", in the absence of a rigorous definition of BACT. The greatest concern with the proposed directed maintenance protocol is that -- since liquefaction plant fugitives could potentially contain more "bad actors" than their conventional petroleum analogues, and since liquefaction leaks could be more frequent due to the abrasiveness of the slurry -- the protocol for the SRC-1 demo should perhaps be even more stringent than the refinery guidelines, at least for the first year or two until operating experience is gained. The basis for the 10,000 ppm trigger concentration and the quarterly/annual monitoring frequency in the refinery guidelines, is that available refinery information suggests that the bulk of the refinery fugitive emissions will be eliminated with these guidelines. It may be valuable to employ a somewhat more stringent approach in the liquefaction plants until the data base is available to confirm that the refinery approach will have similarly efficient results in liquefaction. For example, more frequent monitoring might be necessary if leaks are more frequent. Lower trigger concentrations may be desirable if intermediate-level leaks (below 10,000 ppm) are more prevalent in direct liquefaction plants, or if the leaks contain higher concentrations of "bad actors". This concern actually suggests the need for a careful monitoring effort during the first year or two of plant operation.

Accordingly, the items listed below do not address the fugitive organics control technologies themselves (e.g., double mechanical seals, etc.) since these are BACT insofar as BACT can be defined now; rather, the items are aimed at the initial year or two of monitoring after plant operation begins, in order to help define the necessary stringency of the directed maintenance protocol.

Prior to the FEIS

a. Page 4-133, First Paragraph
The DEIS indicates that DOE will develop a monitoring program for fugitive emissions (including, presumably, fugitive organic air emissions). The FEIS should indicate (in Section 4.5, and in Section C.3.1.5): 1) the schedule by which this monitoring plan will be developed; and 2) the general manner in which the results of this monitoring program will be used in order to help define the trigger concentration, the procedures and monitoring frequency for the fugitive organics directed maintenance protocol. To the extent that the following information is available prior to the FEIS, the nature of the fugitive organics monitoring effort should be defined, including: monitoring techniques; monitoring frequency; species to be determined; monitoring location; duration of monitoring program after plant operation begins; and how information might be used in defining the directed maintenance protocol. It is recognized that the detailed monitoring plan itself, which will present the above information, will not be completed until after the FEIS.

b. Page C-40, Last Paragraph
The DEIS outlines a directed maintenance protocol for the control of fugitive organics. The proposed protocol should be expanded during the first year or two of plant operation, being supplemented and guided by the fugitive organics monitoring program discussed above. The nature of the ultimate directed maintenance protocol for routine operation during subsequent years should be based upon the more complete monitoring accomplished during the first year or two. (In no case would the ultimate protocol be expected to be less stringent than EPA's conventional refinery VOC leak guidelines.)

c. Page C-40, Last Paragraph
The DEIS indicates that various organic fugitive sources will be screened at a trigger concentration ranging from 1,000 to 10,000 ppm. The sampling/analytical techniques which will be used for this screening are not given. This information, if available, or a schedule by which this information will be available, should be included in the FEIS.

d. Page C-40, Last Paragraph
The DEIS describes some aspects of the proposed directed maintenance protocol in general terms: e.g., "valves ... will be inspected regularly." More details should be provided -- source type by source type -- regarding the nature of the inspection and the actual frequency. It is recognized that details on the directed maintenance protocol will not be completed until after the FEIS is submitted. The FEIS should indicate the schedule by which the information, if not currently available, might be expected.

Following the FEIS

a. DOE/ICRC should provide the information requested above regarding the detailed monitoring plan for tracking fugitive organics emissions/control performance after plant operation begins, to the extent that the plan is not available for inclusion in the FEIS.

b. DOE/ICRC should provide further details regarding the directed maintenance protocol, including, for example, the information requested in (c) and (d) above, to the extent that this information is not available for inclusion in the FEIS. (The details should also include monitoring plans for identifying the presence of fugitive organics from aerial coolers.)

c. EPA and DOE/ICRC should agree upon an expanded directed maintenance protocol for the first year or two of plant operation, as supplemented and guided by the more extensive fugitive organics monitoring effort indicated in (a). This expanded protocol could then possibly be relaxed after operating experience is gained, based upon the results from the first year or two of operation; however, the ultimate protocol would not be less stringent than the refinery VOC leak guidelines.

d. EPA and DOE/ICRC should agree upon the ultimate directed maintenance protocol after the results from the first year or two of plant operation become available.

4 Combustor/Flare System

The controlled combustor/flare system proposed includes: conventional elevated flaring of gases from routine process vents, from minor upsets, and from major upsets, following some cooling of the gas stream prior to flaring in order to condense the heavier (and potentially more refractory and environmentally undesirable) hydrocarbons. Condensed hydrocarbons would be knocked out of the gas stream prior to flaring, and the liquids stored either for recycling to the process or for destruction in a controlled combustor at a controlled rate.

It is not possible to make a definitive BACT determination of this system at this time. The FEIS should assess at least one alternative system, as described below.

There are two major concerns with the proposed system. First, the gas cooling system may not adequately remove all of the potential "bad actors". This would be due either to inadequate cooling or because some "bad actor" may be relatively volatile. These potential "bad actors" might not be completely destroyed in the uncontrolled combustion environment of a conventional flare. (Even some heavier materials which are condensed might not be completely knocked out, but might go to the flare as liquid droplets in the gas stream). DOE/ICRC admits that some uncondensed heavier materials might go to the flare in the case of a major upset. However, no system design could effectively prevent that from happening in a worst-case upset, short of a prohibitively expensive oversized controlled combustor. The second major concern with the proposed system is that unless the system is carefully designed, plugging could occur in the coolers as the heavy materials condense. Such plugging, especially in a major upset, could result in direct discharge of non-combusted organic gases/liquid knockout (but without cooling totally) to a controlled combustor. A concern with this alternative system is that, if the controlled combustor were designed -- and temperature maintained -- for the worst-case upset, then the combustor would be grossly oversized and would consume large quantities of fuel while on standby just to keep it at temperature. Thus, an alternative system that might be considered would include:

a. a separate controlled combustor designed solely to totally handle uncooled routine vents;

b. a separate controlled combustor designed solely to totally handle uncooled gases from minor upsets;

c. an elevated flare to handle uncooled gases from major upsets (although if possible, it would be desirable to vent the potentially most hazardous streams to one of the controlled combustors during a major upset); and

d. a controlled combustor for incinerating any liquid knockout, if this liquid cannot be recycled to the process.

With such an alternative system, it would be important to estimate the frequency of major upsets and the emissions that might result.

Accordingly, prior to the FEIS:

a. Page C-40, Second Paragraph
The DEIS considers only one controlled combustor/flare system. The FEIS should include a discussion of at least one additional alternative, involving either: 1) a controlled combustor for all uncooled routine vents; 2) a controlled combustor for uncooled gases from minor upsets; 3) an elevated flare for uncooled gases from major upsets (with most hazardous gases going preferentially to a controlled combustor, if possible); and 4) a controlled combustor for knockout liquids which are not recycled.

b. Page C-40, Second Paragraph
The DEIS does not include an estimate of controlled combustor/flare performance. DOE/ICRC should, in the FEIS, be able to estimate a performance goal for the individual controlled combustors and the elevated flare for at least the two alternative combustor/flare systems. The goal may be, e.g., hydrocarbon destruction efficiency. While a more rigorous estimate of performance might not be possible until later in the design phase, it is considered important that some goal be indicated in the FEIS.

c. Page C-40, Paragraph 2
The FEIS should indicate the schedule by which refined performance estimates, feed stream composition estimates, and controlled combustor/flare system design information will be provided after the FEIS.

d. Page C-40, Section C.3.1.5
The FEIS should indicate the schedule by which the controlled combustor/flare monitoring plan will be prepared.

Following the FEIS:

a. DOE/ICRC will revise the controlled combustor/flare performance estimate, and will estimate the composition of the gas stream to the elevated flare under routine operation and for various upset conditions.

b. DOE/ICRC should provide specifications and design information regarding the controlled combustor/flare system, confirming the ability to achieve the performance goal.

c. A monitoring plan should be prepared, indicating how controlled combustor/flare performance will be determined during the first year or two of plant operation, and routinely thereafter.

5. Heaters/Boilers

Process heat and steam is to be generated on-site through the combustion of fuel gas generated in the plant. Sulfur emissions from these plant furnaces will be minimized through removal of sulfur from the fuel gas using the Stretford unit. Emissions of NO_x are proposed to be reduced through: 1) use of the plant fuel gas, which is anticipated to have a low fuel-bound nitrogen content; and 2) use of combustion modification techniques including low-NO_x burners (utilizing staged combustion), low excess air and possible reduced combustion air preheat, as appropriate. These techniques are estimated to reduce NO_x emissions by 30% compared to the standard emission factors for units fired with natural gas. (No coal-fired boilers -- e.g., for on-site power generation -- are planned.)

This heater/boiler system represents BACT. Removal of sulfur from the fuel gas using the Stretford unit will reduce fuel sulfur content to the lowest level reasonably achievable (5 ppm H_2S, and possibly less than 50 ppm total sulfur). Stretford technology in this application has been commercially demonstrated. The combustion modification techniques indicated for NO_x control (all, individually, or in various combinations) are considered to be BACT candidates for gas-fired boilers in this size range. Low excess air and reduced air preheat have been widely demonstrated commercially; low-NO_x burners are commercially available but have not been widely implemented. The projected NO_x reduction efficiencies for the combustion modification techniques are in the range that EPA would expect.

Accordingly, prior to the FEIS:

DOE/ICRC should estimate the schedule by which they should be able to provide the specific key combustion modification design information on individual in-plant heaters and boilers.

Following the FEIS:

DOE/ICRC should provide the key combustion modification design information and manufacturer guarantees concerning NO_x emissions in order to confirm anticipated reductions in NO_x from individual units.

6. Coker-Calciner Emissions

Controls for the coker-calciner include: incineration to oxidize hydrocarbons and reduced sulfur species; and a sodium carbonate scrubber (venturi plus sieve tray design) designed for 85% SO_2 removal and 92% particulates removal (according to the PSD application). Spent scrubber liquor will be sent to the wastewater treatment plant, although the DEIS does not clearly indicate this.

Soda ash scrubbers are commonly employed for SO_2 removal in relatively small industrial applications; scrubbers are also a commonly-employed technology for particulate removal. Thus, the soda ash scrubber, generically, is a reasonable control technology selection. However, the percentage removals proposed for this scrubber are at the low end of the range that might be expected for SO_2 removal, and, at best, are intermediate for particulate removal. The combination of the sieve tray (good contact time for SO_2 removal) and the venturi (high pressure drop for effective particulate removal) might be expected to enable performance greater than that proposed. Soda ash scrubbers can typically be designed for 90-95% SO_2 removal (compared to the 85% proposed in the DEIS); also, depending upon particle size and acceptable pressure drop, higher particle removals (up to 99%) are achievable, compared to the proposed 92%.

There is no emission standard which would rigorously define "BACT" for SO_2 and particulate removal from this type of source. The proposed removals might be adequate to maintain ambient concentrations at acceptable levels. However, it is noted (from Table C.7, page C-50) that the coker-calciner is the source of over 75% of the SO_2 emissions from the plant and 12% of the particulate emmissions. Improved control of this source could significantly reduce the amount of the PSD increment consumed, especially for SO_2.

Accordingly, prior to the FEIS

a. (No DEIS page number). The PSD application includes more specific information concerning the soda ash scrubber design and projected performance than does the DEIS. The PSD information should be incorporated into the FEIS by reference.

b. (No DEIS page number). The PSD application indicates scrubber design for 85% SO_2 removal and 92% particulate removal. The FEIS should present the rationale for not designing for higher removal efficiencies, especially since the coker-calciner is such a major contributor of SO_2. If the selection of the scrubber system and its performance is less finalized than inferred from the PSD application, then the FEIS should indicate the schedule by which the decision on scrubber design/performance will be made.

c. (Page C-36, First Paragraph).
The DEIS indicates that the hydrocarbons and reduced sulfur species in the coker-calciner off-gas will be incinerated. If at all possible, the FEIS should indicate a performance goal for this incinerator. As a minimum, the FEIS should indicate on what assumptions (stream composition, incinerator performance) the coker-calciner emissions in Table C.7 were estimated, and the schedule by which further information will be available concerning incinerator design, feed gas composition, and performance.

Following the FEIS:

a. DOE/ICRC should provide further information regarding the soda ash scrubber design and performance, as discussed in (b) above, to the extent that this information was not available prior to the FEIS.

b. DOE/ICRC should provide further information regarding the design and performance of the incinerator.

c. DOE/ICRC should indicate any monitoring plans for coker-calciner off gases during operation.

7. Wastewater Treatment Air Emissions

Fugitive hydrocarbons from oil/water separation will be controlled by covering the separation unit. Dissolved acid gases in the wastewaters will be stripped and recovered as part of the wastewater treatment operation. Some sludges from the wastewater treatment plant might be incinerated, including oily sludges, biological sludges and spent activated carbon. The DEIS indicates only that, if incineration is the technique chosen for handling these sludges, a tail gas treatment system will be employed (page C-44). This treatment system is not specified, but presumably would be compatible with RCRA requirements for incinerating hazardous wastes since the sludges are assumed to be hazardous.

Enclosure of the oil/water separation unit, and stripping of acid gases and volatiles, would appear to be reasonable selections as "BACT" for reducing air emissions from those sources. The suitability of the tail gas treatment from any sludge incineration cannot be judged until the incinerator design/emissions and the treatment system are defined.

Accordingly, prior to the FEIS:

Page C-44, Section C.3.2.5, and Page C-45, Section C.3.2.7. DOE/ICRC should identify the schedule by which the decision will be made whether or not to employ incineration, and -- if incineration is to be used -- the schedule by which information on incinerator design and tail gas cleanup will become available. If this information becomes available prior to the FEIS, it should be included in the FEIS. In particular, any tail gas treatment performance goals and emission factors would be of interest.

Following the FEIS:

a. DOE/ICRC should provide information regarding any envisioned wastewater-related incinerators, including key design information, estimated feed stream composition, and estimated emissions.

b. DOE/ICRC should provide key design and performance information for incinerator tail gas treatment systems.

c. DOE/ICRC should prepare a monitoring plan to monitor emissions from any incinerators.

8. Cooling Tower Emissions

A conventional wet cooling tower is planned, with separate aerial cooling for streams containing species of greatest potential environmental concern. Base operation will be in the zero discharge mode, with the highly-treated process wastewater being added to the circulating water/cooling tower system (and ultimately lost as cooling tower drift). During zero discharge operation, a 280 gal/min bleed stream from the cooling tower would be fed to an evaporator to control salt buildup in the circulating water. Fluids (overhead) from the evaporator will be treated in a granular activated carbon bed prior to being returned to the cooling tower in order to minimize organics buildup in the system. Emissions of organics resulting from any leaks in the aerial coolers would be identified by visual inspection.

Alternative cooling systems should be considered (e.g., dry cooling towers) which would eliminate drift emissions and still allow zero liquid discharge.

Accordingly, prior to the FEIS:

No DEIS Page Number.
DOE/ICRC should evaluate at least one alternate cooling system in the FEIS in respect to both the cost effectiveness and environmental acceptability.

9. Product Handling

The controls applied to product storage/handling are basically the same as those used for coal storage/handling, although the product SRC solid is more friable. Procedures include: chemical wetting agent on solid SRC storage pile; emissions during load-on to storage piles minimized by reducing free-fall; under-pile reclaim with use of wetting agents; reclaim system largely enclosed in tunnels vented to a filter; outside conveyors partially enclosed (top and sides); enclosed conveyor transfer points; rail car loading achieved using wetting agents and minimizing free-fall in open-ended enclosure; crusting agent on rail car after loading; coke stored in closed silos vented to filter; sulfur by-product stored in closed tanks; vapor recovery on liquid product storage tanks; and, bottom loading with vapor recovery during tank truck loading of liquids.

The proposed system reflects a substantial environmental control effort that can be considered reasonable control technology.

B. Water Pollution Control

1. Wastewater treatment. The wastewater treatment system includes: ammonia/sulfide acid gas stripping; metals removal from individual streams, as required; oil/water separation, as required; settling; two-stage biological treatment, with the addition of powdered activated carbon, if necessary; multimedia filtration; and polishing using a bed of granular activated carbon. The effluent from this treatment system will be fed to the cooling tower approximately 90% of the time in order to achieve zero liquid discharge. When the zero discharge system is inoperative for some reason (perhaps 10% of the time), the effluent would be discharged to the Green River. The estimates are based on a review of the literature and not an actual waste stream characterization study.

A rigorous evaluation of this system is not possible at this time, since: 1) there is some uncertainty regarding the compostion of some of the wastewater streams (in particular, the nature of the specific organic species that might be present); and 2) the identity of the specific commercial treatment processes that might be selected has not yet been defined. However, in general, the proposed generic treatment steps appear to constitute a logical combination of conventional commercially-demonstrated treatment processes.

The one area of possible concern is the absence of a phenol recovery step prior to the biological treatment system. Without such a recovery step, a temporary surge in phenol concentration -- if it occurred -- could overload the first stage of the biological treatment unit, rendering both biological stages inoperative and thus causing unacceptable contaminant concentrations in the effluent. DOE/ICRC have taken steps to prevent such a problem, including provision of an equalization pond prior to the biological units, provision for recycle of treated water back to the bio-unit feed stream in order to dilute the phenol concentration if necessary, and provision to add powdered activated carbon to the bio-system. These steps may be adequate, however, the FEIS should address phenol recovery as an alternative and present the rationale for not using it. The DEIS indicates that an assessment of phenol recovery is underway.

The effluent concentrations for conventional water pollutants are shown in Table C.16. A rigorous assessment has not been possible to confirm that the discharge levels listed in the table can indeed be achieved by a generic treatment plant of the proposed design. However, it has been identified that a number of the indicated effluent goals (e.g., 0.1 mg/l for phenolics, 5 mg/l for ammonia) appear to be reasonable performance goals for the indicated combination of treatment steps (considering the guaranteed performance for the individual commercially-available processes that might be utilized). The effluent concentrations for more complex, specific organic species, shown in Table C.17, are reasonable as initial projections, but involve considerable uncertainty. In particular, the ability to achieve the assumed reductions in the indicated species through biotreatment (30-80% reduction) and activated carbon absorption (75%) is not clearly demonstrated. It would be useful to bolster the FEIS with data from the on-going studies of SRC wastewater treatability in order to support the treatment system performance estimates (for both conventional pollutants and the more complex species).

Since the composition of the major contaminants in the wastewater entering the treatment system will not be known completely until the facility is operating and since there could be unexpected pollutant species in the wastewater streams, the importance of a comprehensive monitoring program cannot be over stressed.

Accordingly, prior to the FEIS:

a. Page C-48, Last Paragraph.
The DEIS indicates that phenol recovery is under consideration as an alternative for inclusion in the wastewater treatment plant. The FEIS should include the results of this assessment of phenol recovery or should indicate the schedule by which the decision will be made on whether or not to include phenol recovery.

b. Page C-20, Section C-2-1-2.
The DEIS does not clearly confirm that spent scrubber liquor from the coker-calciner soda ash scrubber will be among the streams fed to the wastewater treatment plant. This should be discussed in the FEIS.

c. Page C-55, Section C.4.2.
The effluent concentration/treatment plant performance estimates should be bolstered (in an appropriate FEIS Appendix) with as much SRC wastewater treatability data as available. If the data are not available for incorporation into the FEIS, the on-going waste treatability program should be discussed.

d. No DEIS page number.
The FEIS should include the schedule by which the monitoring plan for the wastewater treatment plant will be prepared.

Following the FEIS:

a. DOE/ICRC should provide estimates of wastewater stream compositions throughout the treatment plant and key design information on individual treatment plant components (e.g., manufacturer, performance guarantees, residence time, etc.). This information would enable confirmation that the performance goals are likely to be met.

b. DOE/ICRC should provide the results of experimental work confirming the estimates of treatment performance and effluent concentrations (to the extent that this information is not included in the FEIS).

c. DOE/ICRC should provide a monitoring plan for the wastewater treatment plant.

d. EPA and DOE should agree regarding what action might be taken if the plant effluent concentrations exceed the goal levels.

2. Rainwater Runoff

Runoff from the coal and solid storage piles will be collected through use of a compacted clay liner. Onsite soils are now being tested to determine their permeability characteristics. Runoff from the process area will be collected using a similar system. Runoff from storage and process areas will be collected in clay lined basins sized to handle the 10-year, 24-hour

storm; the runoff will be treated to varying degrees in the wastewater treatment system. The exact composition and thickness of the liners has not been specified. Runoff from solid waste disposal areas will also be collected and directed to the wastewater treatment system.

Although further details regarding this system might be desired in the NPDES permit application, the indication that runoff will be collected and treated from the indicated plant areas would appear to be, generically, "BACT". Key additional information that would be desirable later include: the identity and characteristics of the liner material ultimately selected, more detailed estimates of runoff composition, and the design of the individual treatment steps.

Accordingly, prior to the FEIS:

a. Page C-12, First Paragraph.
The DEIS indicates that efforts are underway to select the liner material for collecting runoff from the coal pile (and presumably from the process area, product storage area and disposal area as well). If further information is available regarding the nature of, or results from these testing efforts, it should be included in the FEIS.

b. No DEIS Page Number.
The FEIS should indicate the schedule by which a decision is expected regarding liner material/design for runoff collection, and regarding estimation of runoff composition and treatment step design.

c. No DEIS Page Number.
The final EIS should characterize the effluent discharge from the retention basin in the event of a 10-year, 24 hour storm.

Following the FEIS:

DOE/ICRC should provide the information supporting the ultimate decision regarding liner material identity, permeability and thickness.

3. Spills. Storage tanks will be diked, with a diked area large enough to contain the contents of the tank plus water from the 10-year, 24-hour storm. The dikes will be lined with an as-yet unselected impervious material, with the top of the dike above the 500-year floodplain (but with the base below the 100-year flood). Water collected in the dikes would be pumped to the wastewater treatment system. Any spilled oils, presumably, would be recycled or incinerated, although the DEIS does not clearly indicate this.

   Prior to the FEIS:

   a. Page C-15, First Paragraph.
   The DEIS does not clearly indicate the effort underway to select the liner material for the dikes. This effort should be referenced, and the anticipated schedule by which the liner selection decision will be made should be specified.

   b. Page C-15, First Paragraph.
   The FEIS might indicate how any spilled oils will be handled (e.g., recycled or incinerated).

   Following the FEIS:

   DOE/ICRC should provide additional details in the Spill Prevention and Countermeasure Plan.

C. SOLID WASTE

1. Solid Waste Disposal. Gasifier slag/flyash, which will be the largest source of solid waste and likely non-hazardous under RCRA, will be disposed of as a hazardous waste (at least initially until operating experience is gained). The slag/flyash disposal site will be a pond with a 3-foot-thick clay liner. A leachate collection system on top of the clay liner will collect any water which percolates through the waste and return it to the wastewater treatment system. A 20-mil synthetic liner will be placed under the clay, and a leachate detection system will be placed under the synthetic liner to detect any leakage. Sludges (other than brine) from the wastewater treatment plant (metalbearing sludges, biosludge, oily sludges, and spent activated carbon)

will also be disposed of in a separate landfill similar to the one described above. The metal-bearing sludges first will be stabilized. The carbon-containing wastes first will be incinerated. Brine resulting from the evaporator in the wastewater treatment system will be disposed of in a third secure landfill, separate from the other two. Options for stabilizing this brine are actively being investigated in order to prevent the salts from re-dissolving and returning endlessly to the wastewater treatment system through the landfill's leachate collection system. Spent catalysts, if not returned to the supplier for reprocessing, would also go into such a secure landfill. Due to the elevation of the plant site, the base of the slag/flyash landfill would be below the 100-year floodplain. The dike surrounding the landfill would be above the 500-year flood. Techniques are being evaluated for preventing rupture of the liner that might result from increased hydraulic pressure beneath it, e.g., episodes that might be experienced during a 100-year flood in which the water table rises above the landfill base. The smaller landfill for wastewater treatment plant sludges and other wastes will be above the 100-year flood. Groundwater monitoring downgradient and upgradient of the disposal sites is planned after operation begins. The solid wastes and the leachates collected in the underdrain system will be analyzed in order to assess the environmental impact of these wastes (and in order to determine if the gasifier slag/ash should continue to be treated as hazardous).

Disposal of all solid wastes in secure landfills, as proposed, would have to be considered the best control approach for the purposes of the EIS.

Concerning the design of the secure landfills, the specific design will ultimately need to be more fully defined by DOE/ICRC and reviewed by EPA as the RCRA "best engineering judgment" guidelines are developed. Further information regarding the permeability and other characteristics of the clay liner will be necessary after this information is developed, in order to confirm the adequacy of the present design. Further details may be necessary regarding the characteristics of the soils/strata underlying the disposal site.

The FEIS should confirm that all RCRA hazardous waste requirements currently defined will be satisfied for the envisioned landfill (including, e.g., fencing, record-keeping, etc.).

Although the gasifier slag/ash would generally not be expected to be "hazardous" as long as the gasifier is operating properly, the conservative decision to place this waste in a secure landfill nevertheless is technically wise. The inorganics leaching data presented in Table P.3 (page P.5) tend to confirm the expectation that this waste will not be hazardous. Despite this expectation, gasifiers (such as Koppers-Totzek) have not been routinely fired on fuels such as expected here (a solid/heavy liquid slurry, together with some coal). Thus, there exists a possibility that a full-scale gasifier in extended operation might, at least in some instances, produce an ash which could necessitate special treatment. Inclusion of a secure landfill for the slag/ash appears to be a prudent approach.

Since a primary objective of waste disposal is to prevent groundwater contamination, it would be constructive to develop a site specific model which can simulate specific groundwater contamination effects from the proposed landfill under a variety of scenarios (e.g., no liner rupture, shifting of clay liner, and worst case liner rupture.) Such an effort would utilize the best available leaching data on SRC wastes, and any estimates of the permeability/attenuation capacity of the substrata underlying the disposal area.

In Summary, prior to the FEIS:

a. Page C-32, Section C.2.3.2.
   The FEIS should indicate the schedule by which more detailed design information concerning the secure landfills will become available. This more detailed information should include selection of the liner material, including permeability information and the nature of the provisions to prevent rupture of the slag/ash landfill liner in the event of a 100-year flood, etc.

b. Page C-32, Section C.2.3.2.
The FEIS should confirm that all RCRA secure landfill provisions (including, e.g., fencing and record-keeping) will be satisfied.

c. Page 4-133, Section 4.5.3.1, and Page C-34, Top Paragraph.
The FEIS should indicate the schedule by which a leachate/groundwater monitoring plan will be prepared.

d. Page C-42, Section C.3.2.1.
The FEIS should indicate the schedule by which a decision is expected regarding the possible stabilization of waste brines.

e. No DEIS Page Number.
The FEIS should confirm any plans for groundwater modeling, and the schedule for conducting such modeling.

f. No DEIS Page Number.
The FEIS should indicate the schedule and corrective actions to be taken in the event the groundwater does become contaminated.

Following the FEIS:

a. DOE/ICRC should provide further details regarding landfill design, in accordance with (a) above.

b. DOE/ICRC should complete a leachate/groundwater monitoring plan.

c. DOE/ICRC should advise EPA of any decision regarding the stabilization of waste brines.

d. DOE/ICRC should provide the results of any groundwater modelling.

e. DOE/ICRC will advise EPA, after operation of the landfills begins, if the gasifier slag/ash is concluded to no longer require treatment as a hazardous waste.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
Atlanta, Georgia 30333

(404) 262-6649

57

(46) 3/19/81

March 3, 1981

Mr. James A. Reafsnyder
Research and Development Manager
SRC-I Project Office
U.S. Department of Energy
P.O. Box E
Oak Ridge, Tennessee 37830

Dear Mr. Reafsnyder:

We have reviewed the Draft Environmental Impact Statement (EIS) on the Solvent Refined Coal-I Demonstration Project, Newman, Daviess County, Kentucky. We are responding on behalf of the Public Health Service.

While we appreciate the efforts in this document to address possible consequences the proposed project might have on public and occupational health, we still have reservations about the following items:

General Comments

Although the SRC-I pilot plant in Wilsonville, Alabama, has been in operation since 1974, there is little mention of this plant in the text of the EIS. There is much discussion of the industrial hygiene and environmental efforts at the SRC-II, Fort Lewis plant, but virtually no discussion of the SRC-I programs. The Wilsonville pilot plant is supposedly the forerunner of the demonstration project in Newman, Daviess County, yet the EIS discusses the experience of the Fort Lewis plant as indicative of the "most direct experience applicable to SRC-I." Although the SRC-II pilot plant has operated in the SRC-I mode, what about the SRC-I pilot plant experience?

Specific Comments

Page ix - Section 7.1, par. 3, gives the impression that only carcinogenic or mutagenic compounds are formed. There are other compounds that may produce acute-life threatening effects (H_2S, CO) as well as other systemic effects, e.g., cardiovascular (CS_2), renal (coal tar products, CS_2, cresol), respiratory (SO_2, NH_3) etc.

Page x - Line 2, a medical surveillance program should also be included.

Page 1-13 - Section 1.2.5, par. 2, what about the Wilsonville, Alabama, SRC-I pilot plant experience?

Page 1-13 - Section 1.2.5, par. 4, what about the stability problems associated with the storage of non-hydrotreated coal liquids?

Page 4-1 - Section 4.1.1, par. 3, line 2, should include reference for "excess cancers."

Page 4-2 - Par. 2, in addition to carcinogenicity, mutagenicity, and teratogenicity, what about effects on reproduction?

Page 4-3 - Section 4.1.2, par. 1, this paragraph tends to lose sight of the acute hazards, e.g., CO, H_2S.

Page 4-3 - Section 4.1.2, chemical characterization of SRC materials could be financially burdensome venture if every single potential chemical was identified. A recent EPA report* estimates that approximately 1,000 of an estimated 10,000 chemical compounds have been identified in studies of coal, coal tar, and coal hydrogenation process and product streams. Characterization of chemical classes may be a more productive approach.

Page 4-3 - Section 4.1.2, the use of indicator compounds must be pursued with extreme care. Processing of different coal types under one or more operating conditions may result in such complex mixtures of chemicals as to question the usefulness of the indicator compound. Much research will be needed to establish suitable confidence levels for each indicator compound. In general, indicators may be more useful for planning comprehensive experimental monitoring programs and for identifying emission sources of coal derived materials than for estimating inhalation and dermal exposures. What about continuous monitoring/alarm systems for hazardous gases, e.g. H_2S, CO, CH_4--this is not addressed.

Page 4-5 - Wastewater and Spills, par. 1, line 8, total water recycle will concentrate trace materials to potentially toxic concentrations--possibly creating worker exposure problems particularly during maintenance and repairs.

Page 4-6 - Section 4.1.3.2, what plans and procedures will be used to protect all appropriate personnel in a "real" emergency--for example in case of an explosion or major fire? Safeguards discussed in the EIS are only for minimizing the problem but not for dealing with an actual emergency. Emergency procedures must be developed for protecting plant personnel.

Page 4-6 - Section 4.1.3.2, par. 2, laboratory personnel who analyze samples represent another group of workers who will be exposed to process materials.

Page 4-7 - Section 4.1.3.3, par. 4, line 12, "The DOE program . . . " should be in concert with HHS, EPA, OSHA expertise and know how. In fact, these agencies should be called upon to assist DOE in the selection/prioritization of compounds with the greatest potential health effects.

Page 4-9 - Section 4.1.3.6, par. 1, will a full-time industrial hygienist and an occupational nurse and/or physician be physically located at the plant? This is not addressed.

*Pellizzari, E.D. "Identification of Components of Energy-Related Wastes and Effluents," Interagency Energy-Environment Research Development Program, Publication No. EPA-600/7-78-004, 1978.

Page 3 - Mr. James A. Reafsnyder

Page 4-9 - Section 4.1.3.6, par. 3, line 4, it should be noted that there are other occupational diseases besides cancer that may result from exposure to process materials.

Page 4-9 - Section 4.1.3.6, par. 4, line 6, during periodic meetings, the latest health and safety findings should be presented to all workers.

Page 4-9 - Section 4.1.3.6, par. 5, training and education of workers is also needed in the proper maintenance and upkeep of protective equipment to ensure adequate protection as well as to increase the useful life of the equipment.

Page 4-10 - Par. 1, line 9, as the optical fiber method is still developmental, what method will be used if this method is determined not to be safe?

Page 4-10 - Par. 3, will fertile females be prevented from working in the demonstration plant as they have at the SRC-II, Ft. Lewis pilot plant? If so, for what reason will they be excluded from working in the plant?

Page 4-10 - Par. 4, line 6, the records should also contain information on the employees eating, drinking, and smoking habits.

Page 4-10 - Par. 5, line 3, what NIOSH methods are being referred to here? A reference is needed. NIOSH has not specified methods for evaluating potential indicator compounds--although there is a discussion on using the indicator monitoring concept in NIOSH's Coal Gasification Criteria Document (Publication No. 78-191, 1978).

Page 4-15 - Section 4.1.3.9, par. 1, Appendix 2 generally discusses ongoing studies funded by DOE. Only one NIOSH study is cited, an industrial hygiene study of the Wilsonville, Alabama, pilot plant. NIOSH has performed industrial hygiene surveys at the SRC-II pilot plant and the Cresap pilot plant. Plans are underway to survey the H-Coal and Exxon Donor Plants too. In addition, control technology assessments are made at each of these plants concurrently with the industrial hygiene study. NIOSH is also in the process of conducting a medical surveillance study related to coal liquefaction and coal gasification plants. An occupational hazard assessment of coal liquefaction processes is being finalized. This fiscal year preliminary efforts have begun to establish a prospective epidemiology registry of synfuel workers. The EIS should indicate that other agencies besides DOE are involved with health related synfuel activities.

Appendix 2 - Last par., there appears to be some confusion in this particular paragraph between NIOSH and OSHA. NIOSH is a part of the Department of Health and Human Services and is basically a research agency. OSHA is a part of the Department of Labor and is a regulatory agency. Line 4 mentions OSHA sponsored data base projects. Although OSHA has been working closely with NIOSH in terms of offering counsel and advice of a general nature in the areas of control technology and industrial hygiene surveillance related to the energy technologies, NIOSH through an interagency agreement with EPA has been sponsoring the data base projects cited in this paragraph.

Page 4 - Mr. James A. Reafsnyder

Appendix AA - From a safety standpoint, it is extremely important that safety professionals team up with engineers at the earliest stages of design, equipment, and process modifications/changes to insure that the safety considerations will be adequately addressed.

Procedures need to be established for monitoring equipment and materials that are received into the plant (quality control/assurance) to ensure that they meet pre-established specifications. This may ultimately prevent potential safety hazards/problems from occurring.

Thank you for the opportunity of reviewing this Draft EIS. We would appreciate receiving a copy of the final statement when it is issued.

Sincerely yours,

Frank S. Lisella, Ph.D.
Chief, Environmental Affairs Group
Environmental Health Services Division
Center for Environmental Health

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
LOUISVILLE AREA OFFICE
539 RIVER CITY MALL, P.O. BOX 1044
LOUISVILLE, KENTUCKY 40201

58

REGION IV

March 2, 1981

IN REPLY REFER TO:
4.8SE

Mr. James A. Reafsnyder
Research and Development Manager
SRC-1 Project Office
U. S. Department of Energy
P. O. Box C
Oak Ridge, Tennessee 37830

Dear Mr. Reafsnyder:

This is to acknowledge receipt of the DEIS for the SRC-1 Project at Newman, Kentucky. HUD's normal procedure is to have the Regional Administrator respond to your solicitation of comments. Owing to the shortage of time, the Louisville Area Office is responding directly. The Regional Administrator is aware of this through Mr. Russell Jacobsen.

Upon reviewing the DEIS, the staff had the following comments:

1. After conducting a detailed, multi-state survey for a suitable site, why is the proposed location such that over one-half is below the 100-year flood plain? The proposed site is even less attractive, from a strictly environmental viewpoint, because 90% of it consists of prime farmland.

2. From the description of travel patterns of the workforce, many small, rural communities will be adversely affected by heavy through traffic. DOE and the Kentucky Department of Transportation should make a definite commitment to ease the potential traffic burden on U. S. 60. Traffic will have an even greater negative impact if plant operations expand from a demonstration to full scale commercial production.

3. Since the primary impact area consists of small, rural communities without sophisticated urban/regional planning capabilities, induced primary growth and secondary impacts could be haphazard. This would not auger well for housing, water and sewer facilities, public safety, education and recreation. The Kentucky Department of Local Government and the Green River Area Development District, together with their counterparts in Indiana, should be directly involved and consulted at every stage. These bodies should make special provision in planning for non-disruptive growth.

4. The 26 families to be relocated should be protected by the Uniform Relocation Act and its benefits.

2.

Balancing the above-mentioned potentially disruptive impacts are the benefits to be derived from the project. The impact region has a high unemployment rate, and primary construction employment and jobs resulting from secondary residential, commercial and service development will lead to economic growth. This growth will stabilize in the future, provided the plant goes into commercial production on a sustained basis. The use of Western Kentucky coal will also be a boon to the depressed mining industry and those deriving their livelihood from it.

The Newman site has an advantage over the others, in that it is close to three towns which could absorb the impact of growth, whereas the other sites are in relatively unsettled, rural areas. The proximity of Owensboro, Henderson and Evansville also provides a pool of skilled labor, which would reduce the demand for workers from outside the commuting area. Having to absorb fewer newcomers, the environmental impact would be less severe.

Thank you for this opportunity to review and comment on the DEIS. If you require any assistance on environmental issues pertaining to HUD, please call Mr. Behram Shoff at (502) 582-6173.

Sincerely,

Verne Van Ness

for Fred H. Porterfield
Area Manager

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 81/77

FEB 24 1981

SRC Projects Office
U.S. Department of Energy
P.O. Box E
Oak Ridge, TN 37830

Dear Sir:

The Department of the Interior has completed its review of the draft environmental statement for Solvent Refined Coal I, Demonstration Project, Newman, Daviess County, Kentucky. We have the following comments and recommendations.

General

Previous involvement by our Fish and Wildlife Service (FWS) in the planning process has been restricted to matters pertaining to endangered species, particularly the Indiana Bat, and the expected impacts on that species at the selected site. The review of this document is our first opportunity to become involved in the site selection process. Although the proposed Daviess County site (as described in Appendix B) appears to be acceptable, we cannot state with certainty that the selected site is the least damaging alternative from a natural resource viewpoint. Early coordination would assure appropriate consideration of these resources and avoid such uncertainties in the future.

Specific

Section 4 of the statement discusses the impacts expected from the proposed action and the mitigation measures being considered by the DOE to lessen any adverse impacts. The major adverse impact expected to result from this project is a loss of terrestrial habitat. A total of 550-acres will be converted to industrial use immediately upon completion of the demonstration facility. All or part of the remaining acreage within the proposed acquisition area (approximately 934 acres) will be vulnerable to future commercialization and expansion of the facility. Of the acreage designated for immediate

conversion (550 acres), 25 acres are currently in high quality riparian habitat, and the remaining 525 acres are in cropland or some other severely altered floodplain habitat. Although most of the habitats are of moderate to low quality, the magnitude of the immediate and potential habitat conversion makes the overall wildlife losses significant and worthy of mitigation to the fullest extent practical.

Section 4.6.8 addresses the mitigation of these terrestrial impacts. Unfortunately, this discussion is directed primarily towards avoiding adverse impacts where possible, and does not address the mitigation of the unavoidable conversion of 550 acres of terrestrial habitat. Therefore, the final statement should address the available opportunities for offsetting the adverse impacts expected from unavoidable habitat conversion. We recommend that the DOE address the possibilities of utilizing all or part of the remaining acquisition area (approximately 934 acres) as temporary or permanent mitigation lands. Opportunities for mitigation are also available at the nearby State managed Henderson Slough Wildlife Management Area. The FWS would be available to assist DOE in developing a mitigation plan which is harmonious to both the demonstration facility and future commercial expansion plans.

The floodplain and wetland assessment eliminates alternative sites from consideration because some degree of floodplain encroachment would occur at all sites to accommodate barge access and water intake and discharge facilities (p. D.4, item D.2.2.). This reasoning would be appropriate if floodplain encroachment at the proposed site were limited to these facilities. However, at the proposed site coal- and liquid-storage areas and waste disposal areas also would be located on the floodplain (p. D-13, par. 1-4).

Although there is no discussion of whether there are practicable alternative sites where floodplain encroachment can be limited to barge access and water intake and discharge facilities, this in fact appears to be the case at the two alternative sites where plant layout is shown (Equity site, fig. 3.20, p. 3-57, and fig. 3.21, p. 61; Ravenswood site, fig. 3.25, p. 3-71, and fig. 3.26, p. 3-74). We recommend further consideration of the possibility of reducing encroachment on a floodplain.

We hope these comments and recommendations will be of assistance.

Sincerely,

CECIL S. HOFFMANN
Special Assistant to
Assistant SECRETARY

COMMENTS ON DRAFT ENVIRONMENTAL IMPACT STATEMENT

SOLVENT REFINED COAL-1

DEMONSTRATION PROJECT

NEWMAN, KENTUCKY

60

Submitted by

Richard A. Wham, M.D.

On behalf of

The Audubon Coalition

Daviess County Audubon Society

Evansville Audubon Society

Henderson Audubon Society

Citizens for Responsible Growth

Valley Watch

Henderson, Kentucky

February 24, 1981

THE HEALTH IMPACTS OF THE PROPOSED PLANT ARE NOT ASSESSED.

The Department of Energy (DOE) clearly recognizes that public health is one of the areas of greatest concern to the people of this area.

> (p.4-10EIS): The public scoping process revealed that occupational and public health effects were principal concerns regarding the development of a synfuel industry.

The cover sheet of the Draft Environmental Impact Statement (DEIS) clearly states that health effects are assessed in the document:

> Impacts assessed include effects of the project on occupational and public health resulting from the production and use of SRC products.

From that statement, one would logically conclude that somewhere in the DEIS a description and discussion of the expected health effects would appear. No such information is in the document!

Before the DEIS was released, the general public was led to believe that the document would give us a good idea as to what health effects, if any, we could expect from the plant. It is evident from reading the document that the proposers of this project do not know what the effects will be. Lacking this information we are given a discussion of possible (or probable?) effects:

> (p.IX): Through chemical reactions involving coal, the SRC process will produce a broad range of materials that contain carcinogenic and mutagenic organic compounds, including aromatic amines, aromatic and heterocyclic compounds, highly substituted phenols, and other compounds. DOE recognizes the health risk of operating a plant of this nature...

> (p.X): The sources of these hazardous substances to which the public could be exposed include fugative hydrocarbon air emissions (leaks), emissions from the plant flare system, waste-water discharge to the Green River, and SRC liquid spills during product transport.
>
> (p.Xi): Because of their potential toxicity to humans and aquatic organisms, the SRC-I discharge of cyanide, chlorine, phenol, and cadmium during low-flow conditions is considered a significant degradation of water quality.
>
> (p. XIV): Spills of SRC-1 products have the potential for causing significant adverse impacts to surface and groundwaters.... The impacts of worst-case spills could cause water supply emergencies for Evansville, Indiana.....

And since we here in Henderson get our drinking water from the same river, we assume that the same emergency would involve us, although not named in this section.

By such statements as quoted above, the DOE is expressing the same concerns that many of the citizens of this community have expressed over the past several months.

We have been constantly told by government and industrial sources, that our questions and concerns about health effects will be answered in the DEIS.

National Environmental Policy Act (NEPA) requires that an environmental impact statement must describe in detail the impacts of a proposed action, and health effects should be fully addressed. The DEIS of this project <u>does not</u> comply with this requirement.

Figure 1-6, p.1-20, labeled "Potential Health and Safety Hazards", compares alternatives of oil shale, enhanced oil recovery, outer continental shelf petroleum, biomass and SRC-1. The SRC-1 process, proposed for the Newman plant is the most hazardous of all five listed liquid fuel sources! And there is still no explaination as to just what are those hazards.

Section 4.1.1 gives a brief historical description of health effects related to earlier coal conversion technologies. Cancers of skin, lung, liver, bladder and kidney have been related to workers exposed to coal carbonization products. Carcinogenic, teratogenic and mutagenic are terms frequently mentioned in this section. Cancer, birth-defects, and mutations are terms which more people readily recognize and understand. DOE recognizes the association of SRC process and cancer:

> (p.4-2) These studies may be interpreted to indicate increased potential for a variety of cancers associated with coal gassification systems.... Certain SRC process intermediates, products, by-products, and wastes will contain heavy metals and organometallic compounds and a broad range of complex organic materials, including PNA's, aromatic amines, and heterocyclic sulfur compounds that are known or suspected to be (1) mutagenic in microbial systems or (2) carcinogenic, teratogenic or toxic in laboratory animals.....

Included in the above description of toxic materials are some of the most powerful cancer causing agents known to science- not just to laboratory animals, but to humans. Thus DOE is guilty of grossly understating the case. The DOE has reviewed the data showing increased incidences of various types of cancer associated with workers in coal-conversion plants and related industries. This type of information is useful and necessary in the DEIS, but the document fails completely to go to the next logical step and inform us "what will be the health effects on the people of this community, and what will be the health effects on the workers if the proposed plant is built?" The obvious answer if that the DOE does not know; International Coal and Refining Company, the operator of the plant does not know. Why is this information not available? The answer to this simple question is not-so-simply stated in the DEIS:

> (p 4.2).....the fact that only a conceptual SRC plant design exists at this time, reduces the ability to predict the specific compounds and exact concentrations of such compounds that will be present in products, intermediate streams, wastes, and occupational environments. This, in turn, limits the ability to quantitatively predict occupational and public health consequences of altered plant operating conditions.

Simply stated, the plans of the plant are not completed; the exact operating conditions are not known; the exact products and by-products are not known; and therefore it is impossible to determine what the occupational and public health effects will be!

It is therefore impossible for the public or any government reviewer to make a responsible judgement as to what the health and environmental consequences will be. Lacking this information one can not make an informed choice among this proposed plant and the various alternatives actions. In this very basic respect, this document does not fulfill the NEPA requirements for an acceptable DEIS.

THE PROPOSED HEALTH AND ECOLOGICAL STUDIES PLAN IS TOO LITTLE AND TOO LATE TO PROVIDE MEANINGFUL DATA FOR THE NEWMAN PROJECT.

The DOE is to be congratulated for proposing a research program to determine the health and environmental effects of an SRC process plant:

> (p.1-13) The development of environmental, health, and safety information is one of the objectives of DOE's coal liquefaction program.
>
> (p. III) One of the primary objectives of the demonstration plant program is to establish an environmental data base..

Appendix Z in Volume II of the DEIS describes a "Health and Ecological Studies Plan" which will provide information about SRC-I products, waste materials, and internal process streams and the health and ecological impacts which might result from exposure to these materials.

A four phase program is described. The first three phases are to be completed before operation of the plant begins. Operation is scheduled to begin in 1984 according to the DEIS.

Phase I of the research involves screening SRC-I materials for potential biomedical and ecological effects of

Acute exposures. Judging from the statement on page Z-3 one would assume that such research is well under way:

> SRC-I related health and environmental characterization activities have been under way since the construction of the Wilsonville Pilot Plant in 1974 and the Fort Lewis Pilot Plant in 1972. The activities have been significantly intensified since 1977 in response to DOE's decision to extend development studies to demonstration-scale operations.

This statement indicates that for the past eight years, this research has been underway. What are the results of this eight years' activity? Table 1, page Z-43 lists a total of twenty one "Samples for Biological and Ecological Assays." The table indicates that the research on these samples was started in the fall of 1980 or to be started in 1981. However the text on page Z-41 states:

> Of the proposed Demonstration Plant materials that could potentially inpact human health and/or the environment, only process solvent has been screened to date.

Process solvent is one of twenty-one samples which have been screened to date! Why was this screening not started back in the seventies?

Phase II of this plan will determine "long-term effects of chronic exposures." Certain Phase II activities such as testing for cancer causing agents depend on data from Phase I - which has just barely started!

Considering the long latency periods for carcinogenic effects to become apparent,and considering that Phase II is supposed to study "long term effects of chronic exposures," it is beyond belief that these two phases can be completed before 1984- especially since only one of twenty-one samples to be tested has begun, according to the text of the DEIS.

Phase I and II data, when completed "will provide guidance for the design of Phase III experiments." (p.Z-38).

> (p. Z-35) Phase III will explore the effects of altered plant operating conditions on the toxic properties of these SRC-I materials.

It is difficult to comprehend how this phase, which deals with altered plant operating conditions,can be completed before the plant experiences normal operating conditions.

HEALTH WILL NOT NECESSARILY BE PROTECTED BY EXISTING LAWS AND REGULATIONS

Throughout the many meetings and discussions with government and industry representatives they have repeatedly stressed that the plants must be fully permitted and will comply with existing laws and regulations. Thus we were supposed to assume no harm would result from such a government regulated situation. However the DEIS admits that such regulation leaves much to be concerned about:

> (p. 4-2) .....standards and limitations do not yet exist for most of the classes of compounds that are of concern.....Thus,compliance with existing environmental requirements alone will not ensure complete protection of the workers, the public or the environment.

This problem was mentioned in the Wall Street Journal, 10/28/80: "The federal government won't be able to regulate many aspects of the first generation plant. Instead, officials say the EPA

will begin issuing sometime next year preliminary versions of non-binding "guide lines" to control air and water pollution from the synthesis industry."

The problem of regulating and enforcing is further compounded in this proposed project because both the United States Government and the State of Kentucky have a large financial interest in seeing that the plant is a commercial success-possibly even at the expense of local health and environmental concerns. The DEIS does not address this very real conflict of interest.

THE OZONE PROBLEM HAS NOT BEEN ACCURATELY DESCRIBED IN THE DEIS

Ozone is a gas formed in the presence of sunlight from hydrocarbons and oxides of nitrogen released from pollution sources. Ozone is an irritant and toxic material which can cause or aggravate asthma, emphysema and bronchitis. We here in the Ohio River Valley have considerable experience with ozone. The air pollution which occurs with increasing frequency in the summer months is usually due to ozone.

From reading the DEIS there is certainly no indication that we have any problem with ozone, although the document does state that Henderson County is non-attainment. Monitoring on the proposed plant site is within the legal limits, according to the results reported in the DEIS. However data contained in Phase Zero material indicates otherwise: (Appendix I,

Meteorology And Air Quality Reports, December 1978 and March 1979, p.I-4):

> Measured ozone concentrations did exceed the Kentucky ambient air quality standard of 150 ug/m^3 maximum 1-hr average.... The standard was exceeded in a total of 109 hours during the period monitored from July 8 to October, 19, 1978.

Table I-21 from this report shows numerous violations occurring from 8/20/78 through 8/26/78, with values reading as high as 382. The following year the standard was changed to 235. This period in August, 1978, corresponds to an air pollution episode described in the Henderson Gleaner 8/23/78 and 8/25/78:

> The National Weather Service at Louisville...said a stagnant high-pressure system was causing a build-up of smoke, gasses, and other pollutants, state-wide. In Henderson and Daviess Counties, ozone levels reached unhealthful levels... Persons with respiratory or heart conditions are advised to stay indoors....

The monitoring data which showed 109 houly violations was accepted as being correct until two years later when suddenly a "computer error" was discovered. The revised data in the pending Permit Application for Air Contaminant Source, State of Kentucky, states:

> (p. A-4) A re-examination of the data clearly indicated that higher values previously presented were actually about twice their correct value.

This does not explain the fact that the National Weather Service issued an air-pollution warning and the people of Henderson and throughout the area were feeling real effects of air pollution. Were these ill effects due to "computer error"?

If a computer error actually occurred, (the Director or Kentucky Department of Natural Resources and Environmental Protection was quoted in the Henderson Gleaner 2/14/81, "happens

all the time"), what should we conclude about all the rest of the data in the air monitoring section of the DEIS? What steps have the DOE taken to validate the remainder of the data?

Monitoring continued at the plant site during 1979. Phase Zero states:

> Following a redefination of the SRC-I project, an expanded one-year monitoring program was begun on the same site on April 30, 1979.

For some unexplained reason the "expanded monitoring" did not include ozone- in spite of the fact that the previous years' data showed 109 violations and in spite of the fact that immediately adjacent to the plant site, Henderson County was non-attainment! Why was ozone not monitored in 1979? Such an omission is inexcusable and casts doubt on the scientific validity of the entire monitoring effort.

According to the DEIS the ozone concentrations are not expected to be affected locally:

> (p.2-21) because of the long-range transport nature of the photochemical reaction of ozone's precusors.. Hydrocarbon emissions will total about 60 tons per year.

Yet it is well accepted in scientific literature that during common summer-time dispersion and atmospheric conditions, it is frequent that the maximum ozone effect will be 10-15 miles from the source of the hydrocarbon emission. This is approximately the distance to the cities of Owensboro and Henderson.

Since approximately 90% of the hydrocarbon emissions will be due to fugative sources- that is -leaks and unforseen occurances, it is difficult to accept the 60 tons per year as being a firm figure. Also that figure assumes very efficient operation of the flare-combustor system- which is untested on the proposed scale and is therefore unproven. What data exists to confirm such expectations?

The monitoring at the plant site in 1978 showed levels which exceeded the then-existing standards. After the figures were revised (due to the computer error discovered two years later), the levels come very close to the new standard of 235ug/m^3. Henderson County is currently a non-attainment area for ozone. Therefor it is difficult to agree with the DEIS that ozone will not be a problem. Indeed, the DEIS admits that if the plant is enlarged to commercial scale "offsets will be obtained as necessary". (p. XVIII). Since no major source of hydrocarbons exists in the plant site now, what offsets does the DOE have in mind?

In regards to the offsets which would be needed for particulates for the commercial size plant, there is a suggestion that additional agricultural land could be purchased and kept out of production! This does not appear to be a rational approach in a world that will be starving in the next twenty to twenty five years, according to numerous studies.

TOO MUCH FAITH HAS BEEN PLACED ON THE CONTROLLED COMBUSTOR-FLARE SYSTEM

Throughout the DEIS one finds numerous references to the controlled combustor-flare system which is necessary to prevent hydrocarbons and various cancer-causing agents from

being released into the atmosphere where workers and public would be exposed:

> (p.C-30) The controlled combustor will be burning heavy hydrocarbon compounds that are potentially toxic and/or carcinogenic.
>
> (p.C-40) A controlled-combustor is a highly efficient combuston system.
>
> (p. C-31) The flare system must be safe, environmentallly acceptable, and flexible in operation.

These statements if taken at face value give the reader the impression that this is proven technology. No data in the DEIS supports this assumption.. The pending Kentucky Air Contaminant Source Permit Application gives what is described as a "Detailed Description" of the Flare-Controlled Combustor:

> The system presently being evaluated contains two elevated flares, one to handle the high pressure streams and one to handle low pressure streams, and a controlled combustor to combust liquids which are condensed from the vapor streams which are sent to the elevated flare. The aim of the design is to combust all heavy hydrocarbons (which may be toxic and/or carcinogenic) in the controlled combustor. The controlled combustor can be designed for complete combustion of the feed by operating with high temperature combustion and long residence times. It can be fed at controlled rates from a liquid holding tank.

Nowhere in the "detailed description" is a statement of operating temperature, feed-rate, residence-time, capacity, by-products or efficiency. It is obvious that the system is still in the design stage and yet the DEIS contains many statements which assume the presence of a well-functioning flare-combustor system.

The flare-combustor system is just one of many aspects of this proposed plant which would be demonstrated for the first time:

> (p.VII) Operation of the fully integrated process, that is, liquefaction, deashing, hydrocracking, product separation, solidifieation, gasification, and hydrogen production and environmental monitoring and control equipment, will be demonstrated for the first time.

THE SITE SELECTION DOES NOT MEET DOE'S OWN RECOMMENDATIONS

In June, 1980, DOE published a document called Synthetic Fuels and the Environment-An Environmental and Regulatory Impacts Analysis. In this document the DOE determined what locations would be best and worst for locating a coal conversion plant. Several categories were considered. Four classes were determined in each category. In the Environmental Health category- which is based on population density and existing cancer rates- Daviess County- the Newman site is in the worst class, and Henderson County is in the next-to-worst class. In the category of Ecological Sensitivity- which is based on prime farm land- the Newman site is in the next-to-worst class. In regards to existing air quality- the cities of Owensboro and Henderson and Vanderburgh County in Indiana are shown to be in the next-to-worst class. All of these factors would indicate that Newman is not a likely site.

This information was available to the proposers of this project, but nowhere in the DEIS is this information described. This type of information certainly indicates that the site selection-process is open to question.

THE ENTIRE PROJECT HAS BEEN QUESTIONED BY RECENT GOVERNMENT REPORTS

Several other very serious questions have been raised by recently released reports from the General Accounting Office. The following quotations are from an article in the Evansville Press, February 18, 1981:

> The report prepared by the General Accounting Office, the investigation arm of Congress, criticized the Department of Energy and the contractors of the solvent refined coal plant (SRC-I) at Newman...."for rushing to commit about $1 billion of Government funds and hire construction management"....In addition, the report questioned whether there had been adequate testing of smaller pilot plants to justify the construction of large demonstration plants.
>
> .....the report questioned the wisdom of building the Newman plant to handle 6,000 tons of coal a day when the largest pilot plant now operating only handles 50 tons a day. The great jump in size, the GAO report said, poses serious risks that the known technology can not be adapted successfully to the Newman plant..

These reports raise very fundamental questions which the DOE must answer.

LOCAL MEDICAL ORGANIZATIONS HAVE URGED DELAY IN SYNFUEL PLANTS

On June 17, 1980, the Henderson County Medical Society passed the following resolution:

> The Henderson County Medical Society is interested in protecting the health of the Citizens of this community. According to the studies available to us, the proposed coal liquefaction and coal gasification projects planned for this area would significantly increase the amounts of certain pollutants released into the air and water. Some of these pollutants are known to be health hazards.
>
> Therefore we urge all interested parties, private and public, to defer the development of these proposed plants, until it can be proved that adequate technology exists to protect the health of the people of this community.

On January 30, 1981, the Evansville-Vanderburgh County Department of Health passed a very similar resolution.

SUMMARY

The proposers of this plant have come to us with a document that does not fulfill the basic requirement of a DEIS- namely that of giving us enough information to make an informed opinion about the project. Much of what the DEIS does contain is confusing and at times deceptive.

The plant design is not known, and much of the control technology is untested and unproven. The risks of SRC-I process are great both to the occupational work force and the public at large.

In view of these factors, it is our opinion that the proposed plant should not be built at the Newman site- or anywhere else- until more information is known!

(23) 3/13/81

February 24, 1981

61

James A. Reafsnyder
U.S. Dept of Energy
P O Box E
Oak Ridge, Tn 37830

Dear Sir,

I live in the Ohio Valley Basin area of Daviess County, Ky and for the past several years we've seen the pollution settle here from the plants in Hancock County and from the Barnett Plant in Rockport, Ind. I'm not educated in the field of air pollution but I have sense enough to know if you can scrape the muck off your windshield in the morning then there's too much pollution in the air to be safe for our lungs. This mess hangs heavy in this

Valley and I certainly am opposed to any more factories being built in this area. What good are more jobs if the people aren't physically able to work? Surely there's a more suitable location for this "demonstration project".

Please record my "vote" against.

Thank you -

Betty Wilhoyte

3/9/81

L. E. WILSON
RT. 4, BOX 13
CHEMESBORO KY 42301

62

Feb. 27, 1981

MAR 0 2 RECD

Mr. James A. Reafsnyder
Al. L. Dept. of Energy
Oak Ridge, Tenn 37830

Dear mr Reafsnyder.

I am a resident living within ~~five~~ miles of the proposed demonstration plant at Newman, Ky. I am concerned about some aspects of the plant that I do not feel have been addressed in the E.I.S. Namely:

1. How will the plant effect our community in ten to thirty year from now as regards roads, getting coal to the plant and strip mining with the destruction of land.

2. Even if all the plants are built will they add very much toward meeting the energy demands of our country.

3. What will the gasoline and other products cost. Can the consumers, ~~afford~~ be able to afford them.

These concerns make me wonder if this is really the way to go. I think that conservation is the one thing that will do more with less cost than other solutions.

Respectfully submitted,

L. E. Wilson

MEMORANDUM

TO: James A. Reasnyder

FROM: William E. Wilson

DATE: 2-28-81

SUBJECT:

63

I am submitting herewith a copy of the talk I was to have made at the Henderson SRC-I EIS hearing.

I could not enter the building due to the fire regulations pertaining to the number of people inside.

Hope they will be given consideration.

Sincerely
William E Wilson

WILLIAM E. WILSON
PROFESSIONAL ENGINEER
117 West Lake Street
Madisonville, Kentucky 42431

Area-wide development

There seems to be a story on synthetic fuels development every day in the newpaper. Last month, Ron Jenkins, the editor of the Henderson Gleaner, wrote in his column that a friend stopped him downtown and said he was pretty sick of all this media coverage. I'd like to tell Mr. Jenkins that not all of us share that feeling. I, for one, have been proud of the industry. The more information available to us, the better.

I put the same importance on the Draft Environmental Impact Statement. It provides us with a lot of information. We are able to review the Solvent Refined Coal project in detail. The Statement not only gives us the facts, but it also tells us of possible impacts caused by developing the plant. As is its mandate, the Impact Statement paints these impacts in the worst possible light. This is good. This way we know the worst and can plan on measures to lessen or do away with the adverse effects of the impacts.

The Draft Environmental Impact Statement is important in yet another way. The document focuses on one project. It makes sense of one synthetic fuels plant. This seldom has been the case elsewhere.

Understandably, the media has been fasicnated with the abundance of proposed synthetic fuel plants. There is the H-Coal commercial plant in Breckenridge County; the W.R. Grace indirect liquefaction plant near Baskett; the Texas Eastern and Texas Gas Company SASOL project in Henderson; and the Ken-Tex high-BTU gas project in Webster County. Kentucky's media have been most concerned with the proliferation of synthetic fuels projects. We, as readers, are often overwhelmed by the stories. If I may slightly misuse a well worn phrase, we're left looking at the forest without a view of the trees.

Often, the effects of being overwhelmed is to throw up your hands in defeat. "The challenges are too much," some people might say. They are overloaded with information and refuse to listen anymore. Their mind is made up. If change means confusion, then they will fight all change.

There was a meeting last month attended by many people who felt this way and who had decided to fight growth in this region. While I did not attend that meeting, I read in the newpapers that an attorney spoke there about the different options available to people who wanted to stop this growth. According to the story, there is a lot people can do. But to me, the most interesting statement came near the end of the article. This lawyer said that citizen action doesn't have to be adversary. He said compromises between plant developers and environmentalists can be hammered out, if a well designed plant is the goal. That is important. Instead of fighting everything, we can focus our efforts to better the project, "IF A WELL DESIGNED PLANT IS THE GOAL."

One other observation: the lawyer, or in the least, the reporter, described opponents as "environmentalists." Most often all opponents to the development of synthetic fuels are called "environmentalists." I take exception to that term. I am an environmentalist. I care about my environment and the environment of my children and grandchildren. As an environmentalist, I care not only that the environment is clean, but also that my children will have the time and means to enjoy it.

That is why I have chosen the path which the attorney mentioned last. I have chosen to work with the developers by making known my concerns as this project develops. I am sifting through the information as it develops. I read as much information as I can, and act on it when I can. I believe this Draft Environmental Impact Statement is a result of many other people working under that same belief.

Sure, we all must be aware of the cumulative effects of several synthetic fuel plants if they should develop. But the other plants are not nearly as advanced as the SRC-1 project, and SRC-1 won't break ground until late summer or early fall. A lot can be done between then and now ... and a lot can be done to protect the environment throughout the life of this project.

But nothing will get done if we don't focus our attention on individual issues, individual projects and proposed mitigating measures. We have to take this one step at a time.

I applaud the release of the Draft Environmental Impact Statement. It is a well written document filled with needed information for the community. I hope the information will not stop here. This type of communication should develop throughout the construction and operation of the demonstration and operation of the project.

If we can continue like this, we can build at least one plant. We can develop a much needed project to our liking. There will be time for decisions on the other projects and the amount of growth we are willing to accept. For now, let's focus on SRC-1.

Todays coal represents 18% of this nations energy sources while oil represents 49%.

Oil represents 11% of our energy reserves.

Coal represents 87% of our energy reserves.

One half of the known coal reserves in the free world lie within the borders of America and is a seven time greater energy reserve than all middle eastern nations combined.

VALLEY WATCH, Inc.
P.O. Box 2262 Evansville, IN 47714 812-464-5663

MAR 0 4 1981

Tom Zeller
President,
Valley Watch
Feb. 25, 1981

Carcin-
ogens

64

BOARD OF DIRECTORS

Dr. Hugh Spencer
Principal Investigator
ORBES Study

H. Joel Deckard
Member of Congress

John Blair
Pulitzer Prize
News Photography

Dr. Andrew Jorgensen
Chemist
ISU-Evansville

Dr. Richard Wham, M.D.
Radiologist-Henderson
Community Hospital

Fred Hauck
President
Save the Valley, Inc

Tom Zeller
President
Valley Watch Inc

James A. Reafsnyder
Research and Development Manager
SRC-1 Project Office,
U.S. Department of Energy
P.O. Box E
Oak Ridge, Tennessee 37830

Valley Watch is a non-profit corporation whose purpose is the protection of the environmental quality of the lower Ohio Valley. As such we would like to submit written comments on the Draft Environmental Impact Statement for the Solvent Refined Coal-1 Project. Due to the short amount of time allowed for comment on such a complex document, each Valley Watch board member will send his testimony under separate cover. Nonetheless, the sum total of these documents are to be considered as Valley Watch's comments.

First of all, I question the propriety of preparing a document which purports to delineate all environmental impacts of a major industrial project at a time when the plant is only in a "conceptual design" stage, when major air pollution control equipment remains undesigned, when the classification of a potential billion pounds of solid waste (as would result from the gasifier of the commercial facility) as hazardous under the federal Resource Conservation and Recovery Act remains uncertain, and indeed the composition of wastes from the various liquifaction process are not yet known.

In fact, I conclude that the DEIS doesnot, and cannot at this time, adequately indicate the magnitude of the impact of this proposed project on the health of the citizens of the area.

My main misgiving concerning the construction of the SRC-1 Pilot Plant is the exposure of Valley citizens to airborne carcinogens. It is known that the SRC process will involve the production of several classes of chemical compounds which are either known to be or strongly suspected to be carcinogenic, mutagenic, or tetragenic. These substances will be produced in large quantities and will exist under high pressure.

The only question remaining, and this question is not answered, or even adequately addressed in the DEIS, is to what degree will these harmful chemicals be contained? Vague references to a "directed maintenance and monitoring program" are not reassuring, nor do they present a specific impact.

According to the DEIS, in an emergency upset condition, 700 tons of hydrocarbons, containing these toxic compounds, will have to be burned off by the controlled combustor. The destruction efficiency of this device is not known,as it has not yet been designed. Thus the health impact of such a situation, which is not unlikely to occur over the lifetime of the plant, is not specific.

Of course the health impacts themselves cannot be specified, as the degree of knowledge concerning the dose-response relationship related to these substance is not known. Nonetheless, an estimate of expected concentrations is in order.

Indeed, the nature of the pollutants involved and the lack of knowledge of their effects makes this plant experimental in more than a technological sense. Because no health monitoring has been performed at the few existing similar plants in the world, the lower Ohio Valley will be a testing ground for such healths effects.

The DEIS informs us that high molecular weight polycyclic aromatic hydrocarbons and amines were found in the work environment by monitoring at Donor Solvent pilot facilities. The observed concentrations should be included in the final EIS.

Appendix z, Health Effects, shows that several crucial studies have not yet begun, or have only just begun. It is unacceptable to present an EIS which fails to characterize the very natureof waste streams, much less provide a detailed examination of toxicity of waste components and a discussion of their human health effects.

Ozone

The DEIS is also deficient with regard to its discussion of the impact of the plant on the ozone concentrations in the area. Evansville experienced three episodes of .12 ppm or above in the surmer of 1980 alone, yet the DEIS seems to dwell on TSP and SO2 impacts with little attention given this serious problem. It would seem desirable to have ozone modelling performed to predict ground level impacts, instead of simply stating that "ozone concentrations are not expected to be affected locally because of the long range transport nature of the photochemical reaction.

This is simply an invalid conclusion, and one that is not supported by documentation whatsoever. In truth, while the photochemical reation does occur during hydrocarbon transport, the highest ozone concentrations are recorded on days with very low wind velocities, such that the maximum concentration due to a major source of hydrocarbons, which this plant will be, is in the range of ten to twenty miles. Thus Evansville, Henderson, and Owensboro are likely to be adversely affected, and may indeed be thrown into a non-attainment status.

The matter of the not-yet-designed controlled combustor enters this discussion as well, as the 700 tons of hydrocarbons which must be broken down rapidly by combustion during an upset represent a massive amountof potential ozone, even with a 90% destruction factor. A 10% release would be more than the DEIS predicts for an entire year of plant operation. How often do traditional refineries experience upsets?

The DEIS does not address the cumulative impacts of hydrocarbons from the SRC plant in combination with those from the proposed Grace and Sasol plants. The impacts of three major plants within twenty miles of Evansville would be highly significant, and would, in my opinion as a former air quality specialist with the U.S. Environmental Protection Agency, not only create a non-attainment situation, but could quite possibly result in considerably higher concentrations which would represent a significant health threat.

What exactly is a "directed maintenance and monitoring program" and what assurance does the public have that such a program, which should be detailed in the FEIS, will be carried out, especially several years into operation when valves, pumps, compressors and other fugitive emission sources begin to leak? What ambient monitoring for ozone will be performed? What type of monitoring will be done on the emissions from the controlled combustor?

TSP

Looking at TSP impacts, one finds that if the plant goes commercial scale, that over 100% of the PSD increment will be required. Is the DOE hoping that the PSD sections of the Clean Air Act will be repealed by the new congress? The public is basically told that this issue will be addressed when that particular decision is upon us. Should we be so naive as to ignore the capital inertia effect which pushes towards those projects which already have a significant investment involved. It is either poor planning by DOE to build a demonstration plant with the option to commercialize in an area whose air quality will not allow commercialliza-tion, or it is misleading on their part to ignore this aspect of the decision by postponig it.

The statement on page 3-30 concerning a possible secondary standard violation measured at the site is inaccurate in my understanding of the fugitive dust clause of the Clean Air Act regulations. I don't believe that it has been normal procedure to void a violation based simply on a microscopic examination of the particle make-up. Instead, the fugitive dust provision is used in areas which are considerably more rural than the Ohio Valley, such as the southwest.

Solid Waste

Tests to determine the classification of the gasifier waste under RCRA have not been completed. If these tests show the waste to be hazardous, will the landfill be raised above the 100 year flood level? This determination, as well as the leaching tests for the metal-bearing sludge from the water treatment system should be included in the FEIS.

The DEIS does not address the long term effects of the waste landfills. Once the areas have been covered, will their be any restrictions on the use of the land. If not, what is the potential for eventual seepage from the pits and contamination of soil,plants, and grazing animals? As no material is completley impermeable, tests should be performed and reported in the FEIS as to the permeability of the clay to be used for lining and sealing the landfills.

Have tests been performed on the proposed synthetic liner for the landfill, and what will that liner be made of? Will it provide 100% impermeability to leachate? If not, how impermeable is it? Will it be susceptible to attack by the organic chemical fraction of the waste?

Specific groundwater monitoring plans should be provided in the FEIS. How many monitoring wells will be used, what will their locations be, and at what depths will

they sample? The cross-section on page 3-9 is too generalized for a realistic appraisal of alluvial deposits and their influence on groundwater flow and degree of complexity of the subsurface regime. Logs of the drill borings should be included in the FEIS. A detailed examination of this information may reveal the need for monitoring at several vertical layers in order to have adequate information pertaining to leachate movement.

Accelerations of .1g resulting from seismic activity are not unlikely according to a USGS report sited in the DEIS, and a .25g force is estimated to have occurred at the site during the New Madrid quake. What is the design criteria for the hazardous waste landfills? Will they maintain their integrity after a .1g shock? a .25g shock? Page 2-16 assures us that "provisions to prevent floating of the liner will be included", and two potential techniques are mentioned. Which of these techniques, or others, will be used?

Appendix L discusses the potential for liquifaction at the site and concludes that the landfill site "may be susceptible to liquifaction". What measures to insure landfill integrity during such an event will be taken, or is the plan to hope that it doesn't occur? My conclusion is that the floodplain geology IS INADEQUATE for construction of a secure landfill, and that at the very least differential settlement of the landfill due to seismic activity should be expected.

MISC. Miscellaneous questions raised by reading the DEIS include:

What is the anticipated frequency of plant start-ups? Significantly higher air pollution occurs during this 50-hr. phase than during normal operation. Does the 150 ton/year figure for SO2 include only normal operation or start-up emissions as well?

Page 2-9 states that "the sulfite- and particulate-laden scrubbing stream will be disposed of in an environmentally appropriate manner". If such vague statements are appropriate for a DEIS, then the entire document could be written in one page by assurances that all impacts of the plant will be "environmentally appropriate".

What were the results of the industrial hygeine program conducted at the Wilsonville Pilot Plant? What were the results of plant ambient air monitoring? How do the predictions in the DEIS for this pilot plant compare with what actually occurred?

In 1977 a series of chemical spills into the Ohio River illustrated the lack of communication and coordination between governmental agencies, and the lack of ability to predict spill travel time. If the potential for spills which may create "water supply emergencies" exists as stated in the DEIS, then the operators of the plant should have on line a river flow modelling program which could be fed current river conditions at the time of a spill and result in predicted spill arrival times for use by water supply agencies for timing additional filtering or water intake shutoffs.

The finding that certain electrostatic precipitators do not perform adequately when using the SRC solid product affects the environmental feasibility of the project, since providing "clean coal" is one of the major reasons for the plant. How many ESP's cannot handle the SRC product compared to the number that can?

I have attempted to bringto attention the main questions which occurred to me about the DEIS. The time allowed for review was short, and my presentation herewithin has been rushed. However, I hope that the issueds raised by myself and others will be addressed in the FEIS and that the final document will more adequately specify expected impacts of the SRC plant.

Sincerely,

Tom Zeller, President
Valley Watch

COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT
FOR THE PROPOSED SRC-I DEMONSTRATION PLANT
(DOE/EIS-0073-D/VI)

65

submitted on behalf of
SYNFUELS INQUIRY CORPORATION
and
its members and
the various individuals
who prepared the comments

February 24, 1981

Prepared by:

Howard E. Dunn - Ph.D. - Chemistry
Chris Prendergast - Ph.D. - Sociology
David A. Gugin - Ph.D. - Political Science
H. Mallareddy - Ph.D. - Civil Engineer
Gordon K. Weddle - M.S. - Zoology
Thomas R. Kozel - Ph.D. - Aquatic Biology
Warren Hankins - Ph.D. - Chemistry
James E. Rode, Jr. - LL.B.
Hugo C. Songer - LL.B.

SRC-I CHEMICAL EMISSIONS, CANCER, BACKGROUND POLLUTION, AND OTHER HEALTH IMPLICATIONS.

On January 1, 1970, the President signed into law the National Environmental Policy Act (NEPA). This act established in the Executive Office of the President a Council on Environmental Quality (CEQ), charged with the responsibility to study the condition of the nation's environment, to develop new environmental programs and policies, to coordinate the wide array of federal environmental efforts, and to see that all federal activities take environmental considerations into account. To insure that environmental amenities and values are given systematic consideration equal to economic and technical considerations in the federal decision-making process, NEPA requires each federal agency to prepare a statement of environmental impact in advance of each major action. Each Environmental Impact Statement (EIS) must assess in detail the potential environmental impact of a proposed action, and all federal agencies are required to prepare statements for matters under their jurisdiction.

The primary purpose of the EIS is to disclose the environmental consequences of a proposed action, thus alerting the agency decision-maker, the public, and ultimately Congress and the President to the environmental risks involved.

According to NEPA, the EIS must include:

1. A detailed description of the proposed action including information and technical data adequate to permit a careful assessment of environmental impact.

2. Discussion of the probable impact on the environment, including any impact on ecological systems and any direct or indirect consequences that may result from the action.

3. Any adverse environmental effects that cannot be avoided.

4. Alternatives to the proposed action that might avoid some or all of the adverse environmental effects, including analysis of costs and environmental impacts of these alternatives.

5. An assessment of the cumulative, long-term effects of the proposed action including its relationship to short-term use of the environment versus the environment's long-term productivity.

6. Any irreversible or irretrievable commitment of resources that might result from the action or which would curtail beneficial use of the environment.

The Draft Environmental Impact Statement for the Solvent Refined Coal - I Demonstration Plant Project planned for Newman, Kentucky, does not meet the criterion spelled out in the NEPA act. The SRC-I EIS asserts in several places that the design of the plant is conceptual. From this conceptual design numbers are projected for particulate, hydrocarbon, sulfur dioxide, nitrogen oxide and other emissions. From these very tenuous values, statements are made such as: "No significant impact on local ozone concentration is expected." Furthermore, Section 4 of the EIS refers to previous studies that have been done that would lead one to believe that there will be an increase in cancer risk to workers and to the general public.

"Scrotal cancer was associated with exposure to soot as early as the late eighteenth century. Coal-carbonization workers exposed to complex mixtures of soots, tars, ashes, smokes, and pitch have experienced excess cancer as compared to general population rates. The U.S. Department of Health, Education and Welfare found that workers exposed to coal carbonization products experienced excesses of skin, lung, bladder, and kidney cancer. In addition, Doll et al. reported the mortality experience of gas workers in Great Britain over a 12-year period and found significant increases in lung, bladder, skin, and scrotal cancer among coal carbonizing workers. Concentrations of benzo(a) pyrene (BaP) and several other polynuclear aromatic hydrocarbons (PNAs) were elevated in worker atmospheres. Another study shows that workers with the highest exposures to these tarry fumes exhibited the greatest risk of dying from lung, liver, and scrotal cancer. In human populations many exogenous and endogenous factors offset cancer of the bladder, but bladder cancers were associated with coal-tar occupations as early as 1931. Induction of lung cancer has been known since 1936 when Kurada and Kawahata reported excesses of this disease among coal-gas workers in Japan. Kennaway and Kennaway found a lung cancer mortality rate in coke oven-charger workers three times that of the average population.

"These studies may be interpreted to indicate increased potential for a variety of cancers associated with coal gasification systems. Studies of coal liquefaction systems are discussed below. Although elevated exposures to carcinogenic PNAs (e.g., BaP) have been measured, coal conversion processes in general contain complex mixtures of many hundreds of organic compounds as well as many inorganic materials (e.g., sulfur compounds, trace metals, and their compounds and radioactive materials - in short, anything in coal plus anything produced in the process). Also, the metabolic detoxification-toxification mechanisms convert many fugitive agents into carcinogens and/or carcinogenic potentiators.

"Certain SRC process intermediates, products, by-products, and wastes will contain heavy metals and organometallic compounds and a broad range of complex organic materials, including PNAs, aromatic amines, and heterocyclic sulfur compounds that are known or suspected to be (1) mutagenic in microbial systems or (2) carcinogenic, teratogenic or toxic in laboratory animals. In an SRC plant, these complex organic compounds result primarily from the hydrogenation reaction.

"Although current and projected environmental quality standards and emission limitations require application of

state-of-the-art pollution control techniques, standards and limitations do not yet exist for most of the classes of compounds that are of concern. For example, many agents may not be carcinogens but may act as strong potentiators of carcinogens through hyperplastic or cytotoxic activities that cause deviations in the normal homeostatic control mechanism. These toxic but noncarcinogenic and/or non-mutagenic agents are not addressed by current health guidelines, but the EPA and NCI are both concerned with policy recommendations related to promoters. The Toxic Substances Control Act (TSCA) and its applicability to SRC materials are discussed in Appendix BB. Thus, compliance with existing environmental requirements alone will not ensure complete protection of the workers, the public, or the environment. For this reason, the design of the SRC-I demonstration plant focuses particular attention on (1) minimizing the release of such materials, and (2) reducing the exposure of workers and the public. Section 4.4.3, 'Sources of Exposure and Control Plans,' discusses the steps proposed for accomplishing this.

"Furthermore, pilot plant studies have shown that the qualitative and quantitative compositions of SRC products and wastes vary and are sensitive to changes in coal feedstock and process conditions such as temperature, hydrogen pressure, and residence time. This variability, combined with the fact that only a conceptual SRC plant design exists at this time, reduces the ability to predict the specific compounds and exact concentrations of such compounds that will be present in products, intermediate streams, wastes, and occupational environments. This, in turn, limits the ability to quantitatively predict occupational and public health consequences of altered plant operating conditions."

In the underlined portion above, the authors admit again that the design of the plant is only conceptual, and, therefore, they cannot estimate the emissions of these known carcinogens and, thus, cannot make a quantitative estimate as to the number of increased cancers expected. Again, the NEPA requirement that the Environmental Impact Statement must contain a detailed description of the proposed action including information and technical data adequate to permit a careful assessment of the environmental impact has been violated. It would appear that the health impact on humans should be very carefully determined and not just written off as an

acceptable risk, or worse yet, building a plant that costs billions of dollars and using humans as experimental animals to see what the effect will be.

The EIS goes on to say,

"Chemical and biological screening analyses of available SRC pilot plant materials by Battelle Pacific Northwest Laboratory indicates that selected materials are active in certain toxicological tests. However, an extensive industrial hygiene program has been in place since startup of the Fort Lewis SRC pilot plant (5 years) and there have been no increases of skin cancer traceable to chemicals found in the workers' environment. This is in distinct contrast to experiences in previous coal hydrogenation plants where equivalent industrial hygiene practices were not employed. In one particular case (Institute, West Virginia), an increased incidence of skin tumors (about five-fold) was found in the work force of 359 individuals after exposure times as short as 11 months to as long as 7 years."

We find the above quote a little disconcerting because it does not expand on the results of the Batelle Study. The Batelle Study shows the products, particularly the high boiling fraction, to be mutagenic in the Ames test and also carcinogenic in animal tests. It is also hard for us to understand the statement: "However, an extensive industrial hygiene program has been in place since startup of the Fort Lewis SRC pilot plant (5 years) and there have been no increases of skin cancer traceable to chemicals found in the workers' environment." This statement has no meaning, particularly in view of the fact that we have been repeatedly told that no epidemiological studies have been done and also it is nearly impossible to prove a cause and effect relationship between a given chemical and increase in skin cancer. Only statistical evidence can be forthcoming and the EIS makes no mention of such a study. Were there in fact skin cancers observed in workers?

Were the number of cases statistically higher or lower than the general populous? The EIS also mentions the study conducted by Richard J. Sexton, M.D., at a coal conversion plant located in Institute, West Virginia. The SRC-I Draft EIS unfortunately misinforms the public about the severity of the cancer risks found in that study. The EIS says that "an increased incidence of skin tumors (about five-fold) was found in the work force..." The actual study by Sexton, however, states, "The incidence of cancer in these men was between 16 and 37 times that reported in the literature." (page 229, Sexton, reference 1) This is hardly the same as saying "about five fold." Considering this obvious inaccuracy, one worries about the validity of the SRC-I Draft Environmental Impact Statement and the reasons for such errors.

Probably the most health-threatening effect of synfuel plants (coal conversion plants) is the possibility of increased cancer rates. The organic structure of coal contains large molecules of fused aromatic rings. When this organic matter is broken down to lower molecular weight materials by using high temperatures and pressures, a variety of organic cancer-causing (carcinogenic) chemicals are produced. These chemicals are found throughout the product and waste streams of coal conversion (synfuel) plants, and are emitted as both planned and fugitive emissions. These organic chemical emissions contain a large number of carcinogenic and toxic materials.

A listing of these identified and potential organic substances can be found in a report published by the Department of Energy

(DOE), Department of Health, Education, and Welfare (HEW), and the Environmental Protection Agency (EPA).[2] This list contains 178 organic chemicals, 22 carcinogens, 68 suspected carcinogens, 14 mutagens, 26 toxics, 2 caustics, 16 with disagreeable odors and 30 irritants. Compounds that will be emitted include benzo(a)pyrene, chrysene, and some dibenzanthracene. For benzo(a)pyrene and dibenz [a,h] anthracene OSHA has prescribed no "safe" exposure limits for these proven carcinogens.[3]

Since there are no operating-full-scale coal conversion plants in this country, the U.S.E.P.A. recently conducted an air monitoring study around the synfuel plant located in Kosovo, Yugoslavia. They placed five air monitors around the plant, approximately 2 km outside the plant boundary. Ronald K. Patterson[4] reported this work at the Symposium on Environmental Aspects of Fuel Conversion Technology-V, held in St. Louis, Missouri, on September 16-19, 1980. He reported that the downwind monitors showed levels of benzo(a)pyrene at 1000 times the A-MEG value. The A-MEG value is the Ambient-Multimedia Environmental Goal concentration target value below which the component is of low concern for its potential health effect.

Patterson concludes that this indicates that benzo(a)pyrene may cause harmful health effects. Benzene, another chemical carcinogen, was also found off the plant site at 10 to 100 times the A-MEG value. It was also found that even though this plant is located in a relatively remote area, the aerosol levels

exceeded the primary and secondary U.S. National Ambient Air Quality Standards. These aerosols also appeared to be carriers of other polynuclear aromatic hydrocarbons (PAH), many of which are carcinogens. Plant sponsors argue that the U.S. will use better control technology, but it should be realized that this plant in Yugoslavia is only one-tenth the size of any proposed commercial-sized U.S. facility. All of these organic pollutants were traced to the synfuel plant and numerous other classes of organic compounds were found, including aromatic and aliphatic hydrocarbons as well as their oxygen, sulfur, and nitrogen-containing derivatives.

A book published by DHEW and EPA[3] states: "The greatest toxic hazards in coal conversion are presented by the known and suspected carcinogens, because they are hazardous at low levels of exposure, have delayed action with no immediate warning, and have grave consequences. As for routes of entry, it is to be noted that carcinogenicity is shown by various solids and liquids which may reach the body by inhalation of particles, deposition of particles, or indirectly by contact with dirty surfaces."

No epidemiological study of the health effects of commercial synfuel plants on the general populous has ever been done. If the development of synfuel plants in Western Kentucky proceed as planned the people in Henderson and Owensboro, Kentucky and Evansville, Indiana will be the subjects of the first epidemiological study.

An epidemiological study on workers at a synfuel plant was reported in 1960.[5,6,7,1,8] Even though precautions were taken to prevent exposure of workers to carcinogens and a strict hygiene program was instituted, the skin cancer rates among workers was found to be from 16 to 37 times that of the normal populous.[1]

Another paper written by Diane Yale Sauter[9] summarizes some of the literature related to synthetic fuels and cancer. In her paper she calls our attention to a report submitted to the President's Energy Resources Council by the Synfuels Interagency Task Force. It says in part, "Some damage to .... humans from air pollutants may be unavoidable. Adverse human health effects, including cancer, might result from long-term exposure to polycyclic aeromatic hydrocarbons and trace elements emitted from synthetic fuel plants in the form of or absorbed on fine particulates."

There is every reason to expect increased cancer rates to occur because of the development of coal conversion plants. We think that the SRC-I Draft Environmental Impact Statement is insufficient both legally and technically in assessing the increased cancer risk. The SRC-I EIS does not contain enough information to assess the risk due to the SRC-I demonstration plant, the SRC-I commercial-sized plant, or the combined effect of the SRC-I plant and other synfuel plants planned for this area.

A recent study[10] conducted on a cluster of heavily industrialized counties along the Ohio River (along the Ohio and Kentucky border) found a relation between high mortality rates for lung cancer and persons residing near emission sources. They state, "A preliminary review of available statistics for the South Eastern Ohio Study area revealed that several counties have lung cancer mortality rates significantly above the United States rate. (Several counties

were also found to exhibit high mortality rates for cancer of the large intestine, liver and bladder.) Age-standardized mortality ratios (SMRs) for respiratory cancer and chronic obstructive lung disease are significantly higher in the industrialized river counties of Scioto, Lawrence, Boyd and Cabell. Mortality ratios equal to or exceeding expected deaths, based on overall United States rates, are also found in adjacent counties." The benz(a)pyrene concentrations are predicted to be relatively high in these counties according to a AQDM modeling study, but due to insufficient data a positive correlation between this particular contaminant and death rates could not be shown.

In July of 1978 the U.S.E.P.A. released a document[11] entitled, "Carcinogen Assessment Group's Preliminary Report On POM Exposures." This study summarized several epidemiological studies and points out the good consistency in the estimates of excess lung cancer from exposure to airborne polycyclic organic materials (POM). The study concludes that one can expect an increase in lung cancer rate of 0.28% for a lifetime exposure to 1 nanogram of POM per cubic meter of air. (1 nanogram = .000000001 grams). In the Kosovo, Yugoslavia study[4] benz(a)pyrene, only one of many POM's, was found in concentrations as high as 80 nanograms per cubic meter. A lifetime exposure to this concentration would translate into an expected increase in lung cancer rate of approximately 22%. ~~Again, we state that the expected increase in cancer rate and excess human deaths should be calculated based on the best available information and made public.~~

The SRC-I EIS does not contain enough information to assess the real cancer risks. Blanket statements in the EIS minimizing such risks are arbitrary and capricious.

Present Air Quality In The SRC-I Study Area

Even though the proposed SRC-I site selection is basically in a rural area, it is surrounded by three metropolitan centers, all of which have experienced air quality problems. Owensboro, county seat of Daviess County, is located 12 miles to the east of the proposed site; Henderson, county seat of Henderson County, is about 16 miles to the west; and Evansville, Indiana, about 17 miles to the northwest is the county seat of Vanderburgh County.

The following air quality information was obtained from the 1978, 1979, and 1980 reports put out by the Kentucky Division of Air Pollution Control, Frankfort, Kentucky.[12,13,14]

ATTAINMENT STATUS
FOR VARIOUS POLLUTANTS 1978

Designated Area	Pollutant	Does Not Meet Primary Standard	Does Not Meet Secondary Standard
That Portion of Daviess County in Owensboro	TSP	X	X
	SO_2	X	X
Davis County	Ozone	X	
That Portion of Henderson County in Henderson	TSP	X	X
	SO_2	X	X
Henderson County	Ozone		

ATTAINMENT STATUS
FOR VARIOUS POLLUTANTS 1979

Designated Area	Pollutant	Does Not Meet Primary Standard	Does Not Meet Secondary Standard
That Portion of Daviess County in Owensboro	TSP	X	X
	SO_2	X	X
That Portion of Henderson County in Henderson	TSP	X	X
	SO_2	X	
Henderson County	Ozone	X	

ATTAINMENT STATUS
FOR VARIOUS POLLUTANTS 1980

Designated Area	Pollutant	Does Not Meet Primary Standard	Does Not Meet Secondary Standard	Meets Standards
That Portion of Daviess County in Owensboro	TSP	X	X	
	SO_2	[X]	[X]	X
Daviess County	Ozone			X
That Portion of Henderson County in Henderson	TSP	X	X	
	SO_2	[X]		X
Henderson County	Ozone	[X]		X

Evansville, Indiana has had a long history of total suspended particulate (TSP) problems. The city has spent a large sum of money studying the problem and taking corrective measures. Evansville has also been on the border line of breaking the primary standard (0.12 ppm) for ozone. In 1980 they had readings of 0.123, 0.124, 0.14 ppm.

One would have to say that in view of the above air monitoring data, there should not be any synfuel plants located in this already heavily polluted area. The citizens of this geographical area should not have to suffer additional insults to their health. On August 23, 1978, a local newspaper reported that the National Weather Service at Louisville had issued the following air stagnation advisory. A stagnant high pressure system was causing a build-up of smoke, gases and other pollutants. In Henderson and Daviess counties, ozone levels reached unhealthy levels, according to the weather service. The National Primary Standards were set to protect public health. Several of these standards are already being exceeded in this area. We already have some very large pollution sources in the region; for example, in Warrick County, Indiana, just a few miles (~ 7 miles) north of the proposed site, there is a complex of sources that put out over 1,000,000 lbs. of sulfur dioxide daily.[15] This is just one of several major sources in the region.

The mortality statistics for Daviess and Henderson counties indicate problems.[16] The deaths of residents in Daviess County exceed the U.S. rate for certain causes in early infancy, heart disease, cerebrovascular disease, emphysema, and malignant neoplasms. The deaths of residents in Henderson County exceed the U.S. rate for certain causes in early infancy, pneumonia and influenza, heart disease, arteriosclerosis, emphysema and malignant neoplasms. The proposed SRC-I site is in Daviess County on the Daviess-Henderson county line. How can this site even be considered?

A recent paper by Robert Mendelsohn and Guy Orcutt[17] shows that the SRC-I proposed site is in an area where the probability of death associated with air pollution for white adults is one of the highest in the nation (see map).

The SRC-I Draft Environmental Impact Statement contains four tables that should help the reader ascertain the present quality of the air and to assess the expected quality of the air if the SRC-1 demonstration plant were to be built. These are Table 3.11, p. 3-31 (Summary of Air Quality Data for the Proposed SRC-1 Site and Surrounding Area), Table 4.16, p. 4-48 (Projected Maximum Pollutant Concentration of the SRC-I Plant, ug/m^3), Table 5.1, p. 5-4 of the Appendix (Summary of Modeled and Measured Maximum SO_2 Concentrations) and Table 5.2, p. 5-5 of the Appendix (Summary of Modeled and Measured Maximum Total Suspended Particulate TSP Concentrations).

These Tables constitute a maze of confusing, inaccurate, improperly obtained, improperly used, missing, highly suspicious, and inconsistent numbers. We will just mention a representative sample of what we observed. In Table 3.11, we note that the primary ambient air standards for particulates (TSP) has been broken in both Henderson and Owensboro, and the TSP secondary standard was exceeded on the proposed site. How can this site be selected in view of this data? It is also noted that the monitoring program was expanded between 1977, 1978 and 1979; 1980 except for ozone. The ozone data was not listed for the 5/79-4/80 monitoring period. On checking further, it was found that the Preliminary Draft EIS, which was not generally available for public

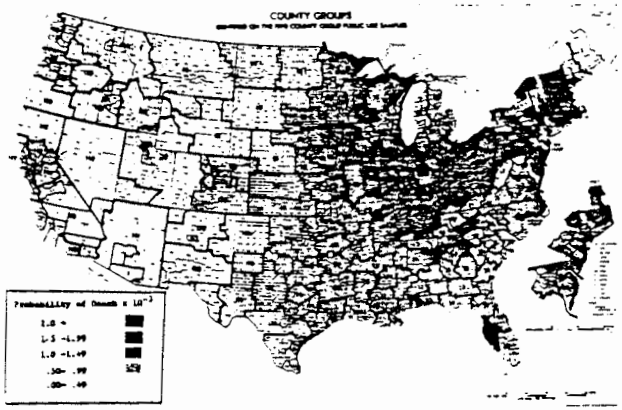


FIG. 1. Probability of death associated with air pollution for white adults.

viewing, contained ozone values of 382 and 370, highest and second highest values, respectively. These values were not included in the Draft EIS that was circulated for public viewing. Both of these values are over the primary ambient air health standard (235) for ozone. It may or may not be of significance that the National Weather Bureau on August 23, 1978, issued an ozone health level warning for residents of Daviess County, but ozone monitoring taking place during that period, according to Table 3.11, did not show a violation.

Table 4.16 is inaccurate and very misleading. In the second column there is a series of values labeled highest 24 h, highest 3 h, etc.; all of these values are footnoted. The footnote says that they are really the second highest values, not the highest values. Now, let's do a little addition. If one adds the "Baseline air quality" to the "concentration due to all PSD sources within 50 km," one should obtain the value obtained in the column entitled "Projected Air Quality." This works well for the annual sulfur dioxide concentration (20 + 0.7 = 20.7); however, if one adds up these columns regarding the highest 24 h sulfur dioxide concentration, it does not work. (490 + 12.2 ≠ 202.2). If one goes to the next line (highest 3 h sulfur dioxide concentration), 842 + 53.7 = 895.7, it adds up correctly, but the value 842 is not consistent with the value of 883 found in Table 3.11. The corrected line should therefore read 883 + 53.7 = 936.7. The value of 936.7 is getting closer to a violation of the 3 hr. ambient air standard. The next line in Table 4.16 is for the annual average concentration for particulate matter (42 + 3.4 = 45.4); these numbers sum correctly. The next line is for highest 24 hr.

TSP (54 + 26.9 = 80.9) sums correctly; however, the value 54 has been copied incorrectly from Table 3.11. It should be 94 (94 + 26.9 = 120.9). One wonders why the value for the 26.9 for the concentration due to all PSD sources is so low. One has to read the Appendix to find out. The Appendix on page S-4 says, "The concentration predicted from the model is not very high because it included only the contributions of the point sources listed in Section 4.2.3. Most of the TSP measured in the atmosphere comes from fugitive sources." It takes a persistent reader to find out that the projected TSP levels are not accurate. Almost certainly the SRC-I demonstration plant will cause a violation of the secondary TSP standard and more than likely the primary standard as well. When one tries to add up the line for the 8 h carbon monoxide levels, he gives up. Even though one realizes that in one table the values are in micrograms and in the other table they are in milligrams, the numbers do not correspond. Not only do they not sum correctly, they do not even correspond. There are very serious questions to be raised about the accuracy of the monitored values of the various air pollutants. There are also serious questions to be raised about the use of modified and probably not USEPA-approved computer models. On the surface, the air quality data appears to be inaccurate, incomplete, and deceptively presented. It appears that the National Environmental Policy Act (NEPA) has been violated. The Draft Environmental Impact Statement for the SRC-I demonstration plant does not contain enough information or technical data to adequately permit a careful assessment of the environmental impact. In fact, it appears that

important data has been purposely excluded and some data jumbled to prevent such an assessment from taking place.

It is inconceivable that the thought even exists of the possibility of building the SRC-I Demonstration Plant, let alone a five-fold scale up. Table 4.16 projects that the SRC-I Demonstration Plant alone will produce an ambient air concentration of 0.82 ug/m^3 for lead. The ambient air standard for lead is 1.5 ug/m^3. A five-fold increase in plant size could conceivably produce an ambient level of 4.10 ug/m^3 for lead. This would exceed the human health standard by well over a factor of two.

The ozone problem is not addressed adequately in the Draft EIS for the SRC-I project. Evansville, Henderson, and Owensboro have all experienced problems obtaining the primary standard for ozone. The Draft EIS fails to address the fact that ozone is formed by the mixing of NOX, hydrocarbons, air and sunlight, and it forms slowly as the mix moves downwind from the source of those pollutants. The proposed SRC-I Demonstration Plant is a source of NOX and hydrocarbons which are necessary ingredients for the formation of ozone. Several studies indicate that the ozone concentration maximized after the mix has moved from 10 to 15 miles downwind. On page 3-2 of the Draft EIS is a wind direction chart. Above the chart it says that, "The two most prevalent wind directions were from the southeast through south (27% occurrence) and west through northwest (23% occurrence)." It appears that the proposed plant would have a significant effect on the ozone levels in both Evansville and Owensboro. The estimate of 60 tons per year hydrocarbon emissions from SRC-I plant appears

to be very low. A small to medium size refinery located in Posey County, Indiana, emits 2295 tons of hydrocarbons per year.[15] The proposed hydrocarbon emissions from the conceptually designed SRC-I Demonstration Plant needs to be carefully re-evaluated. Even a trace of an increase of ozone in Evansville, Indiana, would place that city in nonattainment. Henderson County is trying hard to regain attainment status for ozone.

REFERENCES

1. Sexton, R.J., Archives of Environmental HEALTH, Vol. 1, Page 208 (1960)

2. "HEALTH AND ENVIRONME TAL EFFECTS OF COAL GASIFICATION AND LIQUEFACTION TECHNOLOGIES," DOE/HEW/EPA-01, M78-58, edited by James Antizzo, prepared by The Mitre Corporation, METREK Division, July 1978

3. "Recommended Health and Safety Guidelines for Coal Gasification Pilot Plants," NIOSH, Enviro Control, Inc., Contract No. 210-76-0171, January 1978

4. Patterson, R.K., "AMBIENT AIR DOWNWIND OF THE KOSOVO GASIFICATION COMPLEX: A COMPENDIUM," Environmental Sciences Research Laboratory, Office of Research and Development, U.S.E.P.A., Research Triangle Park, North Carolina 27711

5. Sexton, R.J., Archives of ENVIRONMENTAL HEALTH, Vol. 1, p. 181, September 1960

6. Weil, C.S., Condra, N.I., ibid p. 187

7. Ketcham, N.H. and Norton, R.W., ibid p. 194

8. Eckardt, R.E., ibid p. 232

9. Sauter, Diane Yale, "Synthetic Fuels and Cancer," Emergency Task Force on Energy Options, Scientist's Institute for Public Information, November 1975, 355 Lexington Avenue, New York, New York 10017

10. Ward, John R. and Nagda, Niren L., "Studies of Ambient Carcinogens and Respiratory Cancer in High Risk Communities," Presented at The Fifth International Clean Air Congress, October 20-26, 1980, Buenos Aires, Argentina.

11. Albert, Roy E., et.al., "Carcinogen Assessment Group's Preliminary Report on POM Exposure," USEPA, July 14, 1978 (Draft)

12. "Proposed Kentucky Air Pollution Control Regulations," December 1, 1978, Division of Air Pollution Control, Department of Natural Resources and Environmental Protection, Capital Plaza Tower, Frankfort, Kentucky 40601

13. "Division of Air Pollution Control Regulations," 1979, Division of Air Pollution Control, Frankfort, Kentucky 40601

14. "Proposed Regulations of the Kentucky Division of Air Pollution Control," September 1980, Division of Air Pollution Control, Frankfort, Kentucky 40601

15. U.S.E.P.A. Emission Inventory, 1979

16. "Kentucky Selected Vital Statistics and Planning Data," 1976, Department for Human Resources, Bureau for Health Services, Health Information Systems Branch

17. Mendelsohn, R. and Orcutt, G., Journal of Environmental Economics and Management, 6, 85-106 (1979).

Howard E. Dunn
Ph.D., Chemistry
Indiana State University Evansville
Evansville, Indiana 47712

SOCIO-ECONOMIC IMPACT

Summary Evaluation.

The Draft Environmental Impact Statement (DEIS) of the SRC-1 facility at Newman, Kentucky, released in January 1981, devotes 35 pages to the socioeconomic impact of the proposed plant (plus Appendices). Of these 35 pages, 29 are devoted to the impact of the demonstration-scale plant, 3 to the commercial-scale plant, and 3 to the cumulative impact of the four synthetic fuel plants and five electrical power plants proposed for the 21-county tri-state region. The sections devoted to the immediate impact of the demonstration facility are adequate within the limitations of the evidence. That is to say, it is basically correct to conclude that SRC-1 will not produce a boomtown effect in the tri-state region. On the other hand, the DEIS tends to underestimate the disruptive impact of SRC-1 on the immediate vicinity of the plant, to ignore important areas of public concern, and to overly rely on the results of formal projective models, rather than the witness of officials and citizens who are more attuned to local conditions. The sections devoted to the commercial-scale and cumulative impacts are largely inadequate, both in length and content. These sections (1) display an insufficient concern for quality of life and growth management issues, (2) do not adequately develop "worst-case scenarios," especially with respect to the number of in-migrants, (3) ignore issues pertaining to secondary industrial development, urbanization and rapid social change, and (4) do not detail the full public costs of synthetic fuel development, identify the agents who can mitigate these costs, or recommend available sources of revenue or capital to meet them. The report, in short, does not provide the information citizens need in deciding whether or not to acquiesce in the creation of an industry that is likely to be subsidized at every stage by taxpayers' money.

1. Major Impacts of SRC-1 Alone.

The most frequently used terms in the DEIS to describe the impact of SRC-1 on schools, housing, public finance, social services and price inflation in the tri-county area of Daviess, Henderson and Vanderburgh are "minor," "insignificant," "small," "slight," etc. These terms reflect the report's judgment that the area has the infrastructure to absorb the approximately 2600 persons (including families) who are expected to migrate to the 21 county region during the construction phase (4-71). It implies, further, that the problems which do emerge can be mitigated. For the most part the DEIS is correct as far as SRC-1 is concerned. There are three important exceptions to this judgment, however.

(1) Social Disruption of Small Communities -- The small surrounding communities of Reed, Birk City, Carlinburg, Stanley, Spottsville/Beals, Baskett and Newman, with average populations of 232, will be severely impacted. The DEIS correctly predicts "major disruption in the lives of these community residents unless appropriate mitigating measures are implemented" (4-70). No "mitigating measures," however, will overcome the life-style changes brought about by the construction activity, disruption of traffic, population influx, commercialization of traffic intersections and changing land-use patterns. These 1,626 persons, along with the 60 persons displaced at the plant site itself, must either cope or leave.

(2) Traffic along U.S. 60 -- Of all the socioeconomic impact issues, the DEIS specifically insists on the mitigation of only one: the improvement of U.S. 60. Little wonder: it predicts traffic delays of 1 1/4 - 3 hours to Henderson and 40 minutes - 2 hours to Owensboro. Ten pages are devoted to alternative transportation schemes, such as park and ride by bus. Unfortunately, public transportation is culturally alien to the region and could not be implemented on a voluntary basis. It is also extremely expensive; $12.3 million for the bus-pooling alone (Evansville Courier, 2/5/81: 24). Unless the area is to suffer the adverse economic consequences such regional traffic tie-ups can bring, U.S. 60 will have to be widened to four lanes, certainly before the facility reaches commercial stage. This is estimated to cost at least $9 million (Evansville Courier, 2/5/81: 24). These additional tax burdens constitute a direct social cost of synfuel development. These costs will be borne even if no other synfuel plants are built in Baskett and Geneva.

(3) Urbanization -- One important lifestyle consequence of the SRC-I facility that does not figure into the DEIS' cost/benefit formulas at all is urban sprawl. The reconstruction of U.S. 60 between Henderson and Owensboro to serve the Newman facility will greatly affect the commercial potential of the route. Henderson and Owensboro are already regional retail centers. As traffic along U.S. 60 increases, the farmland will become increasingly attractive to developers. Although this increased urbanization and loss of agricultural land hinges on the reconstruction of U.S. 60, the latter is a necessary consequence of SRC-I. Only the rate of urbanization will be affected by the proposed Baskett and Geneva plants. The DEIS does not make it clear to the public that the siting of SRC-I involves urbanization as a consequence.

These concerns are not "minor" nor "insignificant." Yet, the DEIS sidesteps them. It assumes the synthetic fuel experiment is worth the irreparable disruption of seven small communities, the public transportation costs and the resulting urbanization. It overlooks the fact that the American public was never asked to decide between alternative energy futures. It expects the public to acquiesce to the technocratic questions of mitigation, rather than discuss the democratic questions of desired outcomes, alternatives and acceptable tradeoffs.

One thing that could be done before any demonstration plants are built is to arrange public referenda on synthetic fuel development in order to permit the democratic weighing of alternatives. Short of that, the least that could be done would be to undertake community receptivity studies in the impacted areas to determine whether citizens are aware of and willing to make the necessary tradeoffs. With respect to SRC-I, the results of a 21-county receptivity study should be included in the Final EIS.

2. Labor Force Estimates.

The standardized models employed by the social scientists in predicting the impact of SRC-I are likely correct with respect to the major conclusions: "The SRC-I site is located in an area in which boomtown responses are very unlikely due to SRC-I alone" (3-39). The area at issue here is the 3-county region as a whole, not the small communities in the immediate vicinity of the plant which will be severely disrupted by SRC-I alone. Although the

DEIS is correct that the 3-county area has sufficient infrastructure to absorb the labor force impact of SRC-1, it does not adequately address public finance and growth management issues. What's more, its projective models tend to be highly generic in nature, producing results which are only first approximations, and which do not adequately reflect local conditions.

A crucial issue, about which there is considerable (and unavoidable) uncertainty, is the size of the imported work force. The DEIS estimates that 36% of the construction work force will be imported. That amounts to 1241 workers, with 746 taking up temporary residence and 495 moving into the area permanently (4-71). With 67% of movers bringing their families, average size 3.2, and including secondary employment, that amounts to almost 2600, with 1600 residing in the 3-county area (4-71). These estimates are based on a projected peak labor force of 3500. The DEIS mentions a "worse case" figure of 5000, but does not compute the impact of this 43% increase in labor demand. The DEIS also mentions an Oak Ridge Laboratory Study of 33 nuclear power plants, all of which exceeded the original labor estimates, 14 of them by 100 - 300% (4-65). Indeed, the DEIS states that "it is not unreasonable to believe that the projected SRC-1 peak work force estimate (of 3500) for an emerging technology may be low" (4-65). Since the size of the peak construction work force is the key variable in socioeconomic impact analysis, a conservative bias here would severely hinder local growth planning. The DEIS rightly insists that the Final EIS use the 5000 figure as the basis of its projections, although why the DEIS discarded its own advice is unclear. The Final EIS should provide a genuine worse-case analysis; the DEIS by its own admission does not.

3. Impact of SRC-1 Alone on Housing, Medical, Police and Fire Services.

(a) Housing -- The DEIS model assumes approximately 50% of the in-migrants will occupy single-family residences, 25% will occupy mobile homes, and 25% motels, rooms and apartments. Since 65% of the migration will occur during a 12-month period, the model may overstate the single-family home occupancy and understate the mobile home occupancy. Overall, the numbers are not significant. Nevertheless, Henderson County, which lacks an effective zoning ordinance, may suffer inordinately in this regard.

With respect to rental housing, the DEIS estimates tend to be optimistic. Vacancy rates are highly variable: if apartments under renovation were excluded from Evansville's September 1980 survey, for example, the rate would have been 1.5% (Evansville Courier, 12/4/80: 8). Even if the DEIS' projected 2.4% rate for apartments in Vanderburgh County were correct, one still has no idea what kind of apartments these are or in what census tracts they are located. Vacant apartments are not necessarily apartments of choice. For example, the September 1980 survey found only 197 vacant apartments in Vanderburgh County. Ninety-nine of these were in housing owned by the Evansville Housing Authority or reserved for low-income tenants. If these units were too small or otherwise unacceptable to movers, the competition for the remaining units would be severe. It is for reasons such as these that the U.S. Department of Housing and Urban Development set reasonable vacancy standards at 5 - 8%. Inasmuch as SRC-1 related employment will adversely affect the rental housing market, which is already cramped, the Final EIS should include specific estimates

of where movers are likely to locate and the likely inflationary impact on rental prices.

Also, the strain on motel accommodations may negatively impact the tourism and convention business, especially in Owensboro and Evansville. The Final EIS should address the impact of synfuel development on the tourism and convention trade, which is of increasing importance to the local economy and which could be adversely affected by the decline in the aesthetic quality of the region.

(b) Health Care and Medical Facilities -- The DEIS does not address adequately the need for emergency transport vehicles and services at the plant site. It states that EMS units operating in Henderson and Owensboro will be dispatched to the plant site and adjacent highways in the event of emergency. Such an arrangement is not realistic, due both to the distance from the plant site and the possibility that U.S. 60 will be heavily congested a fair portion of the time. Both situations would prolong response times and lead to unreasonable service delays to accidents at the plant site or adjacent highways.

To adequately address these issues, the Final EIS should include (1) a contingency EMS plan for accidents at the plant site and for potential chemical spills on arteries leading from the site; (2) a summary of the kinds of emergency medical equipment and personnel located on-site; (3) a statement of the kinds of additional emergency personnel and technology area hospitals will need to handle potential disasters at the plant site; and (4) the projected costs to local town governments (Henderson and Owensboro, especially) of additional emergency medical personnel and equipment.

(c) Police and Fire -- In concluding that SRC-1's impact would be "minimal," the DEIS first estimated the ratio of police and fire personnel to the service population, computed the likely population increase and inferred the number of additional officers needed to maintain the existing ratio. It concluded the need for 4-5 municipal police officers, 1 state highway patrolman, 3-4 firefighters, an emergency medical team and an ambulance (4-75). This procedure systematically understates both personnel and equipment needs. A chemical fire at the Newman facility would be completely beyond the experience of local Fire Departments. Gearing up for such a fire would require expensive, specialized equipment and the extensive retraining of firefighters. The DEIS does not provide an itemized cost estimate nor does it address how these costs would be mitigated. Neither does it describe the training and equipment that will be available to ICRC personnel at the site.

With respect to police services, to simply add the number of migrants to the general population and compute from the existing per capita ratio the number of new officers required is methodologically fallacious. The migrants are not demographically similar to the local population. Seventy-five per cent of the incoming workers will be either unmarried males aged 20-26, or husbands separated from their families (4-71). Given the family-oriented recreational facilities in the 3-county area where two-thirds of them will reside, the unmet needs of these individuals will be considerable. Although the numbers are small, the danger to public order is greater than the report implies, especially when the demographics are compounded by mobile home occupancy.

Finally, although the DEIS states that 10% of the secondary employment expansion will be filled by in-migrants (4-71), these numbers are not added into the demand estimates for police and fire, housing, medical care and schooling. In short, these estimates (especially police and fire) are biased in a conservative direction and need to be reformulated in the Final EIS. The final report should utilize the estimates of local agencies as well, rather than these formalistic per capita projections.

4. Public Finance.

Most socioeconomic impacts are considered "mitigable" because remedial measures can be taken either in advance or after the fact. Certain things, however, are not mitigable: loss of prime agricultural land, dispersion of long-time residents, disruption of sociocultural continuity of a region through urbanization, diminution of animal habitat and the aesthetic quality of the environs, and the loss of community. Industrial development is premised on the economics of non-mitigation. Other things, however, disrupt less totally. To maintain an orderly society, they must be remedied. Since remedial action lies outside the responsibility of the private sector, this task falls to government.

The DEIS consistently ignores, understates or disaggregates the public costs of SRC-1. To give some examples:

(a) Approximately $32 million must be spent to improve transportation deficiencies around the SRC-1 site, to convert U.S. 60 for industrial use, and to temporarily ease traffic congestion via "park and ride" planning (Evansville Courier, 2/5/81: 24).

(b) Under the terms of the agreement, the U.S. Government is liable for all damages that may result from environmental

accidents, plant disasters, or injuries to the public due to plant operations.

(c) Cost overruns will be borne by the U.S. Government. Cost overruns in government-backed military and nuclear power projects of 50 - 100% or more are commonplace.

(d) Should the site prove economically infeasible for private industry after the demonstration phase, costs of preparing the site for conversion or mothballing fall to the DOE.

(e) Henderson and Daviess counties are expected to receive $16,200 and $30,000 respectively in additional property taxes as a result of SRC-1 employment (4-78). These monies will not even cover the additional police and fire services, let alone the medical team and ambulance. State income and sales taxes are likely to be used to mitigate transportation costs. (ICRC has agreed to pay local property taxes for the site, although as a partner of the DOE it is not required to do so. Unfortunately, ICRC plans to pay at the old agricultural rate rather than the industrial rate, even though the site will be rezoned to industrial use before construction begins.)

(f) Similar problems exist with respect to Vanderburgh County. Assuming an average income for each Indiana resident working construction at SRC-1 of $24,440, the State of Indiana would receive $490 per worker per year. Vanderburgh would receive none of that directly. While Indiana would receive 60% of the "total property tax revenues indirectly attributable to SRC-1," this would amount to only $58,000 (4-78). These revenues are inadequate to sustain the substantial expenses expected in several public service areas.

(g) The DEIS does not consider the social service and mental-health costs associated with the influx of a temporary work force

which is unintegrated to the local community; physical and social isolation in rural mobile homes can be especially stressful for the wives of construction workers. If a percentage of these families breaks up, an unknown number of dependents will likely remain in the area in need of social services.

(h) Local support for synfuels largely hinges on the economic benefits, including SRC-1's contribution to local taxes. Yet SRC-1 will apparently pay property taxes at rates 88% lower than manufacturing firms with the same market value of assets, and then only for property other than land and buildings, for "land and buildings will not be subject to property taxes" (4-97). This enormous tax expenditure was mandated by the Kentucky legislature for alcohol production plants and will be expanded to include coal plants and synfuel projects in July 1981 (3-47, 4-97). As the DEIS states, "the potential loss of these revenues could create short-term fiscal imbalances requiring mitigative measures ... since the area might experience a need for increased public services while not receiving tax payments" (4-96).

Public finance issues are inadequately addressed in the DEIS. Although it often warns of "potential adverse impacts ... unless mitigative measures are undertaken," the DEIS is reticent to identify the levels of government financially capable of undertaking the unspecified measures. Yet the area can expect less Federal support today than in the past, as block grants (whose distribution is determined at state capitols) replace revenue sharing. Indiana currently gets back 70c on every dollar contributed to the Federal Treasury (Evansville Courier, 2/8/81: 1). Kentucky does better because of its military bases, but neither state can be said to have governmental infrastructure in place to

ameliorate the public costs of SRC-1. Both states operate off the "minimum government" principle. As a result, Indiana is 50th in the union in the percentage of tax revenues spent on education; a property tax freeze has been in effect in Indiana since 1974. In parts of Henderson County, property tax rates are 315% higher than coal severance taxes. Both states are likely to respond to the tax-lag crisis by imposing higher sales or gasoline taxes, measures which take larger portions of the incomes of the less affluent relative to the wealthy.

The EIS cannot be expected to present a blueprint for tax reform, but the Final EIS should aggregate, in a single itemized table, the full public costs of synthetic fuels. It should also inventory the offsetting tax revenues for each responsible level of government. If the expected impacts are indeed mitigable, the Final EIS should state precisely how, by whom, and how much. Such information is essential to socioeconomic impact assessment.

5. Conversion or Abandonment.

The Department of Energy is expected to function as a joint partner for 2 to 5 years, then sell its share of the facility. At that point, the facility must either be taken over by private industry and upgraded to commercial scale, converted to alternative use, or mothballed.

Conversion is tantamount to failure. One does not spend $1.5 billion plus for a coal storage area. Conversion means that ICRC bailed out, leaving DOE holding the bag; it is not required to operate an uneconomical facility. The decision to upgrade to commercial scale, on the other hand, is a private economic one. It depends on numerous factors regarding the costs of production, costs of capital, market price of products, supply demand factors

and distributional costs. It also depends on the state of gasification and liquefaction technologies and the outcomes of environmental monitoring. These are the very factors which led industry to consider synthetic fuels unprofitable in the first place. What is really being demonstrated in the "demonstration phase," then, is not so much the technology, but the economics of synthetic fuels. The final EIS should make this fact plain to the public. If the costs of production under market conditions are such as to make synthetic oil unattractive, commercial upgrading would be impossible without continued federal subsidies, such as purchases by the Department of Defense at prices above market prices. The public has a right to know before approving these plants whether continued subsidies are expected, the cumulative costs of such subsidies, and the likelihood of either conversion or abandonment without them.

There is one conversion option available to ICRC which should be considered unacceptable to the government and the public. In an interview in Forbes magazine (May 12, 1980: 176), Edward Donley, Chief Executive Officer of Air Products and Chemicals Corporation, one of the parent firms of ICRC, noted that it was considerably cheaper to produce solid rather than liquid fuels from the technical process. If the differences in price proved significant, "we could then use the plant to produce only boiler fuel and coke. We could sell the coke, actually, for an even better price than we can get now for the synfuels." The beneficiaries would be refineries, aluminum and steel mills and power plants.

The sole justification for this multi-billion dollar crash program, however, is the production of gasoline-grade liquid crude,

not coke nor boiler fuel. What is to stop ICRC/Air Products from taking Federal money to build the demonstration plant, then commercializing only for the economical products, boiler fuel and coke? In fact, there is nothing in the agreement which prohibits ICRC from using DOE-supplied venture capital in this way.

The DEIS does not adequately consider the social consequences of conversion or abandonment, either on the general public or the local population. The general public would suffer the highly inefficient and uncontrolled misuse of its tax revenues. The local population would have undergone the social disruptions of the boom phase, the expenses of transportation improvements, and the sudden loss of income and employment of the bust phase with very little or no gas to show for it in the end. Conversion to a boiler fuel and coke-producing facility would lessen the local impact of the bust phase, but in no way advance the public's interest in the program, the synthetic production of gasoline.

The EIS must be revised to indicate the proportions, in oil equivalent barrels, of each type of product, their estimated prices and marketability, and the allowed freedom of decision of ICRC in choosing which products to commercialize. If the public is financing this technology, it must be the major beneficiary.

6. Cumulative Labor Demands.

No section of the socioeconomic impact assessment is more important than the cumulative work force projections, especially in lieu of the DEIS' own warning that "The potential adverse economic, social and cultural impacts are the most significant cumulative effects on the region's development" (xxiii). This warning is based on a projected labor demand of 48,000 workers

involved in 9 coal-related energy projects during the peak period, 1985-1986 (4-102). Unfortunately, the report makes a number of questionable assumptions in arriving at these figures, the upshot of which is to make one seriously doubt their reliability.

One of these is the assumption that all 9 plants will proceed on schedule. If SRC-1, Big Rivers or other early plants should experience time delays, "such changes could radically alter the magnitude of the impacts" (4-103). In light of the importance of reliable work force estimates, the DEIS should have included best and worst-case futures taking the time delay factor as a variable. A second assumption is even more damaging: the DEIS excludes mining employment impacts. Increased coal mining in the next 5 years will not only pick up the slack in mining unemployment, it will draw from the construction trades. This runs directly counter to a third DEIS assumption: that 25% of peak construction employment will be drawn from local non-construction sources (xxiii, 4-101). Although the DEIS does not indicate which industries these 7000 workers will be drawn from, it could only be from the mining and manufacturing sectors. If the increase in mining employment occurs as expected, the resulting craft labor shortage would mean either a further drain on skilled manufacturing employment (causing higher turnover and lower productivity in those industries) or an increase in the number of in-migrating workers. (Another possibility: high school dropouts. Boomtown theorist John Gilmore has shown that unskilled labor has been drawn from this source during recent Western mining booms, Science v.191, 2/13/1976: 536). If the DEIS only slightly underprojected the incoming work force, all subsequent impacts would be magnified. If 85% of the construction force were imported instead of 75%, for example, this would be 4200 workers, a work force larger than SRC-1's alone.

The most tenuous assumption of them all, however, is the fourth. The DEIS assumes that a baseline construction force of 20,000 will reside in the area by 1985 (4-102). Yet the total estimated number of employed craftsmen within the 21-county area in 1979 was only 9,966 (Table 3.18, p. 3-40). If the baseline work force grows at the projected rate of 3% a year between 1979 and 1985, as assumed (4-65, CC-12), then the baseline estimate of 1985 should be 11,900, not 20,000.

The DEIS labor force estimates appear to be pulled like rabbits from several hats at once, and mostly offstage. Table 4.23 (4-67) begins from a 9,933 figure (a slight modification of Table 3.18's 9,966) and projects a 21-county construction labor demand of 13,104 by 1981. Yet Table CC.3 (CC-12) assumes a baseline force of 17,000 in 1981, and projects a 3% baseline growth rate from that figure. The latter is the basis for the 20,000 baseline figure. Not only is there no justification for assuming a base of 17,000 in 1981, empirical evidence suggests a base of about 10,000.

There are two further problems with the cumulative labor force estimates. First, it is stated, without evidence or justification, that peak construction will bring 3000 "additional population associated with indirect economic expansion" (4-101). How this figure was computed is not explained. Presumably it corresponds to the demonstration and commercial phase projections that 10% of the secondary employment will be filled by movers (4-94). Since 2/3rds of movers bring with them 2.2 additional people, about

1200 workers would be involved (810 of them married). That would mean an indirect employment of 12,000 at the peak. [redacted] Surely not from the unemployed or June graduates. The local labor market would surely be saturated by then. [redacted] Its continued use introduces a systematic conservative bias in the secondary employment estimates. [redacted]

Even the 12,000 figure may be conservative. If the commercial-scale plant employing 5000 construction workers at the peak would generate 330 in-migrants (6.6% of 5000), as stated (4-94), then the 21,000 peak force should generate 1386 (6.6% of 21,000). The 1200 figure represents only 5.7% of the peak force.

[redacted] with greater care. The secondary employment multiplier should be outlined. The saturation of the local labor market should be factored in. A "worst case" estimate should be included. If by 1985-1986 the local labor market is saturated, such that 40% of indirect employment needs must be met by imported labor, then the total secondary population (travelers, movers and families) could approach [redacted] estimate.

Secondly, the DEIS employs two methods to compute expected total population increases. One, used for the demonstration and commercial-scale plants, divides migrants into travelers and movers. This method uses the family population multiplier of 3.2 for movers only, and then for only 67% of movers (4-70 - 4-72). The second method treats movers and travelers indiscriminately and applies the 3.2 multiplier to 67% of all migrants. The second method is

used to compute the cumulative figure of 52,000 (4-101, xxiii). The second method obviously produces much higher numbers; it overstates the impact. Such overstatement does just as much a disservice to local growth planners as underprojection. It is an embarrassment for the social scientists who computed it. The **final EIS must decide which of the two methods is the more empirically efficacious and justify its choice.**

With these inaccuracies, omissions, dual methodologies, over- and underprojections and questionable assumptions, the DEIS cumulative labor force statistic, the single most important element in socioeconomic impact assessment, must be considered inadequate, if not mysterious. The baseline estimates for 1981 are 83% higher than the estimated total construction for 1979. Because no explanation for the 1981 baseline figure of 17,000 is given, there is no way to verify it independently, nor is any justification given for the assumption that 25% of the peak construction force will be drawn from local non-construction sources. Which sources? ... and are these the same sources which are supposed to contribute up to 90% of the 12,000 or so indirect jobs associated with peak construction? Precisely at what point does the local labor market become saturated? What rates of turnover, declines in productivity and levels of wage inflation must regional employers expect? None of these questions are answered in the DEIS. Crucial assumptions are in doubt. Crucial projections are unverifiable or unreliable. Crucial methodologies are contradictory. Local planners, therefore, can have no confidence in the DEIS cumulative estimates.

The following is a demonstration of just how misleading the DEIS projections could be. It is a "worst case" future premised

on (1) a baseline work force of 13,000 in 1985 (rather than 20,000), (2) a secondary employment of 12,000 with 40% of the labor imported (instead of 10%), and (3) a peak construction force of 48,000, with only 15% drawn from local non-construction sources (instead of 25%). The demonstration presumes that 61.2% of the in-migrants will be travelers without families and 38.8% will be movers with families, average size 3.2. (If the DEIS' second method were used, the results would be even larger. Here it is assumed that the 55,000 figure is a mistake and that if the first method were used, the "worst case" DEIS figure would actually be 42,442.)

(1) With a baseline of 13,000, and a peak construction need of 48,000, 35,000 workers would be needed.

(2) If 15% of these came from non-construction sources (5,250 persons), 29,750 would have to be imported.

(3) Of the 29,750, 18,207 would be travelers, 3,809 unmarried movers, and 7,734 married movers (family population of 24,748). Total: 46,764.

(4) If 40% of the peak secondary work force of 12,000 were imported, that would be 4800 workers. Since all of these are movers (the model does not admit travelers since this is not construction employment), 3216 would be married with a family population of 10,291, and 1584 unmarried. Total: 11,875.

(5) Total in-migrating population: 58,639.

Obviously, this projection is just as tenuous as the DEIS'. The point is, its assumptions are every bit as reasonable as those of the DEIS. One knows as little (or as much) with these ad hoc estimates as with the blue chip DEIS projections. In either case,

local planners will have to compute their own estimates, at additional public cost, because of the unreliability of the DEIS projections. (Note: the above 58,639 figure is close enough to the DEIS' 55,000 to justify Synfuel Inquiry and other groups continuing to use the 55,000 estimate, despite the aforementioned suspicions regarding its derivation.)

The Final EIS must recompute its cumulative labor force estimates. It must justify its assumptions. It must use a single methodology. ...and it must publicly display its calculations so that they may be replicated by planners and the general public.

7. Boomtown Effects.

Although a boom/bust cycle is unlikely due to SRC-1 alone, it is quite a different matter when numbers as large as 55,000 are involved. According to NEPA, the DEIS must assess the cumulative, long-term effects of the proposed action, as well as any irreversible changes in the human environment. In devoting all of three pages to these effects, the DEIS cannot be said to have fulfilled its obligation to the public.

The DEIS states that the 55,000 population increase "constitutes only 8% of the existing population of the 21-county region" (4-101). It is unclear why it selects the 21-county region as the unit of analysis when earlier it estimated that 60% of the impact would be felt in the 3 counties of Daviess, Henderson and Vanderburgh (4-69). Inexplicably, it fails to compute the increase of 33,000 on the 3-county population of 292,366 (see Table 3.13). It comes to 11.3%. That is very sizable, but the DEIS should have computed further still. It should have computed the population increase for the two counties of Daviess and Henderson. Since Daviess and Henderson will house 75% of the 3-county migrants during SRC-1

construction (see Table 4.26), it is reasonable to presume that they will absorb the bulk of the cumulative 3-county impact as well. Now, the 9 plants are more widely dispersed, so the impact should be less than 60%. The 3 most urbanized counties might attract around 50% of the increase or 27,500 persons. The two counties would then house 75% of those or 20,625. Based on an estimated 1980 population of 125,643 (Table 3.13), that is a population increase of 16.4%. An annual increase of only 8% is the usual indicator of boomtown effects. One would have to conclude, therefore, that boomtown effects are likely to occur in Henderson and Daviess Counties, and perhaps in Vanderburgh as well. Why the DEIS holds back from this conclusion is a mystery.

It is also unclear why the DEIS considers the simultaneous construction of the 9 energy-related projects the "worst case" limit (CC-13). It should not, for there are at least four other major construction projects in the works for the tri-county area. They are (1) the $100 million Division Street project in Evansville, (2) the reconstruction of U.S. 60, (3) the expansion of Evansville's Dress Regional Airport, which also involves the re-routing of S.R. 57, and (4) the I-164 project. The last two have strong business backing and the support of congressional and gubernatorial leaders, although they are still in the conception stage. Even if the requiring three synfuels plants were not built, these other projects (all federally financed) would still keep the in-migration levels around 55,000. If all were built, the boomtown consequences would be disastrous.

The DEIS does not fulfill its obligation with respect to the possibility of boomtown effects in the 3-county area. It should

treat this as a serious possibility instead of submerging it in the 21-county estimate. More precise data should be included in the Final EIS. At the very least, the Final EIS must justify why boomtown effects are not likely, if this is its opinion. Otherwise local planners will be seriously underprepared for the socioeconomic impacts.

8. Summary of General Public Concerns Not Addressed in the DEIS.

a. Quality of life factors, such as the sense of community, satisfaction with available recreational and leisure facilities, sense of responsiveness from local and national government, and generalized satisfaction with the human environment comprising work, leisure and family activities.

b. Growth management issues: mitigative measures should be spelled out, agencies identified, and precedents enumerated.

c. Public finance issues, especially re: transportation and public service costs.

d. Social change and urbanization impacts, in particular, the social disruption of seven small communities and the rapid urbanization of the 3-county area and the Ohio River flood plain must be addressed.

9. Specific Recommendations for Inclusion in the Final EIS.

a. Results of public referenda or community receptivity studies of the 21-county area.

b. Projection of the impact of 5000 rather than 3500 construction workers at the peak of SRC-1 construction.

c. Reconsideration of the assumed 25% mobile home occupancy rate in light of the short, 12-month construction period.

d. Improved housing impact statements, especially the rental vacancy rates and rent inflation impacts.

e. Impact assessment of (1) SRC-1 and (2) cumulative industrial development on the tourism and convention trade.

f. A contingency EMS plan for on-site and highway accidents; a summary of on-site medical personnel and equipment; projected additional hospital costs for emergencies related to SRC-1; and mitigation sources.

g. Re-estimation of police and fire personnel needs based on realistic demographic data.

h. Summary of on-site fire protection procedures and equipment.

i. Cost estimates for tri-county fire equipment and personnel retraining required by SRC-1 construction.

j. Realistic scenarios for maintaining public order in light of (1) SRC-1, and (2) cumulative labor force migration levels and demographics.

k. Display of procedures for secondary employment computations, inclusion of the in-migrants from indirect employment in all impact estimates, re: housing, public services, etc.

l. Utilization of data and informal estimates provided by local officials.

m. Statement of the likely governmental costs of conversion or mothballing of SRC-1.

n. Social service and mental health impacts of (1) SRC-1, and (2) cumulative work force migration, including cost estimates and mitigation strategies.

o. Statement of SRC-1's likely contribution to local property taxes compared to manufacturing establishments of similar assets.

p. Itemized summary of the full public costs of SRC-1 development, including transportation improvements, tax expenditures and mitigation costs.

q. Statement explaining to what extent SRC-1 construction is intended to demonstrate the economics rather than technology of synthetic fuels.

r. Statement of the legal prohibitions against ICRC/Air Products and Chemicals, Inc. converting SRC-1 to a solid fuel facility.

s. Statement of the proportions, in oil equivalent barrels per day, of each type of SRC-1 product, and the estimated prices and marketability of each.

t. Summary of the likely adverse regional consequences of conversion or mothballing of SRC-1 after the demonstration phase.

u. Justification for assuming that time-delays will not interfere in the construction of the 9 energy-related plants, thus magnifying the socioeconomic impacts.

v. Justification for assuming mining employment will not rise before 1985, thus subtracting from the available baseline construction force.

w. Justification for assuming that 25% of the peak construction force will be drawn from local non-construction sources; identification of the industries thus adversely affected.

x. Estimations of the impact of peak construction on (1) employee turnover rates, (2) productivity, and (3) wage inflation in the affected industries supplying construction labor.

y. Statement of the size of the secondary employment expected at peak construction; justification of same; display of computation technique.

z. Estimation of the number of high school dropouts attracted to construction projects during peak period.

aa. Justification for assuming a baseline construction work force of 17,000 in 1981 in light of the actual employment of less than 10,000 in 1979.

bb. Justification for assuming only 10% of secondary employment will be imported when the local labor market approaches saturation.

cc. Decision as to which method for computing family population of imported workers is the more empirically efficacious; justification of same; display of computation for (1) SRC-1 demonstration plant, (2) SRC-1 commercial-scale plant, and (3) cumulative energy-related employment.

dd. Correction of the 55,000 total population projection.

ee. Justification for assuming boomtown responses will not occur in the 3-county area in light of population increases of 11-16%.

Chris Prendergast
Ph.D., Sociology
University of Evansville
Evansville, Indiana 47702

ECONOMIC, SOCIAL AND CULTURAL IMPACTS
DEIS PP. 3-34 THROUGH 3-52 AND 4-64 THROUGH 4-94.
EMPHASIS - VANDERBURGH COUNTY

The DEIS ought to make clear both the importance of and the purposes for which the material in Tables 3.16 and 3.18 will be used. If the material in Table 3.16, "Distribution of employment by major occupation group ---," for example, is used to justify any statement, we must wonder if any 5 year old data of this kind is reliable. Similarly, the data in Table 3.18 are at least two years old.

Some serious questions are raised by the commentary on multipliers on page 3-39 which underlies the assumed effect of expenditure impacts of labor force households in Table 3.17 on page 3-40. The effect of the conservative impact is to downplay the possibility of the "boomtown" dislocations caused by the rapid increase in the demand levels of the labor force. (The various expenditure multipliers are noted in 3.17.) The problem with this Table is that the demoralizing effect of the cumulative multiplier effect is ignored as none of the other synfuel plants are built into their calculations. Aside from the boomtown effect of SRC-I, what about the vastly greater trauma occasioned by several plants?

Section 3.2.4.3 Housing, on pages 3-42 and 3-43, is particularly problematic for Vanderburgh County. For example:

> If we can accept their 2.4% vacancy rate for apartments in Vanderburgh County, we have no idea what kind of apartments these are or in what census tracts they are located.

are they public housing or low income apartments or luxury condominiums, or what? [redacted] specific data are needed. For example, in September of 1980, there were 197 apartment vacancies in Vanderburgh County - 99 of these or approximately one-half of these are vacancies in housing owned by the Evansville Housing Authority or reserved for low income tenants. There are almost literally no vacant apartments here.

On page 3-43 the report says "transient lodging opportunities are abundant in the three-county area as well." What is the relevance of this statement? Where is information on vacancy rates, or willingness of motels, eager for convention business, to welcome transients?

Table 3-21 (on page 3.44), which notes available excess capacity of [redacted] districts in Henderson, Daviess and Vanderburgh counties. The Evansville-Vanderburgh County "excess capacity" is 17%. That is not the critical point. What is the critical point is the total lack of local and/or state money to finance instruction and instruction related services to use any of that 17%. The school corporation is funded more and more from the State of Indiana according to a school attendance formula which would not finance the Indiana School Corporation's increased student load until one year later. What happens the first year? Probably chaos, unless the impact of school children were scattered throughout the system. Can this be guaranteed?

The other point is also a finance-related point. Most germane is the material on pages 3-47 and 3-48. If there were any need for increased public services as a result of construction workers

living in or visiting Indiana counties, such services would have to be paid for by special state appropriations, as Indiana's cities and towns are tied to a tax program which has seriously hindered their ability to provide additional services. Much care will have to be given to financing of public service expansion. Our financial incapacity is not adequately addressed, and questions must be raised as to the willingness of the Indiana State Legislature to appropriate special funds to Indiana counties impacted by not only SRC-I but all other synthetic fuel plants. Where is the cumulative financial impact addressed?

Socioeconomic Impacts from Project Construction.

Initially, attention should be directed at one of the major premises underlying all the estimates pertaining to construction-related socioeconomic impacts. I have reference to the apparently arbitrary decision to use a 70-mile commuting zone as the estimated norm for commuters. The work force required to build the project is compared with the labor force available in the 70-mile commuting zone. Obviously, if a smaller commuting zone were used, then the labor force available would be less and a larger labor force would have to be imported from outside. Thus, the effect of a 70-mile commuting zone (as opposed to 40 or 50) is to distort downward the immediate or construction-period impact of the plant. This is a serious question because, given the apparently hopelessly-inadequate transportation system and increasing fuel costs, a 70-mile commute is likely to be much, much longer than 90 minutes, or may not be made at all. What reasonable grounds are there to continue to use the 70-mile commuting zone other than to minimize the nature of the "imported labor" dimension which, of course, minimizes also the

socioeconomic impact of construction. If a more reasonable commuting zone were used, the multiplier effect noted in Table 3.17 on page 3-40 would be greater. Our point is that the methodology used in the DEIS distorts downward and thus disguises the economic and social dislocations which construction will cause to the area.

In a similar vein, we feel that the deliberate distortion of the size of the work force required for construction must also be questioned. The DEIS notes on p. 4-65, the work force projection for construction of SRC-I is 3500 which is known to be, in all probability, an underprojection. It then says, still on p. 4-65, "To provide a broader range of analysis the DEIS will consider a worst case (emphasis mine) peak labor force of 5000. Why should the apparently more accurate prediction be worst case? Why couldn't the more accurate figure be used in the first case? Isn't the methodology deceptive?

We feel very, very strongly that all projected impacts of construction for SRC-I which run through page 4-94 are seriously low because of the premises and assumptions upon which they are made. This says nothing whatsoever about the individual tables and charts themselves.

For example, on p. 4-69, the DEIS estimates that 36% (1241 workers) will in-migrate to the 70-mile zone around the site. We feel very strongly that the in-migration must be calculated to a much smaller zone, perhaps 30 or 40 because of transportation problems not examined properly in the DEIS. Thus, we argue that the DEIS must calculate a smaller commuter zone which has to absorb a greater in-migration. The in-migration to Vanderburgh, Spencer, Daviess and Henderson is seriously underestimated.

The "movers to county" and "travellers locating in county" figures in Table 4.25 of 75 and 112 respectively may be seriously low.

The Housing Requirement sections on p. 4-74 are much too general and vague, particularly in terms of "other types of residences." If these are apartments, where are they?

A very basic problem is addressed (I think unintentionally) on p. 4-78, where the DEIS is addressing the positive effect of the SRC-I on general revenues. Assuming an average salary for each Indiana resident working at DEIS of $24,440, the State of Indiana would receive $490 per worker per year. Vanderburgh would receive none of that directly. While Indiana would receive 60% of the "total property tax revenues indirectly attributable to SRC-I," this would amount to $58,000. See Table 4.32. The point is that the Indiana counties would receive virtually nothing in tax revenues and be expected to sustain substantial expenses in several public service areas.

Why, by the way, does the DEIS use an annual average wage of $24,440 when calculating tax revenues occurring to Kentucky and Indiana from SRC-I employment, and significantly lower figures of $18,250 (for "operating labor") and $22,500 ("supervisory personnel") on pages 4-92.

To belabor yet again the point that the DEIS seriously ignores the impact of SRC-I on public services and public finance, we point to a quote on p. 4-96, "The population in-migration into the Henderson County area could result in negative financial impacts, since the area might experience a need for increased public services while not receiving tax payments directly associated with the construction and operation of the SRC-I facility." This is hopelessly inadequate as it pertains to Henderson County. Also, in addition, it does not

speak to the strain on services brought about by SRC-I related demands in Vanderburgh County where 17.8% of all SRC-I employment will be located. Even using SRC-I methodology, that's 187 new public service demands and no new tax revenues. The impact on public services and finances on p. 4-95-96 must be addressed.

David A. Gugin
Ph.D., Political Science
University of Evansville
Evansville, Indiana 47702

IMPACT ON SURFACE AND GROUNDWATER SOURCES

The environmental impacts - short- and long-term - of SRC-1 and other synfuel plants on the surface and groundwater sources for Evansville and its vicinity are significant and serious.

Water pollution from coal spillage, from barge traffic, and fugitive dust, would cause water supply emergencies for Evansville because the contaminated water slug will reach the city water intake within several hours.

Because pollutant releases would cause higher concentrations of chemicals, the contaminated water reaching the water intake of Evansville water treatment plant may contain soluble toxic compounds that would pose toxicity to humans. This problem becomes a serious threat during the low periods of the Ohio and Green Rivers. Phenolic compounds (phenols, cresols, xylenols) and other compounds that would reach water treatment plant of Evansville at moderate concentration levels would contribute to the toxicity.

Even assuming "zero discharge," mode of these energy-related projects, occasional waste water discharge due to the failure of recycling systems of the plants and spills would result in release of significant amounts of pollutants and subsequent direct cumulative effect on water quality of the Ohio River which is the main source of the drinking water for Evansville and its vicinity.

Release of heavy metals and polynuclear aromatic hydrocarbons (PNAs) and their subsequent accumulation in the river sediment could become serious contaminants in downstream ecosystems.

Phenolic and PNAs are of concern because of their carcinogenic and mutagenic character.

The impact of synfuel plants on groundwater quality is also very significant. Toxic pollutants enter groundwater reservoirs through infiltration of leachates generated by the storage of solid waste residues stored outdoors, and spill of liquids. Phenolic compounds are water soluble and, therefore, they have the greatest potential for groundwater contamination. Contaminants mixed with substrate could pose a long-term hazard. Seepage of contaminants into groundwater reservoirs would increase mercury, lead, selenium, flouring and nitrate levels which already present in excess of recommended quantities. The seepage of these contaminants from open coal storage areas from encroachment of floods, is still more serious.

Breaching of the clay units during the construction of the Barge Ship would drastically change the groundwater flow regime -- increase of hydraulic gradient, more contaminants entry into ground water reservoirs from leachates due to increase of ground water velocity in the area and subsequent pollution of drinking water wells. This problem is a great threat to the communities nearby who depend on wells as sources for drinking water.

H. Mallareddy
Ph.D., Civil Engineer
University of Evansville
Evansville, Indiana 47702

IMPACT ON WILDLIFE RESULTING FROM FLOODPLAIN ENCROACHMENT

"One of the purposes of the SRC-I demonstration program is to identify health and environmental risks associated with the demonstration plant itself and a future commercial SRC industry." This quotation from the draft environmental impact statement (DEIS) exemplifies problems inherent in the report. The DEIS is replete with statements admitting insufficient baseline data, followed by implication of minimal effect. For example, although it is admitted that "all [possible] pollutants ...cannot be identified...because of unknown aspects of the SRC-I process," it is implied that "maximum pollutant concentrations due to plant operation would be a small fraction of existing levels [and that] any impacts due to the plant would probably be undetectable." Such language casts doubt on the validity of the DEIS as a predictor of possible health and environmental impacts of the proposed plant. Inadequacies of the DEIS that specifically relate to the terrestrial ecosystem are outlined below.

The controversy regarding the Indiana bat, Myotis sodalis, probably overshadows (but is no less a part of) a more important aspect, that of continued encroachment on floodplain habitat. Typical floodplain forests near the confluence of the Wabash and Ohio Rivers are of regional ecologic importance because of the generally southern affinities of their biota and the unique assemblages of species they contain. Loss of such habitats could result in significant reductions of species, at least on a regional basis.

The impact statement sites data indicating that "as much as 90% of the nation's original floodplain forests may have already been lost, and [that] current losses approximate 6% of the remaining area per year." Although construction of the Newman plant will not result in loss of "significant" tracts of riparian habitat, it is not yet clear that activities of SRC-I will not be harmful to a habitat whose existence is, at best, precarious.

The DEIS falls short of truly assessing the impact of the proposed Newman plant on terrestrial species on several points as follow:

1) It is invalid to assume that elimination of or degrading of small segments of a declining habitat will have no effect on species inhabiting the area. Areas now considered to be marginal habitat for a species may with time become critical. The writers imply that there is sufficient available habitat in neighboring areas to act as a dispersal sink for wildlife which cannot persist onsite. If this assumption is made, then assessment of impact on these potential dispersal sinks should be incorporated in the DEIS.

2) Biological surveys completed to date are inadequate on two counts: a) sufficient data regarding species identification (particularly of vertebrates other than Myotis sodalis) and regional abundance were not provided for the Newman site but were provided for the Equality site, and b) the length of term of the survey was inadequate to determine habitancy of M. sodalis in marginal onsite habitats during periods of stress in Martin forest and other optimum sites near the proposed plant.

3) No baseline data on the productivity of onsite habitats were reported in the DEIS. Collection of these data is necessary to assess long range effects on productivity as mandated by the National Environmental Policy Act.

4) No data were presented which specifically address the impact of pollutants (both air and water) on the biota of the plant site. Simple statement that there is no published information that adequately supports the hypothesis that M. sodalis and other species would be affected by pollutants does not allow the assumption of truth, because there is, also, no evidence that proves no harm. The structural ecology of the onsite ecosystem has not been reported; therefore, there can be no assurance that ecological accumulation of toxins will not occur. Elucidation of the food chain ecology of the Indiana Myotis would be prerequisite to statement of minimal harm.

5) Data presented are insufficient to make any hypotheses regarding long term effects of possible accumulations of trace metals on the productivity of Martin and Green River forests and of Richland slough.

6) No baseline genetic data have been reported for any onsite species. These data would be necessary as a reference in assessing potential effects of mutagenic compounds released by operation of the plant.

7) There was at the time of publication of the DEIS no finalized routing of powerlines which would avoid both Martin forest and Richland slough.

Inasmuch as the above listed points have not been adequately addressed, the Department of Energy has not completely assessed the impact of its proposed action on either the endangered Indiana Myotis or on the endangered wetlands habitat.

Gordon K. Weddle
M.S., Zoology
Indiana State University Evansville
Evansville, Indiana

IMPACT ON AQUATIC ECOLOGY

The purpose of this response is not to arbitrarily criticize the DEIS, but to constructively indicate areas in it where data could be presented more clearly and where further investigation might be of value in attempting to predict impacts on the aquatic ecology of the proposed site.

The following six areas of concern will be addressed:

1. No complete species list is presented for phytoplankton, zooplankton or benthic macroinvertebrates sampled at either the primary site or the alternate sites.

2. The methods used for collecting phytoplankton, zooplankton and benthic macroinvertebrates at the primary and alternate sites are not presented in the report.

3. At the Newman site, sampling of phytoplankton and zooplankton was apparently conducted only during Fall 1977 and Spring 1978. Benthic macroinvertebrates were apparently collected only during Fall 1977 and Winter and Spring 1978. No summer collecting seems to have been done.

4. It is not clear from the data presented when sampling was done for any organism at the Equality and Ravenswood sites.

5. Effects of construction and periodic plant effluent release on aquatic productivity are not thoroughly discussed.

6. The possible predisposition of fishes to infectious diseases due to the stresses of construction and periodic plant effluent release has not been mentioned.

The National Environmental Policy Act (NEPA) of 1969 directs investigators preparing EIS statements to include technical data adequate to permit a careful assessment of environmental impact. Since complete species lists for phytoplankton, zooplankton and benthic macroinvertebrates were not included in the DEIS conclusions

regarding the effects of construction and plant operation on these organisms are impossible. Apparently these lists are available, but they should be included in the DEIS, at least in the Appendix, for easy inspection. Tables 3.8 and 3.10 present summary lists of the organisms mentioned above. However, with the admitted effects of construction and periodic plant effluent release potentially severe on these groups, it is very important to know the complete aquatic community structure at the proposed sites.

Presumably, standard collection methods were used to obtain baseline data on the phytoplankton, zooplankton and benthic macroinvertebrates collected at the primary and alternate sites. Once again, however, these data are not available in the DEIS. In order to adequately assess the impact of the proposed plant on the aquatic ecology of the region, it is necessary to know which methods were used to collect the data. Resh (1979) points out that different sampling methods can give rise to variability in results when working with aquatic insects (benthic macroinvertebrates). He further indicates that a variety of substrates in a given area may produce the need for several sampling protocols. Keeping these very basic considerations in mind, how is the reader of this DEIS able to compare data from several sampling stations taken at different seasons without the methods being made available? Just as important, the reader does not know the exact dates of these samples - only relative seasons. It is well known that many aquatic organisms exhibit pulses of population increase which can be very short-lived (2-3 weeks duration). Without knowing exact collection dates, reliable statements regarding the abundance or even the presence of these organisms (if not detected in a temporally wide-spaced collecting protocol) cannot be made.

The temporal criticism of sampling techniques can be extended. Sampling of phytoplankton and zooplankton only during the Fall and Spring seasons can miss many organisms present in low numbers during these times, but which experience population increases during the summer months. During late summer the flow rate of waters in this geographic region begins to decline, and it is important to know when population peaks and nulls occur so that the timing of (potential) effluent release into the potentially smaller volume of water can be accurately estimated. Knowledge of numbers and species of organisms present during the winter season is important for similar reasons.

Benthic macroinvertebrates were apparently not collected during the summer months, and the same criticism applies here as well. If the organisms were sampled during the summer (or winter, where appropriate) why is the data not presented?

It is not clear from the data presented in the DEIS when phytoplankton, zooplankton, benthic macroinvertebrates or fishes were collected from the proposed alternate sites. This omission is important for the reasons mentioned above.

An assessment of the cumulative long-term effects of a proposed action (in this case, the construction and operation of SRC-I) including its relationship to short-term use of the environment versus the environment's long-term productivity must be made to satisfy the requirements of the NEPA. Aside from some general statements about low productivity in the Green River during the baseline studies, no detailed assessment of current primary or secondary productivity is presented for either the proposed primary or alternate sites. Although there

are many references to the effects of construction and periodic effluent release on specific organisms, no attempt to predict long-term effects on either primary or secondary productivity in the Green River or its tributaries appears to have been made.

Finally, the NEPA requires that a discussion of the probable impact on the environment including any impact on ecological systems and any direct or indirect consequences that may result from an action be made. The DEIS does discuss many areas of probable impact; however, one important potential problem is not mentioned.

It is now known that various environmental stresses will predispose fishes to infectious diseases (Wedemeyer et al.). Excessive siltation and the presence of a wide variety of chemical compounds, in both high and sub-lethal concentrations, are sources of stress which could predispose fishes to infectious diseases. Several viral, bacterial, fungal and protozoan diseases infect a broad spectrum of host fishes, and the possibility of contracting and spreading an infection in a reservoir of stressed individuals near the proposed plant site to other stretches of the Green River (principally downstream) must be considered. These epizootics, if they occurred, would probably be intermittent and not sustained; however, the effects on forage and game fishes could be significant.

Overall, the DEIS addresses many areas of obvious concern to the aquatic environment. These include, among others, direct effects of siltation during construction, toxic effects of effluent and impingement of fishes on intake screens. The areas not

addressed, or incompletely addressed, as listed above, are certainly of equal concern, however, and should be included in any final EIS.

LITERATURE CITED

Resh, V.H. 1979. Sampling variability and life history features: Basic considerations in the design of aquatic insect studies. J. Fish. Res. Bd. Can. 36(3) = 290-311.

Wedemeyer, G. A., F. P. Meyer and Lynwood. 1972. Fish Diseases, Vol. 5, Ecology and Environment. T.F.H. Publ., Neptune, N.J.

Thomas R. Kozel
Ph.D., Aquatic Biology
and Parasitology
Indiana State University Evansville
Evansville, Indiana

IMPACT OF TOXIC MATERIALS

According to the EIS (4.3), "coal liquefaction produces complex organic materials which have the potential for serious adverse health effects." The most pronounced effects are associated with the heavy, high boiling fractions. All SRC materials are categorized as "moderate acute toxicity" as determined from mutagenicity, and several (at high doses) have been found to be teratogenic in rats (e.g., causing malformations in fetal tissue). Furthermore, a laboratory test report states:

- the heavy distillate product from SRC-II is mutagenically active;
- both the HD of SRC-II and process solvent from SRC-I are highly toxic;
- epidermal carcinogenesis studies on mice resulted in 100% of the mice developing tumors (medium doses);
- oral toxicity studies on mice indicate SRC-I wash solvent is highly toxic.

EIS' conclusions (1) SRC liquid products are generally toxic and definitely more toxic than conventional fuel oils, and (2) TSCA requirements for SRC liquid remain unknown, probably because there is a lack of definitive data on the chemical constituents in synfuel products (although there are several known carcinogens in the SRC process (PAHs, naphthalene, aromatic amines, and inorganic trace elements).

With this scenario of potential lethality of SRC process materials, it is understandable that a fair portion of EIS addresses

worker protection, research studies on SRC-products, development of specific TSCA requirements for SRC liquids, elaborate procedures for monitoring and for handling of waste products; and mechanisms for dealing with potential transportation spills. In fact, a proposed Health and Ecological Studies Plan (HESP) will be conducted in four phases and will provide information on the health and ecological impacts of SRC-I products, and waste materials and internal process streams. Despite the appearance of a comprehensive approach to the assessment of the potential effects of toxic materials, the EIS still does not adequately relate or address:

1. a reasonable timetable for the proposed four phases of the Health and Ecological Studies Plan. For example, it is stated (2-34) that most of the studies in the first three phases will be completed before operation of the plant begins. However, it states repeatedly that Phase II will determine long-term effects of chronic exposures. How long is long-term if studies in Phase II are to be completed before plant operation? Also, a number of studies in Phase II are dependent on results from Phase I studies. It seems improbable, given the complexity of the studies and the proposed timetable, that these studies will be completed before plant operation.
2. why there was not sufficient studies conducted either in pilot projects or research programs that would have led, at this point in time, to
   a) better chemical characterization of toxic materials,

   b) essential biological testing of materials including dermal and inhalation carcinogenesis, teratogenesis, and male reproductive effects,
   c) basic assays, which indicate mutation and chromosomal alteration in microorganisms and which would have identified materials to be assayed for long-term chronic effects.
3. Why there is proposed an occupational health protection program (4-9) that includes medical monitoring, protective equipment, specific work practices, industrial hygiene monitoring, special procedures and equipment, etc., but mentions only a safety engineer and a safety and health director as personnel responsible for the program. In other words, the personnel requirements for such a comprehensive program do not seem to be adequately addressed.
4. EIS addresses the potential seriousness of spills of toxic chemicals during transportation and that the impacts from SRC liquid product spills will be reduced by careful selection of markets, routes .., but it is obvious from discussion of transportation routes (4-11) that the routes designated for railroad transport are through the metropolitan areas of Nashville, Birmingham, Mobile, Biloxi, New Orleans, and Gulfport to the south, and Louisville, Cincinnati, Columbus, and Pittsburgh to the north. In fact, the rail shipment from Newman to the Lake Charles destination will pass through more than 100 towns and communities which have a combined population of over 2.5 million people.

In summary, it is obvious that the potential adverse health effects from toxic chemicals produced in the SRC process is significant. Hence, the need for a demonstration plant and the opportunity to determine long-term chronic effects of these toxic chemicals on workers and the surrounding population. The discomforting point is that, with such a host of unknowns to be resolved, why would a corporation choose to locate such a huge facility on the fringe of a metropolitan area of 300,000 plus, and upstream from two major cities (Henderson and Evansville) that depend on the Ohio River for their water supply? The site selectors were incredibly insensitive to the demographics of this proposed site.

Warren Hankins
Ph.D., Chemistry
Evansville, Indiana

FAILURE TO STATE ALTERNATIVES

The DEIS does not contain an adequate consideration of "alternatives" as required by NEPA. The National Environmental Policy Act (NEPA) expressly refers to agency consideration of alternatives not once, but twice. Section 102(2)(D) provides that the agency shall:

> "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources."

Section 102(2)(C)(iii) requires the agency to comment on "alternatives to the proposed action."

The recommended course of action in the DEIS is to "Proceed With Construction And Operation In Accordance With The Currently Proposed Design." (DEIS, Vol. 1, p. ix).

Clearly, this Section 102(2)(D) is supplemental to and more extensive in its commands than Section 102(2)(C)(iii), and will be primarily addressed herein.

The DEIS addresses the question of alternatives in two places. The discussion beginning in Vol. 1 p. 1-16 deals with alternative sources of liquid fuels. The discussion beginning at Vol. 1 p. 2-1 deals with alternatives with regard to various design features and plant locations.

At the outset, it shall be noted that the entire DEIS discussion deals with the need for a coal liquification facility, whereas the SRC-I process was initially designed as a producer of solid fuel with a liquification feature being added only

recently. Conversely, the proposed SRC-II plant to be located in Morgantown, West Virginia, was designed as a liquid fuel facility. Therefore, the entire discussion with regard to alternative sources of liquid fuel is misdirected, because it deals only with liquid fuel.

The DEIS states, at the outset:

> "The primary product, which is a liquid at process temperature, is a high heating value, low sulfur, low ash fuel product that may be directly substituted for oil or coal in certain applications. Three products will be produced in the proposed demonstration facility: solid SRC-I boiler fuel, anode grade coke and a hydrogenated liquid boiler fuel."

Implicit in this statement is the fact that a solid fuel is the primary product of the SRC-I Process, and, in fact, was the only contemplated product in all public announcements prior to submission of the DEIS. Also implicit is the fact that such solid fuel is a suitable replacement for coal in industrial applications. ~~It is impossible to burn coal in automobiles.~~ Therefore, the proper ~~alternatives~~ to discuss in the DEIS should include the contained use of coal in industrial uses and power generating ~~facilities~~ as opposed to the use of SRC-I solid fuel.

No one questions the deleterious environmental effects of burning coal without proper treatment of resultant emissions. The question which should be addressed, therefore, and which DOE is required by law to "study, develop and describe" is whether it makes economic and environmental sense to take "dirty" coal and, through the SRC-I process, turn it into a relatively clean burning coal substitute. The "alternative," of course, is to burn coal "as is," with proven emission controls. Obviously, this alternative is nowhere addressed in the DEIS.

This defect was implicitly recognized by the Office of Management & Budget (OMB) in their recommendation regarding the DOE budget for F Y 1982. The OMB recommended that SRC-I be eliminated based on the following reasoning:

> The OMB recommendation also would terminate the SRC-I project. Construction on this project is not yet underway although some site preparation work has begun and contracts have been entered into. Originally, SRC-I was distinguished from the SRC-II project on the basis that it produced a solid product. Now, however, project sponsors are proposing to also produce liquids after hydro-processing of the primary solid product. As the product slate for SRC-I approaches that for the SRC-II project there is less of a justification for proceeding. With the advent of the SFC, it is likely that the commercial adoption of SRC technology would not be delayed if this project were terminated. Although there are important differences between SRC-I and SRC-II, the processes have many common steps. The differences are not judged to be so significant that the private sector could not commercialize the SRC-I approach given a successful demonstration of SRC-II and the existence of the SFC. Also, given the high technical risks of scaling up 2 processes from a less than 60 ton-per-day pilot plant to a 6000 ton-per-day demo plant and the substantial Federal cost, at least $1.4 billion, the fiscal and risk savings produced by termination of the SRC-I project are significant.

To summarize, therefore:

1. The objective, or purpose, of the SRC-I plant, according to the DEIS, is to demonstrate the technical economics and environmental feasibility of the process.

2. The process is primarily designed to produce a solid fuel with a liquid fuel as a secondary product.

James E. Rode, Jr.
Attorney At Law
Evansville, Indiana

EPIDEMIOLOGICAL DATA BASE STUDY NEEDED NOW

An epidemiological study should be conducted now in order to provide a data base for future exposure monitoring.

The purpose of the proposed SRC-1 plant is to demonstrate the feasibility of the solvent refined coal process, before the construction of several other such facilities around the United States. The technology is essentially untested and the environmental impact of the technology is unknown. In fact, one of the purposes of the Newman facility is to identify health risks resulting from the process. According to the DEIS:

> "One of the purposes of the SRC-1 demonstration program is to identify health and environmental risks associated with the demonstration plant itself and a future commercial SRC industry." P. XV, DEIS.

> "Because no technological development is risk-free, exposure monitoring for both the work force and public will be a major feature of the health protection program." P. X, DEIS.

Thus, it is obvious that the people living in Owensboro, Henderson, and Evansville, and in all the towns and countryside inbetween, are not only going to share the economic risk of testing this technology, along with other Americans, they are going to have the distinct and unique responsibility of testing the health and environmental risks associated with the process.

According to the DEIS, P. XVI:

> "One of the primary objectives of the demonstration plant program is to obtain an environmental data base."

The stated justification for the federal government's financial support of synfuels projects is that they are too risky for the

private market alone. The public, through its taxes, is taking the financial risk off the shoulders of private industry. The residents of this area are being subjected to health, safety, and environmental risks as well. In return for bearing these financial, health, and other risks, the public has a right to demand that DOE elevate health and safety concerns to the same priority as the goal of demonstrating that coal can be converted to gas.

This being so, the DOE and its clients should conduct an epidemiological study now, prior to the commencement of construction, to determine the existence of and incidence of disease caused or induced by already existing environmental factors, such as the large number of conventional coal-fired plants already on line in this area. How are we to know the effects of the SRC process on the people of this area unless there is a data base with which to compare the incidence of disease caused by the plant in question? An epidemiological study should be conducted now to obtain this data base.

Hugo C. Songer
Attorney at Law
Evansville, Indiana

JOHN Y. BROWN, JR.
GOVERNOR

WILLIAM B. STURGILL
SECRETARY

DEPARTMENT OF ENERGY

March 24, 1981 66

Mr. James A. Reafsnyder
U.S. DOE
P.O. Box E
Oak Ridge, TN 37830

Dear Mr. Reafsnyder:

I presented the Kentucky Department of Energy's testimony on the SRC-I DEIS at the hearings held in Stanley, Kentucky on February 25, 1981. I was the first speaker and called attention during my initial remarks to the fact that I was making our statement instead of John Mitchell who had been originally registered. I also stated that my remarks would be drawn from a longer written statement which was to be entered into the record. At the conclusion of my remarks the recorder, who was seated immediately adjacent to the podium, asked for our written comments which I gave him.

I understand that subsequently these have been misplaced, therefore, I have enclosed a copy of the comments which should be our official comments rather than my oral summary.

Sincerely,

James E. Jones, Jr.
Director
Division of Technology Assessment

JEJ:bs

Enclosure

10659

KENTUCKY CENTER FOR ENERGY RESEARCH
P.O. Box 11888
LEXINGTON, KENTUCKY 40578
(606) 252-5535

2/24/81

Kentucky Department of Energy Statement on
the Draft EIS for the SRC-I Demonstration Project

The Kentucky Department of Energy is pleased to see the Solvent Refined Coal project advanced to the point at which an impact statement for its construction has been drafted. We are further pleased to comment on that statement. As a major participant in the project we will restrict our comments to three areas addressed by the Statement:

1. The need for the coal liquefaction program and the need for the proposed demonstration project.
2. The site selection process for the project.
3. The cumulative impacts of synfuel plants in the West Kentucky area.

Before commenting on these subjects we want to make clear the nature of the involvement of the KDOE in synthetic fuels in general and specifically in the SRC-I project.

In 1974, the Kentucky General Assembly instituted a new program of energy and economic development known as the Coal Conversion Demonstration Program. Its purpose was to encourage, support, and participate in large-scale projects that would establish the technical and economic feasibility of conversion processes and also help ensure their environmental acceptability. A fifty-five million dollar trust fund was established to support the demonstration of technologies in Kentucky that would convert coal to clean liquid, gaseous and solid fuels. The SRC technology was among the first of those that received Kentucky support. After initial discussions in mid 1975 with the Wheelabrator Frye Company (now a partner in ICRC), Kentucky signed a contract for $5 million

A-229

in mid 1976 for the design of a 2,000 TPD demonstration plant. That design study was funded totally by the state in order to keep the project moving and commercialize as rapidly as possible. The state assisted with siting and secured options to the site as will be discussed in greater detail. After the project was later expanded to 6,000 TPD and the design completed, Kentucky committed to issuing $30 million in bonds for pollution control equipment in the demonstration plant. Kentucky's commitment of $35 million to the SRC project is the largest by the state for any synfuel project. Development of the SRC process began in the early 1960's and the KDOE believes that the SRC-I process is a versatile, flexible technology that can help meet the energy needs of the 90's.

To be commercially available then, however, long lead times dictate that a large-scale demonstration plant must be in operation in the mid '80s. The Kentucky Department of Energy continues to fully support the Newman project today because we believe that SRC-I is ready to take the all-important demonstration step.

Need for Coal Liquefaction Plants and the SRC-I Demonstration Project

The need for reducing dependency on foreign oil should be apparent from the $100 billion cost of that oil which has been a major factor in the current economic situation that the country faces today. While the level of interest in synthetic fuel development has tended to rise and fall with gasoline lines, it appears that the continuing need to develop synthetics has finally become apparent. The passage of the Energy Security Act and a recent Newsweek poll indicating that 58% of Americans felt that synthetic fuel development was not receiving sufficient funding are evidence of this realization. The fact remains that coal is our most abundant resource, making up over 90% of our energy resource while contributing under 20% of our supply. In order for coal to make a greater contribution and replace liquid fuel imports it must be converted to liquid fuels or their substitutes.

The SRC-I process represents one of the most advanced liquefaction technologies that have the potential for achieving this goal. Process development has occurred over most of the last twenty years at considerable private, State and Federal government expense. The development of synthetic fuel projects in the past has a dismal record of continuity. The demonstration plant activity in the early 1950's came to a halt short of commercial scale because of low cost Middle East oil imports. The more recent round of commercial gasification plants proposed for the southwestern part of the U.S. went through the EIS process only to die primarily due to regulatory delays. The current round of synthetic fuel plants represents to many the last chance to commercially develop synthetic fuels from coal in the U.S. It takes a tremendous amount of energy and money to bring a project to the point of construction, and the failure to proceed with plants now ready for construction will have a severe dampening effect on the synfuels industry.

Site Selection Process

The site selection process is accurately described in the Statement. Further the Department believes that the site selection process followed was not only typical of that used for siting such facilities but is a correct and reasonable procedure. Criteria in such a selection process include proximity to coal and markets, transportation of raw materials and products, labor availability, and general site suitability such as environmental acceptability. The Newman site was selected over two dozen other sites and is clearly a very suitable site for such a facility. Chronologically SRC-I site activities have occurred as follows: In mid 1975 the first discussions were held between

the state of Kentucky and the Wheelabrator-Frye Company (one of the parent companies of ICRC) regarding the construction of an SRC plant. In July of 1975 a proposal was submitted by Wheelabrator-Frye to Kentucky for the design of a 2000 ton per day demonstration plant. The $5 million contract was signed in July of 1976. The site selection process occurred from August through October, 1976, as described in the Statement. The 24 potential sites had been previously identified by the Kentucky Department of Commerce and were supplied to the project by the Kentucky Center for Energy Research. In August of 1977 the state acquired options to 817 acres of the Newman site. The decision was made by the U.S. DOE in March, 1978, to support the construction of a demonstration plant large enough (6,000 tpd) that it could be the first module of a commercial plant. Since that time ICRC has obtained options to 267 additional acres. The acquisition of the 400 acres that remain under negotiation would bring the total Newman site to approximately 1500 acres.

Cumulative Impacts

The cumulative impacts of multiple synfuel plants are discussed in the Statement in a general way. This is because the other plants proposed for the area are at least two and a half to three years away from construction and are in the design stage at this point. Until design is well underway the data does not exist to quantify many aspects of the plants. Further it is premature to consider these as assured projects until the commitment is made to proceed with construction. As sufficient data is generated, each project will prepare a Statement as detailed as that for the SRC-I project. Each project will have to consider any cumulative impacts that it will have with all projects underway and proceeding concurrently. Thus before any project goes into construction the cumulative impacts will have been considered. This approach is a more reasonable cost and time effective approach than attempting in the SRC-I EIS process to consider a future hypothetic set of circumstances.

On the other hand, from a state and local planning perspective it is necessary to consider the synfuel industry that may develop in West Kentucky. Such efforts are well underway and are considering the implications of a synfuel industry made up of four synfuel plants proposed for West Kentucky as well as construction of six conventional power plants. On the local level the most comprehensive planning effort is being carried out by the Green River Area Development District (GRADD), which has a $400,000 two year contract with the U.S. DOE. The purpose of that study is to assist local government in dealing with the impacts of synfuel development, primarily those related to growth and demand for services. Both the Owensboro and Henderson governments have received subcontracts from GRADD. The Lincoln Trail ADD has received a $50,000 grant for a housing study. Both Henderson and Owensboro have set up advisory committees made up of local citizens to address synfuel development.

At the state level coordinated policy formulation will come from the Synthetic Fuels Committee which is comprised of the Governor's Cabinet. The group has met on several occasions to be briefed by project developers on individual projects, to be briefed on the KDOE synfuel assessment, and for review of the SRC-I draft Environmental Impact Statement.

Working under and in support of that Committee is a Synfuel Technical Committee which consists of representatives appointed by each Cabinet. This group has also met and will work closely in the future. As the biennial budget cycle approaches the various departments will be developing a more detailed

analysis of the synfuel industry, identifying priority issues, developing mitigation plans, and determining the support needed for planning and implementing mitigating measures.

The assessment activities related to the synfuel industry are being coordinated by the Kentucky Department of Energy. That coordination role is not only within state planning, but also with affected Area Development Districts and local government as well as between the projects themselves. A comprehensive assessment of the implications of the synfuel industry for Kentucky has begun in the KDOE in July of 1980. The assessment is not an impact assessment per se, but rather more on the order of a technology assessment. A broad range of factors, both positive and negative, are being examined to determine both the short and long term ramifications for Kentucky. The first report resulting from the synfuel assessment is currently being published. It describes the transportation, labor, coal supply, physical environmental, social environment, and economic implications of the synfuel industry. In order for planning on the state and local level to be consistent the initial efforts have been on developing a quantitative description of the synfuel industry. The synfuel plant labor requirement data and the population growth data (which is a function of the labor influx) have also received priority attention. A computerized system for managing the labor requirement data has been developed which will allow estimates of labor requirements for individual projects and the total to be estimated as a function of time, craft, and other variables. The revised labor data will in turn be used to update population forecasts. The population projections are being developed by the Urban Studies Center of the University of Louisville.

The developing synfuel industry clearly poses challenges but it is equally clear that unprecedented opportunities for Kentucky and the nation exist. The commercial size plants are two to six years from construction and six to nine years from operation. Therefore there is sufficient time for the planning and implementation of programs which will not only allow the synfuel industry to develop in an orderly manner but also to maximize the benefits to the Commonwealth and the nation.

Department of Energy
Washington, D.C. 20545

March 23, 1981

67

Mrs. Marian Richardson
Route 6
Owensboro, Kentucky 42301

Dear Mrs. Richardson:

We have received your letter dated February 21, 1981, in which you express concern about the synfuel plant (SRC-I) proposed to be constructed at Newman, Kentucky. Your letter to the Assistant Secretary for Environment was forwarded to my office under the Assistant Secretary for Fossil Energy because we are responsible for assuring that public comments are appropriately handled.

As you may be aware, the Draft Environmental Impact Statement for the SRC-I Demonstration Plant was issued in January 1981, which opened a public comment period starting in January and closing on March 2, 1981. The Oak Ridge Operations Office of the Department of Energy is the office responsible for collecting public comments and for considering all such comments in the preparation of the Final Environmental Impact Statement. Consequently, I have forwarded your letter to Oak Ridge and your letter will be included in their review of comments by citizens such as yourself.

The Final Environmental Impact Statement, which is submitted to the Secretary of the Department of Energy for his action, will include coverage of the public's reaction to the proposed SRC-I Project.

Sincerely,

John L. Morris
Acting Director
SRC-I Program Office

cc: J. A. Reafsnyder, ORO, w/original ltr.

Owensboro, Ky.
Feb. 21 1981

000117

U.S. Dept. of Energy,
Wash. D.C.

Dear Sir:

I am a resident of West. Ky. Daviess County and am very opposed to Synfuell Plant at Newman Ky.

We are living in a non-attainment area and there are already 12 or more coal using plants surrounding us. We don't have clean, fresh air in summer or winter and when its very hot in summer months it is difficult for us, who are allergic to plant pollutants in air to breathe, in fact it is frightening to know we must have air conditioning. Most of us are becoming allergic. We are the endangered species now and our environment is fast becoming destroyed. We are in great need of our beautiful God given environment and other

A-233

environment minded use to protect it.
Senator Wendell Ford of Ky. is not fighting to keep these horrible plants out of Ky. but is fighting to get them in here because he's got an insurance Company here in O'Boro and this is a Conflict of interest scheme. Money is the root of all Evil and we have no responsible leaders in Govt of Ky. regarding this matter.
Many of us don't want the 1st sign. of fuel plant let alone 3 more. Please help us fight against this scheme & for one and fed up with all the Conspiracy now. Our health is at stake. It's already a very bad environment. I live here & know. Will you please help us!

Sincerely Yours,
Mrs. Mariana Richardson
R6 Owensboro, Ky. 42301

Appendix A.3

RESPONSE TO COMMENTS

CONTENTS

		Page
1.	PROGRAMMATIC COMMENTS	A-237
2.	GENERAL COMMENTS ON THE DEIS	A-245
3.	PLANT DESIGN AND ENGINEERING	A-248
4.	SAFETY AND ACCIDENTS	A-272
5.	HEALTH EFFECTS	A-275
6.	WATER RESOURCES	A-289
7.	AIR QUALITY	A-295
8.	SOCIOECONOMICS	A-306
9.	FLOODPLAIN AND WETLANDS	A-332
10.	ECOLOGY	A-334
11.	MONITORING AND MITIGATION	A-344
12.	SITE SELECTION	A-353
13.	SOLID WASTE	A-356
14.	LAND USE	A-361
15.	GEOLOGY AND SOILS	A-363

1. PROGRAMMATIC COMMENTS*

1.1 Comment: DOE and other relevant federal agencies must prepare a programmatic impact statement on synthetic fuels development. The SRC-I DEIS contains a section that is labeled a programmatic overview (DEIS, pp. 1-1 to 1-23). That label is clearly a misnomer. The section is superficial to the point of being meaningless. The DEIS gives cursory and inadequate attention to the possibility of the development of conservation and renewable energy sources as an alternative to the current proposal. (Commenter: 38, p. 3, 5, 10)

Response: The broadest, most comprehensive treatment of the programmatic aspects of synthetic fuels development is contained in the FEIS for the Alternative Fuels Demonstration Program, ERDA-1547 (September 1977).

The Alternative Fuels Demonstration Program EIS presents a generic assessment of the potential environmental impacts associated with the commercialization of synthetic fuels processes. The processes included high- and low-Btu coal gasification, coal liquefaction (direct and indirect), oil shale, and solid waste conversion. Environmental impacts were assessed for various production levels from various combinations of these processes.

The alternative fuels EIS addressed alternatives to the program that included:

- Direct utilization of coal
- Increased energy conservation
- Nuclear energy
- Geothermal energy
- Solar energy
- Wind energy
- Hydroelectric energy
- Tidal energy
- Tar sands
- Increased domestic oil and gas production
- Hydrogen economy
- Energy from solid wastes

These alternatives were assessed from the standpoints of technology status, potential energy contributions, and environmental impacts. In addition, an environmental trade-off analysis was conducted to assess those alternatives that were judged to be reasonable and to assess how those alternatives could meet the goals of the program. The alternatives assessed in this regard were (1) conservation, (2) increase oil and natural gas imports (the no-action alternative), (3) increase domestic oil and natural gas production, and (4) direct coal utilization.

The information contained in the Alternative Fuels EIS provides a basis upon which decisions can be made regarding synthetic fuel versus other energy options, various mixes of synthetic fuels, and total production goals for a mature synthetic fuels industry. In conjunction with this, information in the SRC-I EIS updates the programmatic analysis appropriate for coal liquefaction. The SRC-I EIS places the DOE liquefaction program in perspective regarding information needs, program justificatication, and DOE's strategy for energy policy responses. This is done in a tiered fashion, beginning with the evolution of national energy policy and the obligations of DOE under various Presidential pronouncements and Congressional energy acts.

---

*Throughout Sect. A.3 of Appendix A, the acronym EIS will be used when referring to material that has appeared unchanged in both the Draft Environmental Impact Statement (DEIS) and the Final Environmental Impact Statement (FEIS).

The programmatic sections at the beginning of the EIS serve three functions: to provide an assessment of the environmental consequences of commercialization of the SRC-I process as a result of the DOE direct coal liquefaction activities, to focus on how the SRC-I plant in particular and DOE's direct coal liquefaction activities in general fit into the program goals and objectives, and to focus on environmental impacts as discussed in The Alternative Fuels EIS.

Section 1.4 presents a commercialization scenario in which the potential environmental impacts of locating two liquefaction plants in each of three states, West Virginia, Kentucky, and Illinois, are identified. Section 1.2 examines the alternatives to and within the program along with the environmental consequences associated with these alternatives. The SRC-I EIS and the Alternative Fuels EIS provide the information necessary for reviewing the program in relation to other elements of DOE's Program for Technology Development.

1.2 Comment: No valid reason for constructing a synfuels industry — or even a single synfuels plant — is given in the EIS. Supposedly, the first section of the main body outlines the "Purpose and Need for the Coal Liquefaction Program" but one wonders why this section was written at all. It recites various possibilities for solving the energy crisis without comparing them in any meaningful way. What would be helpful is facts about net energy production for each approach and about cost effectiveness (how many dollars does it cost to produce a barrel of oil by coal liquefaction compared to the cost of securing the equivalent of a barrel of oil by conservation, for instance?) (Commenters: 38, p. 9; Speaker 29; 46, p. 2)

Response: The merits and environmental impacts of the synthetic fuels program as a whole as well as reasonable alternatives were presented in the Alternative Fuels EIS noted in Comment 1.1. As was discussed in Sect. 1 of the EIS, the proposed SRC-I demonstration project is only part of DOE's activities implementing the National Energy Act. A study of the cost effectiveness of each of the alternatives was judged not to be appropriate to the FEIS.

1.3 Comment: Why should DOE support a plant whose primary product will be solid fuel? Much of the nation's energy problem is a "liquids" problem. We consume too much oil — much of it from foreign sources of supply. Why should the federal government invest enormous amounts of taxpayers' money supporting a plant designed to convert domestic coal into another solid fuel? (Commenters: 38, p. 9; Speakers 29; 17, p. 2)

Response: A large fraction of the SRC-I product slate is liquids. The production ratio of solids and liquids can be varied from as much as 85% solids with 15% liquids to as little as 10% solids with 90% liquids. The process is flexible enough that a commercial plant can be designed to produce mostly liquids if this is more appropriate to the market.

There is a significant market for the solid SRC-I product. The driving force for development of SRC-I is displacement of petroleum-based products in the energy market. All SRC-I products are capable of this, including solid products. Combustion tests carried out in fall of 1980 indicate that SRC-I solids can be burned efficiently in an oil-designed boiler. Economic analyses indicated that if a typical power plant oil-designed boiler were converted to firing SRC-I solids at the expected prices, total costs would be lower than for conversion to coal with scrubbers. This is a market in which SRC-I is clearly competitive.

In existing electric utility boilers alone, this is a market segment of 133 million tons/d of SRC-I.

If all similar market segments are totaled, the net market available to SRC-I solids is 1,044 million tons/d by the year 2000. Even a modest penetration of this market would be a large potential market for SRC-I solids.

1.4 Comment: Why do we need two SRC demonstration plants? This plant is one of two proposed SRC demonstration plants; the other proposed for construction near Morgantown, West Virginia. Why isn't it possible to demonstrate the SRC technology with only one plant? (Commenters: 38, p. 9; Speakers 29; 46, p. 2; 17, p.3)

Response: SRC-I and SRC-II are not identical technologies. SRC-I is basically a solids product process but addition of a hydrocracking step in the demonstration plant design provides a version of two-stage liquefaction which enables varying product mix from predominantly solid products to predominantly liquid products. A solvent deashing technique is used to remove ash and unconverted coal from the first stage product. SRC-II increases the degree of hydrogenation of the coal by increasing the time that the coal slurry resides in the reaction vessel. The result is that SRC-II produces distillable liquids instead of a solid product. Ash and unconverted coal are removed by common distillation in the SRC-II process. SRC-I and SRC-II use different approaches to gasifying the ash and unconverted coal residue to produce hydrogen consumed in the liquefaction process. SRC-I and SRC-II each have their respective merits and deployment of these technologies will be governed by interests of current and prospective industrial sponsors of the two approaches and by market forces. To demonstrate both technologies in a single plant would delay both technologies. To convert either project to a dual-process demonstration would require considerable process redesign, with accompanying delay. Unless two complete trains are used (one for each process), one technology must complete its start-up and demonstration periods before the other can begin. This is because considerable process repiping and equipment modification must be done to convert from one mode to the other on a large scale. It would be impractical to switch back and forth.

Even for unit operations which are common to both processes, the optimal design and operating conditions differ. Thus, a compromise demonstration plant design would not allow either process to be given its best demonstration.

If the scale of the processes were maintained as in the present design, total capital costs for a simultaneous two-train demonstration plant would not be greatly less than for two separate plants. If the demonstration were done sequentially, at the same scale, costs would be lower than for two separate projects, but not by a factor of 2.

If the scale of the process was reduced and a simultaneous demonstration carried out, capital costs could be reduced. However, if the total coal feed was kept at 6000 tpsd, capital costs would be much greater than for a single-purpose plant (though not as much as for two plants). Total project costs for the project duration would probably not be greatly reduced, compared to the two plants.

1.5 Comment: Why don't we invest the funds earmarked for the SRC-I project in less expensive, environmentally less damaging energy sources? According to a recent study by the General Accounting Office (GAO), the total cost for the SRC project may exceed $3 billion. Numerous recent studies indicate that DOE could produce far more energy, reduce our consumption of foreign oil, and inflict less damage on the environment by spending this $3 billion on solar energy and other renewable energy sources and energy conservation. (Commenters: 38, p. 9; 47, p. 2; Speaker 29; Speaker 21; Speaker 19)

Response: See response to comment 1.1. The discussions in the 1977 Alternative Fuels EIS (ERDA-1547) and Sect. 1 of this EIS are directed toward the decision concerning the programmatic issue raised by the commenter.

1.6 Comment: Although the DEIS admits possible savings from energy conservation as an immediate and cost-effective way to deal with the energy problem and that solar and other renewable sources may make a contribution, the conclusion seems to be that these contributions are either insignificant or that they need to be augmented by the potential contribution of the SRC-I. This conclusion is not borne out by the facts. If we accept as given the notion that there is a limited amount of Federal money to be spent, then choices

must be made. The most cost-effective and environmentally sound alternatives must be implemented. (Commenters: 38, p. 11, 13; 44, p. 5; 46, p. 2; 17, p. 2)

Response: See response to comment 1.1. The discussions in the 1977 Alternative Fuels EIS (ERDA-1547) and Sect. 1 of this EIS are directed toward the decision concerning the programmatic issue raised by the commenter.

1.7 Comment: Higher prices and the conservation impacts of Federal programs have resulted in significantly lower projected end-use demands than those quoted in Table 1.1 of the DEIS. The attached Table I compares several recent projections, all of which conclude that the DEIS figures overstate the case for end-use demand by more than 19 quads. Recent deregulation of oil prices and proposed deregulation of natural gas prices are not considered in these tables and will probably reduce demand even further. (Commenter: 38, p. 12)

Response: Although conservation offers great potential for near-term reduction in energy consumption and associated dependence on foreign resources, it alone cannot provide a long-term solution. It should be emphasized that the driving force for development of SRC-I is displacement of petroleum-based products in the energy market, regardless of conservation impacts on overall energy consumption. Table 1.1 in the EIS lists total energy consumption in the United States. The table supplied by the commenter only covers the projected end-use consumption. The 19-quad difference between the two tables results from the additional energy required to produce electricity.

1.8 Comment: There is no discussion whatsoever of the comparative environmental impacts of the proposed plant with the possible solar and conservation options. (Commenters: 38, p. 13; 29, p. 3; 44, p. 5)

Response: See response to comment 1.1.

1.9 Comment: Section 1.2.2 is entitled "Need for additional domestic energy sources." The rewritten draft EIS should, if possible, explain how this need can be met by using up our present domestic energy sources in synthetic fuel processes.

Section 1.2.3 discussed "Energy options" other than making synthetic fuels from coal. But very few words, and even fewer figures, are used to cover these options. Some important options such as fusion, the current nuclear power's big and clean brother, are not even mentioned. (Commenter: Speaker 92)

Response: See response to comment 1.1. The alternative fuels EIS (ERDA-1547) noted in the response to comment 1.1 and in Sect. 1 of this FEIS discusses other energy supply options in greater detail. A successful, vigorously supported fusion program would be expected to lead to construction of a demonstration power reactor that would begin operation in the mid-1990s. The 1980 Annual DOE Report to Congress estimates that fusion reactors would add less than .05 quads of energy to our electrical system by the year 2020.

1.10 Comment: Section 1 of the impact statement does not include discussion of the most viable alternative to synthetic fuels, namely, government or market inducement of more efficient transportation vehicles. Yet there is no discussion in the impact statement of the option the government has, through legislation, of raising gas mileage standards. (Commenters: Speaker 92; Speaker 27; Speaker 89)

Response: See response to comment 1.1. As a conservation measure, more efficient transportation vehicles could significantly reduce near-term demand for liquid fuels. However, such measures do not provide long-term solutions to our energy supply problems.

1.11 Comment: On page 1-11, "Direct liquefaction processes typically have thermal efficiencies of 65 to 75 percent and yields of 2.5 to 3.0 barrels of product per ton of coal."

This means that out of 6,000 tons of coal that the SRC-I demonstration plant would be designed to use each day would come to only 4,000 tons worth of energy equivalent in the form of synthetic fuel. And these figures do not allow for any electricity the plant in the process would use. In other words, far from being the new source of energy it is claimed to be, the SRC-I process is really a new way of using up the energy we already have even faster. (Commenter: Speaker 92)

Response: The expected thermal efficiency, including electrical input, of a commercial plant is on the order of 70%. That is, for each 100 Btu of coal mined and fed to the SRC-I plant, 70 Btu of energy are available in the product. If used to generate electricity (without scrubbers) this would produce about 24.5 Btu of electricity in electric plants having a typical conversion efficiency of 35%.

If the same 100 Btu were burned directly in a plant with scrubbers, 35 Btu of electricity would be initially produced. But power required to operate the scrubber would consume about 2 to 2.5 Btu of this, for a net output of 32.5 Btu. Thus the coal processed by SRC produces 75% of the net electric energy of direct combustion with scrubbers.

As compensation for this loss, the SRC-I products are much more flexible to market demands than coal. The liquid products can be used in transportation and other sectors for which coal is unsuitable. Furthermore, the solid products can be used in combustion applications where coal cannot easily be used directly.

There are also other economic and reliability disadvantages of scrubbers which are eliminated by burning SRC-I solids. The SRC-I solid product is environmentally more acceptable than coal in that it reduces the problems associated with disposal of scrubber sludge.

1.12 Comment: Syncrude is the most expensive and least profitable product. In fact, it is possible that the commercial-scale SRC-I may drop syncrude altogether and just produce the more profitable coke and boiler fuel.

In short, there is nothing in the agreement preventing ICRC from receiving over $3 billion in taxpayers' money to build the demonstration plant, and then commercializing it only for boiler fuel and coke.

What's more, if after the demonstration plant is in operation for two to five years, ICRC does not feel it can make the 17 to 20 percent return on equity that it expects, it can bail out, leaving the DOE holding the bag. The FEIS should include a statement of the legal prohibitions against ICRC converting SRC-I to a solid fuel facility. (Commenters: Speaker 43; Commenter 65, p. 45)

Response: A successful demonstration phase will accomplish the major purposes of the demonstration project. Product slates during commercial operation will be determined by the private owners and presumably will be based largely on current market factors and the results of the demonstration phase.

1.13 Comment: The SRC-I facility described in the DEIS will process 6,000 tons per stream day (tpsd) of high-sulfur coal during its demonstration phase. This represents a scale-up of 120 times from the largest SRC facility — the Fort Lewis, Washington pilot plant. The DEIS offers no discussion of the technical, environmental, or financial risks associated with expanding a small-scale pilot plant to a facility of this size, nor does it consider the alternative of constructing a smaller demonstration plant. Hence, it seems obvious that a smaller demonstration unit would inflict less damage on the environment without compromising DOE's programmatic goals. (Commenters: 38, p. 16, 18; 60, p. 14; 29, p. 1; Speaker 21; Speaker 29; 21, p. 1; 17, p. 4, 5)

Response: It is a purpose of the SRC-I Program to demonstrate technical and economic feasibility at commercial scale so private investors would have the confidence and data required to risk private capital and move into early commercialization. While the Government could have scaled from 50 tpsd to a capacity much lower than 6000 tpsd so that only a modest risk would be incurred, very little would be accomplished toward providing a basis for early initiation of a synfuels industry. Components in the liquefaction section of the demonstration plant are at the maximum size that can be manufactured. Consequently, no further scaling is required in making the step from this demonstration to a commercial plant as the components are repeated as many times as needed to reach desired commercial capacity. There are also economic and business reasons for operating a 6000 tpsd plant, as discussed below. If a 2000 or 3000 tpsd plant were operated instead of 6000 tpsd plant, private investors would still be faced with the uncertainty of scaling back up to 6000 tpsd.

A smaller plant will reduce capital cost, but because of the economies of scaling, the reduction in capital cost is not as great as the reduction in capacity. For example, reducing capacity by 67% from 6000 to 2000 tpsd only reduces capital cost by 42%. The net result is that operating costs increase, relative to product quantities, and net revenues fall.

The contract with ICRC is a business arrangement that envisions product sales and profitable operation that will result in ICRC buying the plant from the Government at full economic value. The economic value of a downsized plant may be reduced to the extent that buyout is in jeopardy and the Government will not recover part of its investment.

1.14 Comment: Plant designs are conceptual and control technologies are untested. Fail-safe mechanisms and mitigation measures have not been developed to protect the work force, the public, and the environment from the health risks associated with SRC-I.

More time should be spent compiling data at the 50 tpsd facility at Fort Lewis, Washington, and possibly expanding its operating capacity to at least 2,000 tpsd.

The proposed SRC-I plant should not be built in Newman, Kentucky, or anywhere else until more is known about the SRC-I process. (Commenters: 21, p. 16; 45, p. 1; Speaker 70; Speaker 21)

Response: Section 4.1 of the FEIS discusses occupational and public health effects and protection measures.

The Fort Lewis, Washington, site is not suitable for the construction and operation of a large-scale demonstration facility. It does not have adequate coal, water, and other requirements needed for such a plant. The coal liquefaction pilot plants have been operating for several years, and the technology development has progressed to the point where the technology is ready for demonstration at commercial scale.

1.15 Comment: If, as seems likely, DOE decides to go ahead with this project, it should keep in mind its statement on pages 2-18 and 2-19 which begins, "Through chemical reactions involving coal, the SRC process will produce a broad range of material that contains carcinogenic and mutagenic organic compounds...." This statement is a blanket commitment by DOE to do everything possible to minimize the risks associated with these plants and to conduct ongoing research projects to insure that impacts are kept to an absolute minimum. (Commenter: 46, p. 6)

Response: Commitments regarding health risks are discussed in Sects. 4.1, 4.5.3, and 4.6.9.

1.16 Comment: Not only would I like to see further study done on this plant, but I feel there needs to be a joint study done on the health and environmental effects of all four plants being planned for this area. These studies should not be made individually but together to find the combined effects. (Commenter: 2, p. 1)

Response: Cumulative effects are discussed in Sect. 4.2.5. No significant health effects are expected as a result of the additive emissions of proposed synfuel projects in the area.

1.17 Comment: This plant is apparently designed, from everything I've heard, to make a market for western Kentucky coal. If the $3.1 billion were put into power plant scrubbers which also take a great amount of construction workers to build, that remove sulfur dioxide, we would equip 31 power plants that would consume the same amount of coal per day as the Newman SRC plant. (Commenter: Speaker 89)

Response: The demonstration plant would be constructed to demonstrate SRC-I technology, not to provide a market for western Kentucky coal.

1.18 Comment: Even if all the plants are built, will they add very much towards meeting the energy demands of the country? (Commenter: 62, p. 1)

Response: See Sect. 1.2 of the FEIS.

1.19 Comment: The FEIS should include a statement explaining to what extent SRC-I construction is intendedto demonstrate the economics rather than technology of synthetic fuels. (Commenter: 65, p. 45)

Response: The purpose of the SRC-I project is to demonstrate technical and economic viability as well as environmental acceptability. All are important in achieving a successful demonstration.

1.20 Comment: The FEIS should include a statement of the proportions, in oil equivalent barrels per day, of each type of SRC-I product, and the estimated prices and marketability of each. (Commenters: 65, p. 45; 62, p. 1, Speaker 93)

Response: Economic evaluations of pricing of SRC-I products carried out in late 1980 indicate that the net product slate is economically competitive, for a full-scale commercial plant. The plant design used for analysis produces approximately 50% liquid products and 50% solid products. It was assumed that the plant will start up in 1990.

In this study liquid prices were assumed to be equivalent to the analogous petroleum products, as predicted by the Energy Information Administration's "Annual Report to Congress – 1979." These prices were then used to calculate a required selling price for the solids produced.

This selling price (adjusted to 1980 dollars) would be $2.82 per million Btu or $3.25 per million Btu including transportation within 500 miles. This price is competitive in the large market for conversion of presently oil-fired boilers to coal firing. Analysis indicates that if all cost factors of the conversion are accounted for, SRC-I would be competitive with coal firing plus scrubbers when a representative oil-fired boiler is converted to coal-based fuels. This would be true even if SRC-I solid products were priced as high as $3.80 to $4.30 per million Btu (depending on firing mode) rather than the predicted $3.25 per million Btu.

If petroleum-based fuels escalate faster than predicted by EIA, the allowable solid fuel price is even lower. Thus SRC-I products will be competitive in the overall energy market.

Should solid products be priced at close to their break-even price for conversion of oil-fired boilers (i.e., the price at which net costs to the power company balance coal firing with scrubbers), liquid products from the SRC-I plant could be priced below competing petroleum-based liquids. Where the savings would occur (i.e., in solids pricing or liquids pricing) will depend on the energy marketplace. See Sect. 2.2.1.1 on product slate.

1.21 Comment: Although the DOE has been designated as lead agency, with USEPA assuming the cooperating agency position, co-authorship of the DEIS was agreed upon and presumed.

Question: Why was this understanding not formalized, to give USEPA a stronger position in addressing its concerns and assuring the full consideration of their concerns? Without a formal assurance of co-authorship, can equal jurisdiction be assured? (Commenter: 18, p. 8)

Response: As cooperating agency, the USEPA reviewed and commented on the preliminary Draft EIS for SRC-I. Those comments were considered in preparing the Draft EIS. In addition, a number of interagency meetings and agreements occurred during the EIS process.

2. GENERAL COMMENTS ON THE DEIS

2.1 Comment: For the NEPA process to have any benefit an adequate site selection analysis must be available before the site is selected, an assessment of competing technologies must be available before a technology is selected, an analysis of the impacts of plants of various sizes must be available before a commitment is made to a plant of any set size, and detailed analysis of all the impacts and programmatic issues must be available before a commitment is made to funding the plant. As we have seen none of these analyses have been adequately completed on the SRC-I plant. (Commenter: 38, p. 69; Speaker 29; 65, p. 17)

Response: See responses to Comments 1.1 and 1.13. Site selection is discussed in Appendix B of the FEIS.

2.2 Comment: Under the present circumstances, the obligation of DOE is clear, it must complete an actual plant design as well as environmental studies and either prepare an entirely new EIS or circulate a supplemental EIS. (Commenter: 38, p. 70, Speaker 70; Speaker 21).

Response: To comply with the requirements of NEPA, DOE is issuing this final environmental impact statement (FEIS) based on the best available information prior to any decision to proceed with major detailed design efforts and to commence construction of the SRC facility. Utilizing a tiering approach, DOE will perform supplementary NEPA reviews as necessary to address significant environmental impacts not within the scope of the FEIS. For example, further NEPA review would be required if environmentally significant new information relevant to the selection of environmental control equipment arises as a result of further design efforts. This approach is identical to the one being followed for the proposed SRC-II project near Morgantown, West Virginia, which was coordinated with the Environmental Protection Agency (EPA). Other environmental reviews will be carried out by other Federal agencies during their permitting process.

2.3 Comment: A reader of the DEIS can only conclude that no one knows what the impacts of a synfuels plant will be and that people living near the plant will be used as human guinea pigs. The apparent concealment and the lack of facts are equally frightening. (Commenters: 17, p. 1-9; 21, p. 16; 38, p. 40; 46, p. 2; 65, p. 2)

Response: The EIS analyzes the various environmental impacts including health effects associated with the construction and operation of a 6000 tpsd demonstration plant based upon best available information (see Sect. 4). Impacts of the plant will be minimized to the extent possible through mitigation and monitoring programs detailed in Sects. 4.5 and 4.6 of the FEIS.

2.4 Comment: Have you considered the damage this will do to our city and county? Our air will be polluted, our schools, roads, transportation facilities, everything all over extended. (Commenter: 43, p. 1)

Response: Air quality impacts are discussed in Sect. 4.2.3.1 and socioeconomic impacts in Sect. 4.2.4 of the FEIS. See also response to comment 2.3.

2.5 Comment: When the DEIS is rewritten and sent out to the public again, it should have less jargon and more information, in usable forms, on the proposed SRC-I plant and process, and on other fuels and processes. The entire Volume I should be completely rewritten for easier use by a public which is interested in the ICRC proposal, but not familiar with the technical jargon with which the current document is stuffed. (Commenter: Speaker 92)

Response: Within the constraints of maintaining technical accuracy and credibility, the FEIS has been written in plain language. When possible, the more technical discussions have been placed in Appendixes.

2.6 Comment: Are the products produced by this plant going to benefit directly America, Kentucky, Daviess County, Owensboro? (Commenter: 47, p. 3)

Response: All four will benefit directly to varying degrees. See Sect. 1 of the FEIS. Local economic benefits are discussed in Sect. 4.2.4 of the FEIS.

2.7 Comment: Setting March 2 as the cut off period for comments is certainly not allowing enough time for residents to absorb the lengthy document. (Commenter: 14, p. 1)

Response: The 45-d comment period is consistent with the minimum time period for public comment specified by CEQ regulations.

2.8 Comment: The report doesn't state the environmentalists' views strongly enough. The report straddles the fence. It gives equal play to the pros and to the cons. Since our elected officials won't represent the position of those opposed to the plant, the report should take up the burden. Since the report doesn't emphasize enough the faults of these proposed plants, it is faulty. (Commenter: Speaker 103)

Response: The purpose of the EIS is to provide a full and fair discussion of significant environmental impacts and to inform decision makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment.

2.9 Comment: There is no guarantee that anything the company commits to in the draft environmental impact statement will be carried out. In several instances, the United States Supreme Court has said that the EIS is not a legally binding document. Under the terms of the contract between ICRC and DOE, there is no legal incentive for ICRC to operate this plant under any of the many environmental laws that currently exist. (Commenters: Speaker 89; Speaker 50)

Response: The industrial partner will have to comply with all applicable Federal, state, and local environmental laws. In addition, the industrial partner intends to carry out the monitoring and mitigation except where specifically described as a DOE responsibility alone. (See Sects. 4.5 and 4.6 of the FEIS.)

2.10 Comment: I would like to see a cost-benefit ratio conducted here, including fuel consumption by truck, rail, and barge, socioeconomic impacts on surrounding communities, displacement of landowners cost, possible cleanup costs and rail and road maintenance, and loss to crop yield. (Commenter: 8, p. 1)

Response: A cost-benefit analysis has not been conducted and is not required.

2.11 Comment: Will the land stripped of coal for the Newman SRC-I Plant be restored to a beneficial use similar to the original use? The cost effectiveness of synfuel production cannot be properly evaluated without including the costs of land restoration and assessing the quality of the restoration. (Commenter: 44, p. 2)

Response: Land strip-mined for coal must be reclaimed pursuant to the requirements of the Surface Mining Control and Reclamation Act of 1977. See the third paragraph of the Foreword. Regional coal mining effects are addressed in Sect. 1.4.3.5 of the FEIS.

2.12 Comment: The discussion of cumulative effects (pages 2-30 through 2-32) omits the proposed A. B. Brown Generating Station addition which has a construction schedule parallel to the schedule for the proposed SRC-I project. (Commenter: 55, p. 2)

Response: The text in Sect. 2.3.1.3 has been corrected to include the A. B. Brown Generating Station. However, the summary of the impacts in Sect. 2.3.1.3 of the EIS included the impacts from this plant. In addition, the A. B. Brown Generating Station was considered in Sect. 4.2.5.1 in the EIS.

2.13 Comment: The cumulative impact of SRC-I and the Wilson plant should be adequately considered. (Commenter: 46, p. 4)

Response: The Wilson plant is considered in the cumulative effects discussion in Sect. 4.2.5.1 of the FEIS.

2.14 Comment: Has application been made for the required permits? Will DOE and EPA require a firm commitment to the permit schedule before any construction is allowed? (Commenter: 18, p. 8).

Response: Table W.1 of the FEIS has been revised to show the current status of permits. Before any construction can commence, all necessary permits will be obtained.

2.15 Comment: It is incumbent upon DOE to present a full and candid appraisal of the experience at the SRC pilot plants. (1) How have those plants functioned? (2) What if any spills, fires, accidents or releases of hazardous substances have occurred? (3) What environmental monitoring has taken place at those plants and what did that monitoring demonstrate? (4) What design changes need to be made in the demonstration plant in the light of experience at the pilot facilities. (Commenters: 39, pp. 27-30; 57, p. 1)

Response: The overall experience gained from the operation of the pilot plants has been factored into the design of this project. Transportation spills are discussed in Sect. 4.1.3.7 and Appendix DD of the FEIS. A summary of the Fort Lewis experience regarding spills is provided in a recent report ["Remedial Measures Plan for a Spill of SRC Liquid at the SRC Pilot Plant, Fort Lewis, Washington (Austin, Texas, The Radian Corporation, 1980)]. Appendix Z, Sect. Z.1, presents a summary of the health and safety programs at the Fort Lewis and Wilsonville SRC pilot plants. See also response to Comment 5.6.

3. PLANT DESIGN AND ENGINEERING

Water

3.1 Comment: Although the SRC-I plant is proposed to operate at a zero discharge mode 90% of the time, the probability of this cannot be predicted since the reliability of the recycling system is uncertain. (Commenters: 21, p. 5; 18, p. 9; 17, p. 6; Speaker 19)

Response: The commenter is correct in stating that the probability of zero discharge cannot be predicted with a great degree of certainty because the reliability of the recycling system is uncertain. There are only a limited number of facilities that are practicing zero discharge in the United States. Most of them employ solar ponds and only a few use evaporators. The proposed evaporator design for the SRC-I facility is similar to the Four Corners Power Generation Plant near Farmington, New Mexico, which has successful operating evaporators. The experience at the SRC-I demonstration plant should provide valuable information for coal conversion plant designs in the future. Despite the current uncertainty the SRC-I facility most likely will not cause a significant impact on the river water quality (see Sect. 4.2.2.3).

3.2 Comment: From an environmental viewpoint, the most attractive operation option would be total recycle, with zero discharge.

The plant is being designed to operate in a zero discharge mode — what problems would be encountered in moving plans from zero discharge 90% of the time to zero discharge 100% of the time? (Commenters: 21, p. 6; Speaker 79)

Response: The major problem in changing plant design to achieve zero discharge 100% of the time is primarily cost effectiveness. To design the zero discharge system for 100% on-stream time will require a significant increase in capital and operating costs and will only provide a slight increase in water quality.

Recycling treated wastewater at all times during process operation will require 100% spare capacity for the equipment; this would roughly double equipment costs (i.e., about a $10 million increase). The increase will provide only marginally better protection for river water quality because any treated effluent discharged to the river must still meet stringent limits developed jointly by EPA and KDNREP. The purpose of effluent limits is to protect the water quality of the river.

All environmental impacts, such as those from solid waste disposal and high energy requirements, and not just the impact to surface water quality, must be evaluated when considering total recycle.

3.3 Comment: The final EIS should characterize the effluent discharge from the retention basin in the event of a 10-year, 24-h storm. (Commenter: 56, p. 23)

Response: In the event of a 10-year, 24-h storm, the effluent discharge system from the retention basins will have variable composition. Although characteristics of the discharge have not been fully determined, the discharge will use technology most likely to meet effluent limits defined in the NPDES permit issued by the EPA. More definitive characterization will be made during detailed design. ICRC will simulate runoff composition using a computer model, such as the EPA Short Storm Water Management Model (SSWMM), will provide the analysis to the EPA and KDNREP for use in establishing realistic effluent limitations, and will use the data to design appropriate onsite storage capacities, if necessary.

3.4 Comment: Page C-55, Sect. C.4.2. The effluent concentration/treatment plant performance estimates should be bolstered (in an appropriate FEIS Appendix) with as much SRC wastewater treatability data as available. If the data are not available for incorporation into the FEIS, the on-going waste treatability program should be discussed. (Commenters: 56, p. 22; 8, p. 1 and 18, p. 7)

Response: The laboratory program to characterize expected contaminants in demonstration plant streams will include identification of organic and inorganic constituents. In addition, the program will determine how effectively the proposed wastewater treatment system can control trace toxic metals and complex trace organic materials that may be toxic and/or carcinogenic. Pilot plant wastewaters have been obtained from GKT gasifier mineral ash residue, expanded-bed hydrocracking of SRC-I, SRC-I production, coal and SRC pile runoff, and oily wastewater from SRC-I operation.

The wastewater treatability study will evaluate various proposed pretreatment methods, including separation of emulsified and floatable oils and metal precipitation, to recommend the most suitable pretreatment method and determine waste removal efficiency. The treatability study will also evaluate the use of a biological system to degrade contaminants in various wastewater streams. This study will consist of a series of flow reactors operated as completely mixed activated sludge systems. These flow reactors will assess the effects of sludge age, temperature, and powdered activated carbon on the biological system so that preferred method of biotreatment can be recommended. Finally, the treatability study will evaluate tertiary treatment processes including filtration, granular activated carbon adsorption, and ozonation.

The majority of the wastewater characterization study is expected to be finalized in Late 1981. Preliminary data from the treatability studies should be available in late 1981 or early 1982.

3.5 Comment: Discharges of cadmium, chlorine, chromium, phenol, and selenium would substantially degrade water quality and would require occasional shutdown of the plant during low river flow periods to maintain water quality standards. The question here arises: What does DOE consider as occasional plant shutdown? Would shutdown occur for one hour, one day, for what time period? Who will direct the shutdown? Under what criteria? Would it be safer toward the environment to shut down the plant whenever zero discharge could not be reached? (Commenter: 21, p. 6; 51, p. 2)

Response: Whether or not there will be a need for any plant shutdown in order to protect water quality and/or the indigenous aquatic population will be determined as part of the NPDES permitting process. The frequency, criteria, and responsibility for any operational actions to protect water quality and aquatic life will also be addressed in the NPDES permit.

3.6 Comment: The phrase in the DEIS about river flows sometimes providing insufficient dilution, lends one to believe that at all flow levels the plant plans only to dilute possible contaminants as their major environmental control method. Is the plant to shut down only when the river won't provide enough water for their proper dilution levels? (Commenter: 21, p. 8)

Response: Dilution is not the major environmental control method. The wastewater treatment and reuse system will remove most of the contaminants in the wastewater. Only trace quantities that cannot be practically and economically removed will be discharged. The discharge will cause insignificant impact on environment except in a rare event when it coincides with 7-d, 10-year low flow ($_7Q_{10}$). The analysis of water quality impacts in Sect. 4.2.2.3 uses a worst-case scenario including the occurrence of the $_7Q_{10}$. The plant may be required to shut down when the discharge cannot comply with the effluent limits set by EPA and KDNREP.

3.7 Comment: Metal removal is proposed to be accomplished by using a two-stage precipitation unit (first stage at pH 11.0 and second stage of pH 8.5) with effluent fed to a biological unit via an equalization pond at a pH of 8.5. Since the best efficiency of the biological unit can be obtained at a pH range of 6.5 to 7.5, pH adjustment must occur before any effluent enters the biological system. (Commenter: 12, p. 5; 65, pp. 18-19; Speaker 40; Speaker 61)

Response: A pH-adjustment system has been provided prior to the biological treatment system (see revised Sect. C.2.1.2 of the FEIS).

3.8 Comment: In the two-stage biological treatment process, bacteria are to be used to degrade phenols, organics, and some inorganics. Is this a proven process and can bacteria live at the concentrations of organics and inorganics that will be present in this system? (Commenter: 18, p. 5)

Response: Effective biological treatment of phenolic compounds has been proven by using biological systems to treat wastewater generated by the coking industries and at the Wilsonville pilot plant. To ensure that very high concentrations of organics do not enter the biosystem, organic concentrations will be controlled to a treatable level by: (1) equalization basins to control loading fluctuations, (2) recycling of effluents to the wastewater influent to dilute possible high organic concentrations, and (3) use of completely mixed biological reactors to dilute the wastewater throughout the basin. In addition to relying upon biological degradation of phenolic compounds, the wastewater treatment system will have the capability to add powdered activated carbon directly to the biological aeration basins.

3.9 Comment: While biological treatment should be able to remove most of the carcinogenic phenols, organics, and polynuclear aromatics (PNA), parallel biological treatment units should be provided to avoid the impact of severe shocks. (Commenter: 12, p. 4)

Response: Parallel units provide little or no protection from severe shocks, because both trains would be shocked simultaneously. Protection from shocks is best provided by the surge basins to collect pile runoff and spills, the equalization basin, wastewater monitoring, powdered activated carbon addition during both stages of biological treatment, and recycling treated effluent to dilute biosystem feed.

3.10 Comment: Because even a slight upset in the production process will produce very high levels of phenol in the effluent, every attempt should be made to reduce phenol concentrations by adding powdered activated carbon in the equalization pond. High phenol concentrations resulting from process upset were not addressed in the DEIS. (Commenter: 12, p. 5)

Response: High levels of phenol in the influent and/or effluent of the biological treatment system will be detected by the monitoring program. High phenol concentrations are controlled and lowered by reduced pumping rate from the equalization pond, treated effluent recycle for dilution, increased powdered activated carbon (PAC) addition to the biological system, and increased sludge recycle. Because phenol is amenable to both biological and PAC treatment, no provisions are planned for extra PAC addition to the equalization basin.

3.11 Comment: If you assume that biologicals in the wastewater treatment system are destroyed by an upset (pp. C-25 and 26), how long would it take to reestablish the biologicals; how and from what source would biologicals be replenished; what would be the effect on plant operation, particularly wastewater discharge? (Commenter: 46, p. 6)

Response: Total destruction of the biomass in the wastewater treatment system will result in plant shutdown. Consequently, every precaution has been taken in the wastewater treatment system design to make the probability of biomass destruction extremely low. Also, close monitoring of critical vital signs of the biological system will be performed frequently, if not continuously, so that corrective measures are taken before problems fully develop. However, if total biomass destruction did occur, the holding capacity of the surge ponds, equalization basin, and possibly the ash ponds would be used to reduce or eliminate flow on a short-term basis. Adding powdered activated carbon and using the granular activated carbon filter will control organics. Suspended solids that do not settle will be filtered. An immediate troubleshooting program will be initiated to establish the cause and determine actions required to return on-line with new seed sludge. Restarting the biosystem would proceed as described in Appendix C, Sect. C.2.1.4 of the FEIS.

3.12 Comment: The DEIS indicated that during a failure of any system in the wastewater treatment unit, the untreated or partially treated wastewater will be discharged directly to the Green River. This is totally unacceptable. Adequate and secure onsite storage should be provided to contain the wastewater until full treatment can resume. This alternative should be specified in the FEIS. (Commenter: 12, p. 5)

Response: No capability exists in the wastewater treatment plant design to bypass untreated or partially treated wastewater and discharge it to the Green River except relatively clean runoff in excess of the 10-year, 24-h storm. If a given system were to fail, the plant would operate with spare or parallel equipment, holdup capacity in surge and equalization ponds. Ultimately, reduced production rate or planned shutdown may be required until full treatment can be resumed. In addition, idle ash ponds could be used for emergency wastewater storage. Nevertheless, plant discharge must comply with the NPDES permit limits developed jointly by EPA and KDNREP.

3.13 Comment: Disinfection should be by ozonation, rather than chlorination, with the effluent passed through a final pH adjustment to obtain neutral pH conditions. (Commenter: 12, p. 5)

Response: Sanitary wastes will not be collected and treated separately; instead, combined process and sanitary wastes will be treated and ultimately disinfected by ozonation. This conclusion is based on a required disinfection dose of 25 mg/liter or less. If studies indicate a higher required dose, additional consideration will be given to separate collection and treatment of the sanitary wastewater. If sanitary wastewater is segregated, chlorination will not produce significant quantities of chlorinated hydrocarbons, because chlorination will be practiced for this small stream only. No chlorination will be employed for the treated process wastewater prior to discharge because no fecal coliforms are expected in this stream.

Final adjustment of pH prior to discharge is not provided, because neutral pH conditions are required in the biological systems. No pH changes are expected between the second-stage bioreactor and the final effluent. However, if the ongoing treatability study shows that final pH adjustment is necessary, an adjustment will be provided.

3.14 Comment: The presence of nitrogenous compounds is not addressed in the DEIS. Incorporation of a dependable method of nitrate and nitrogenous compound removal (e.g., biological degradation) should be required in the FEIS. (Commenter: 12, p. 5)

Response: Potentially applicable Kentucky water quality criteria for the Green River calls for 10 mg/liter nitrate and 0.05 mg/liter un-ionized ammonia. Based upon current stream levels and quantities to be discharged for these constituents, the resulting water quality will be well within the noted standards.

3.15 Comment: Page C-48, last paragraph. The DEIS indicates that phenol recovery is under consideration as an alternative for inclusion in the wastewater treatment plant. The FEIS should include the results of this assessment of phenol recovery or should indicate the schedule by which the decision will be made on whether or not to include phenol recovery. (Commenter: 56, p. 21)

Response: A preliminary cost estimate was performed on the removal and recovery of phenolic compounds from the highly contaminated sour water streams expected at the demonstration plant. Capital costs for phenol recovery ranged from $4 million to $13 million. Subsequent capital savings in the wastewater treatment system from a reduced phenolic load was only 3 to 7% of the total capital costs for phenol removal. Based on these economic considerations, a phenol recovery system is not being considered for use in the demonstration plant.

3.16 Comment: Page C-20, Sect. C.2.1.2. The DEIS does not clearly confirm that spent scrubber liquor from the coker-calciner soda ash scrubber will be among the streams fed to the wastewater treatment plant. This should be discussed in the FEIS. (Commenter: 56, p. 21)

Response: The spent scrubbing liquor will be directed to the wastewater treatment system. When the evaporator of the zero-wastewater discharge system is operating, it would be routed to the evaporator. The salts will either appear as part of the evaporator salt cake, or will eventually be discharged as effluent to the Green River. If it is discharged, the sulfite will be oxidized, and the particulate will be removed by clarifiers and filtration in the wastewater treatment system.

3.17 Comment: Information regarding the impact of the demonstration plant on the Green River seems only at this point to be monitored so that performance and reliability of wastewater treatment and recycling systems will be established. Is this to be done at the expense of the quality of the Green River. The information and experience gathered is to provide a basis for the design of the commercial-scale wastewater treatment system. Is it being admitted that a monitoring system disregarding the health of the Green River is to be put into effect so that at some future date, when the plant is scaled up to commercial size, the proper environmental controls will be implemented? Only then, if necessary, will back-up wastewater recycling systems be included in the design to ensure that no discharge occurs when river flows would provide insufficient dilution. Why not implement these plans into the present SRC-I schematic? (Commenter: 21, p. 8)

Response: Monitoring will be used to determine the effectiveness of the plant's pollution control system. An integral part of the program will be to provide plant operators with performance data so that adjustments can be made to achieve effective wastewater pollution control. Contingency plans will be available when monitoring reveals unacceptable pollutant removal in wastewater treatment. These plans include use of activated carbon, storing the effluent, recycling the effluent to the front of the wastewater treatment facility, reduced plant production rate, and plant shutdown.

Effluent monitoring will be required by law. Although EPA and the Commonwealth of Kentucky have not established effluent limitations for the SRC-I Demonstration Plant, these agencies have outlined a plan to jointly develop effluent limitations. Because these limitations will be based partly on effluent contaminant concentrations achievable in wastewater treatability studies, the wastewater treatment system will be designed to meet standards that develop concurrently with design.

During wastewater discharge periods, the effluent will be monitored to determine compliance with the national pollutant discharge elimination system (NPDES) requirements. Subsequent dilution and natural attenuation of discharged materials will lower concentrations of these materials so that impact on water quality will be low (see Sects. 4.2.2.3 and 4.2.2.4). In addition, specific effluent limits for point sources from the SRC-I plant will be determined to help ensure protection of aquatic life indigenous to the Green River and other KDNREP designated stream uses.

3.18 Comment: The use of chromate or phosphate as a corrosion inhibitor in the cooling system should be avoided unless the adverse effect of these constituents on biological treatment units can be negated. Also, high dissolved solids concentrations in the cooling water should be avoided by ion exchange or osmosis. (Commenter: 12, p. 4)

Response: Using chromate or phosphate as corrosion inhibitors in the cooling water system cannot be avoided. It has been a universal practice in industry for decades with no alternates presently available. If chromates are used, cooling tower blowdown will first pass through a chromate removal step before reaching the biological treatment system. Phosphates, if employed, will not adversely affect performance of the activated sludge system. Process options for avoiding high dissolved solids concentrations in the cooling tower, including reverse osmosis and ion exchange, will be evaluated.

3.19 Comment: Our concerns include the designation of the wastewater treatment plant as a zero-discharge system when in fact volatile compounds may be evaporated into the air as well as discharged in the Green River. (Commenter: 18, p. 1)

Response: Zero discharge, in the context of the wastewater treatment design discussion, refers specifically to wastewater. A zero-discharge system is being designed and will be capable of recycling water for zero-wastewater-discharge operation. Volatile compound (VOC) emissions from the wastewater treatment system will be insignificant.

3.20 Comment: If the oil/water separator is enclosed to prevent fugitive NMHC emissions, how will the buildup of explosive levels of NMHC be prevented (p. C-42)? (Commenter: 12, p. 8)

Response: Covered oil/water separation unit design will include adequate purging and venting of any collected hydrocarbon emissions to avoid the safety hazard, as necessary.

3.21 Comment: The FEIS must contain a much more detailed discussion of diffuser design (Fig. C.6) and its capability of achieving essentially complete mixing. (Commenter: 12, p. 5).

Response: The diffuser is designed to extend about halfway across the Green River and will be constructed with a large pipe with perforated 2-in. orifices, 1 in. apart. Jet velocity of the treated wastewater will be about 5 ft/s directed downstream. However, design capacity for the diffuser has not been finalized. Section C.1.2.6 of Appendix C has been revised to include additional discussion and diagrams of the proposed system.

3.22 Comment: Section 4.6.6 (p. 4-140). The FEIS must contain more information on the design and efficiency of the water withdrawal intake screens. The screens should be designed to reduce or prevent potential impingement of larval fishes. (Commenter: 12, p. 7)

Response: Reduction or prevention of impingement of larval species in the Green River is a primary design consideration for the demonstration plant. Two water intake designs are being considered, conventional and submerged water intake structures.

If the conventional intake structure is used, it will be equipped with one or more sets of vertical traveling screens designed with an approach velocity of 0.15 m/s (0.49 ft/s) at mean low-water conditions (which is when velocity would be highest). The design will be in keeping with good practice, so that flow will be distributed as evenly as possible through the screens, with minimal eddies, dead spots, and hot spots. Free passage for fish will be maintained insofar as possible.

If the submerged water intake structure is used, it will be constructed by sinking a concrete caisson about 60 ft into the river bank. A 42-in.-diam pipe will be jacked from inside the caisson toward the river. The pipe will be at least 12 ft below normal pool level to preclude interference with river traffic. Also, the pipe will be laid to obtain sufficient clearance above the river's bed to prevent silt from being sucked into the wedgewire screens installed on the end. The river bed is disturbed only during installation of the pipe and driving of the pipe support piling.

The impact in the EIS is based on the conventional structure, which represents the worst-case analysis. Even so, only minor impacts to the Green River's ecology are expected.

Data supporting minimal impact of entrainment of aquatic microflora and fauna are documented in the ER, Appendix G, pp. 168-172. Information on entrainment of phytoplankton, zooplankton, merobenthos, icthyoplankton, and juvenile and adult fish is provided.

Entrainment cannot be correctly determined before the plant is in operation. However, studies of ichthyoplankton and eggs are being made at 2-week intervals, or more frequently during the height of the spawning season, between March and October 1981, and will be continued until the demonstration plant is in full operation. Also, intake structures and velocities are being studied to mitigate the number of organisms entrained. An intake velocity of 0.5 ft/s or less will be used.

The preliminary studies of phytoplankton and zooplankton will be designed for use in predicting the number of organisms present in various sections of the river and in various areas of the same station. Thus, it will be possible to estimate how many organisms are expected under analogous ecological conditions at similar times and seasons. The relative importance of the species will also be determined.

From these studies, it is possible to estimate the number of organisms that might be entrained. However, it is very difficult to make accurate predictions. The effect of entrainment can be best determined after water is taken into the plant, before it starts to operate. The project sponsors will be responsible for changing design, particularly intake speeds, if necessary.

3.23 Comment: If a perforated pipe/wedgewire screen intake structure is under consideration, a brief discussion of this type of system should be presented in the alternative narrative and could also be incorporated into the discussion of mitigative measures. Our concern is that a conventional intake structure, as proposed in the DEIS, can cause greater entrainment and impingement impacts when compared to a submerged intake structure. (Commenter: 55, p. 2)

Response: Both a conventional and a submerged water intake structure are under consideration. See response to comment 3.22.

3.24 Comment: What is the approach velocity for water intake, since this affects the impact on fish and plankton? (Commenter: 46, p. 6)

Response: See response to comment 3.22. The intake will be designed with an approach velocity of 0.15 m/s (0.49 ft/s).

3.25 Comment: Page 2-16, fifth paragraph. This section implies that a discrete system will be utilized to manage the raw-water treatment sludge. However, the DEIS does not discuss the system. (Commenter: 56, p. 3)

Response: Raw-water treatment sludge is classified as nonhazardous waste. As such, it will be stored, after dewatering, onsite in a nonhazardous waste landfill along with other nonhazardous wastes produced during normal plant operation. The location of the nonhazardous waste landfill will be specified during detailed design.

Hydrocarbon Emissions

3.26 Comment: Since approximately 90% of the hydrocarbon emissions will be due to fugitive sources, it is difficult to accept the 60 tons per year as being a firm figure. Also that figure assumes very efficient operation of the flare-combustor system, which is untested on the proposed scale and is, therefore, unproven. What data exist to confirm such expectations? (Commenters: 60, p. 10; 17, p. 7)

Response: The 62 tons-per-year estimate in the EIS is based on extensive testing by the Radian Corporation for the EPA of process line fittings in petroleum refineries (EPA 600 12-80075C). The following valves, pumps, and flanges were screened:

Device tested	No. tested
Valves, gas/vapor streams	564
Valves, light-liquid streams	913
Valves, heavy-liquid streams	485
Flanges	2094
Pump seals, light-liquid streams	470
Pump seals, heavy-liquid streams	292

The EPA used Radian's data to develop emission rates and monitoring control efficiencies, and to develop the proposed Synthetic Organic Chemical Manufacturing Industry (SOCMI) regulations for fugitive organic emissions.

On the basis of permits issued by EPA over the past few years to modern petroleum refineries employing best available control technology (BACT) or lowest achievable emission rate (LAER) hydrocarbon controls, an emission rate of about 5 to 10 t of hydrocarbons per year per 1000 bbl/d of production is expected.

Coal refining does differ from petroleum refining. Process-line fittings are being designed to handle the abrasive coal slurry. Critical pumps will be spared, and double tandem seals will be equipped on centrifugal pumps that might be exposed to unusual abrasion. Also, the results of regular instrument monitoring will be studied to determine if schedules in the SOCMI standards are adequate. Thus, the petroleum-equivalent rate of 3-t/year hydrocarbons per 1000 bbl/d for the demonstration plant (60 tons per year) will be a reasonable estimate, considering the inherent differences between petroleum refinery and SRC feedstocks, processes, and operations. The rate also agrees well with the estimate for the SRC-II facility.

The design controls and monitoring and maintenance schedules outlined in the EIS are based on the New Source Performance Standards for SOCMI and the Draft Generic Standards (for carcinogenic substances). Both of these regulations are proposed, and neither is finalized. Consequently, no formal regulatory requirements exist for the control of fugitive organic emissions, and the program outlined in the EIS is more stringent than controls typically practiced in industry. The estimated uncontrolled fugitive VOC rate for the demonstration plant would be about 1805 t/year, which is roughly comparable to rates listed for small petroleum refineries presently operating without control restrictions.

3.27 Comment: A design description should be included for the controlled combustor (including the amount of combustion air, residence time, temperature, and turbulence) and for the flare (including height, amount of combustion air, completeness of combustion, flame characteristics, and opacity). What are the expected emissions of particulate, NMHC, PNA, CO, NO_x, H_2S, SO_2, and other sulfur compounds? Provide estimates of the frequency and duration of flaring. Document that flares (in combination with the other emissions) will not violate the ambient standards, PSD increments, the odor standards, or opacity standards (see 401 KAR 63:015, "Flares"). What flared substances will fall out on the ground (such as pulverized coal and NMHC liquids), and what will be the temperature on impact? How far away will the flare cause noticeable night-time illumination? (Commenter: 12, p. 11)

Response: Although preliminary design concepts can be selected and evaluated based on current emission characterization, detailed system design cannot be completed at this time. To establish pretreatment operating conditions, capacities, and turndown ratios of individual elements of the combustor system and to select combined flow rates and crossover flow rates at which different kinds of combustion equipment are employed require detailed information not presently available. This required information includes:

- complete heat and material balances for all process equipment,
- detailed summary of relief valve locations and relief conditions,
- reliability estimates to establish probability of failures or normal relief of individual equipment,
- detailed estimates of magnitude and duration of hydrocarbon releases resulting from specific emergency conditions, and
- probability estimates for frequency and duration of routine (nonemergency) upsets leading to relief valve emissions.

This information depends on completion of detailed engineering currently being carried out. As data become available, they will be analyzed to estimate how frequently the combustion system will have to deal with flow rates of different magnitudes. This analysis will make it possible to design maximum capacity and turndown ratios for each element of the total combustion system. See revised Appendix C, Sects. C.2.2.6 and C.3.1.5, and the DOE/EPA/KDNREP Work Plan in Appendix EE.

3.28 Comment: The FEIS should indicate the schedule by which refined performance estimates, feed-stream composition estimates, and controlled combustor/flare system design information will be provided after the FEIS. (Commenter: 56, p. 14)

Response: The DOE, EPA, and KDNREP have formulated a strategy for generating and reviewing this design information. This can be found in the work plan presented in Appendix EE.

3.29 Comment: The DEIS does not include an estimate of controlled/flare performance. DOE/ICRC should, in the FEIS, be able to estimate a performance goal for the individual controlled combustors and the elevated flare for at least the two alternative combustor/flare systems. The goal may be, for example, hydrocarbon-destruction efficiency. While a more rigorous estimate of performance might not be possible until later in the design phase, it is considered important that some goal be indicated in the FEIS. (Commenter: 56, p. 14)

Response: The design goals and criteria for individual components of the base case controlled combustor/flare system are summarized in revised Appendix C, Sect. C.2.2.6.

3.30 Comment: The DEIS considers only one controlled combustor/flare system. The FEIS should include a discussion of at least one additional alternative, involving either: (1) a controlled combustor for all uncooled routine vents; (2) a controlled combustor for uncooled gases from minor upsets; (3) an elevated flare for uncooled gases from major upsets (with most hazardous gases going preferentially to a controlled combustor, if possible); and (4) a controlled combustor for knockout liquids which are not recycled. (Commenter: 56, p. 14)

Response: Several alternatives will be evaluated and compared to the base-case controlled combustor/flare system (see revised Appendix C, Sects. C.2.2.6 and C.3.1.5). The most important alternative is the use of a thermal oxidizer at all flow rates up to a preselected maximum, and then the ground-flare field at higher flow rates. The crossover flow rate would be selected based upon analysis of reliability data for safety valves and other equipment. If combined random emissions from a large number of components yield a relatively continuous total emission, it would be appropriate to treat this with a thermal oxidizer. The thermal oxidizer in the base case could be designed for a larger capacity, or a separate thermal oxidizer could be used. The increased assured percentage destruction in the thermal oxidizer must be balanced against the higher probability of continued, trouble-free operation for the ground-flare field.

Alternatives within the base-case design must also be evaluated. For example, the thermal oxidizer can be either catalytic or noncatalytic. Quench solvents, solvent rates, and operating conditions for the quench system must be established. The use of a steam-assisted or enclosed flare instead of the ground-flare field will be evaluated. The control system to distribute flows must be selected.

3.31 Comment: If there is an emergency of the type where a massive release of gas is necessary to avoid an explosion, 700 tons of hydrocarbon gas will have to be burned in the air-pollution control device called the control combustor. But this unit is not designed yet, so we cannot know what kind of efficiency of destruction of these toxic chemicals will result in such an emergency. (Commenter: Speaker 22)

Response: The proposed controlled combustor and flare system described in revised Appendix C, Sects. C.2.2.6 and C.3.1.5 includes manifolds and knockout systems to remove most hydrocarbons, except lighter compounds (i.e., C_5) which are easily combusted. In any major emergency the gas will be sent to the elevated emergency flare, which will be designed to handle worst-case upsets (see responses to Comments 3.27, 3.29, and 3.33 also).

3.32 Comment: The 700 tons of hydrocarbons, which must be broken down rapidly by the flare/controlled combustor system during an upset, represent a massive amount of potential ozone, even with a 90% destruction factor. A 10% release would be more than the DEIS predicts for an entire year of plant operation. How often do traditional refineries experience upsets? (Commenter: 64, p. 3)

Response: The 700 tons/h of hydrocarbons that are released during a dissolver dump are not all flared. After release from the dissolver, they enter a blowdown vessel. Nearly half of the hydrocarbons remain here in a liquid phase. The rest are vapors. They are released from the blowdown vessel and further quenched, condensing the heavier components. The quenching should knock out a major portion of the components heavier than C_5. The vapors which remain are made up of 40,000 lbs/h hydrocarbons and 90,000 lbs/h hydrogen, inerts, and nonhydrocarbon combustibles. These are flared. The situation of an uncontrolled dissolver dump is not expected to occur more often than once per year.

3.33 Comment: What will be the role of blowdown tanks in controlling emergency upsets? (Commenter: 46, p. 6)

Response: Blowdown tanks are part of the emissions pretreatment system to reduce the concentration of heavy hydrocarbons in gases fed to the controlled combustor or emergency flare. A blowdown tank will be provided for certain high-pressure equipment that will be sized to handle the effluent from the equipment for a period long enough to safely shut off the feed to that equipment. As material is dumped into the tanks, it will be quenched by spray cooling, using a cold, compatible solvent. The tanks will contain sufficient volume to separate most liquids from gases, except for small entrained droplets. The operating pressures and temperatures of the tanks will be intermediate between those of the equipment being relieved and the manifold to which

the gases discharge. Solvent addition rates and temperatures will be designed to prevent solidification in the blowdown tank and liquid transfer lines.

Hot gases from the blowdown tanks and relief of other equipment not requiring blowdown tanks will be further quenched by spray cooling with a diluent solvent. Solvent addition rates and quench temperatures will be chosen to give a low equilibrium concentration of C_5+ hydrocarbons in the quenched gas. Immediately after this quench, gases will pass through a knockout drum to eliminate entrained solvent and condensed liquids. Further condensation of light liquids will occur in the transfer lines to the controlled combustor. The lines will be designed to prevent accumulation of condensate, and there will be a final liquid knockout just before the controlled combustor system. Liquids collected at various stages of the knockout system will be held for later treatment in the thermal oxidizer or for recycle to the process.

3.34 Comment: It is impossible to look at the EIS data and assess what the impact will truly be. The hydrocarbon emissions are estimated to be only 60 tons, and yet a small refinery in Mount Vernon puts out 2295 tons per year. Something appears to be wrong with the hydrocarbon emission levels. (Commenter: Speaker 40)

Response: See response to comment 3.26.

3.35 Comment: Point-source emissions of hazardous substances can be controlled with proper equipment. Fugitive emission sources cannot be adequately controlled, such as those from valves, joints, etc. I do not believe that the DEIS adequately treated this problem. (Commenter: 39, p. 1)

Response: Fugitive emission source control has been addressed to the fullest extent feasible in the EIS. The EIS discusses available design controls such as double mechanical seals with a barrier fluid system on light liquid hydrocarbon pumps, nitrogen purging of reciprocating compressor distance pieces, and subsequent flaring of purged materials. These systems represent essentially 100% control of these organic leaks. Because no particular valve or flange design which can be used in a variety of process conditions has been substantially proven to reduce leak potential, these components generally cannot be controlled through design considerations. A directed inspection and repair program will be adopted for valves and flanges handling hydrocarbons in the plant. The program will involve instrumental monitoring of these components for leaks, and repair within 15 d of leak detection, if possible. The EPA, in response to the fugitive organic emission control section of the DEIS, has judged these controls to represent "best available control technology (BACT)," as it exists today, and, in some cases, to go beyond BACT requirements.

3.36 Comment: In Table C.5, p. C-41, the proposed efficiencies for flanges and valves in heavy liquid service are too low and should be increased. (Commenter: 12, p. 8)

Response: The Radian study published in the EPA document, *Assessment of Atmospheric Emissions from Petroleum Refining*, Report EPA/600/2-80075c, and the proposed New Stationary Source Performance Standards for the Synthetic Organic Chemical Manufacturing Industry (SOCMI) provided the basis for the design controls, emission estimates, and control efficiencies for fugitive VOC emissions. According to the Radian study, which was conducted at a number of refineries, flanges and valves in heavy liquid service leak at very low rates (as compared to pumps, compressors and valves in gaseous or light liquid service). Heavy liquids are low in volatility, resulting in relatively small leak rates from stemmed valves. The proposed SOCMI standards require monitoring of gaseous and light liquid hydrocarbon service valves for a screening value of 10,000 vppm. SOCMI requires no design controls or regular instrumental monitoring of either flanges or valves in heavy liquid service due to the relatively low leak rate of these components.

The results of the Radian study indicate that flanges and heavy liquid service valves will not leak at high enough concentrations to be detected at 10,000 vppm or higher

with an analyzer. The leaks occur at lower concentrations. Both the EIS and PSD permit application propose going beyond the SOCMI requirements not only in instrumentally monitoring these components on a regular basis but also in adopting a leak definition of 1000 vppm for these components (as compared to the proposed 10,000 vppm regulatory leak definition). Even so, only 55% of total mass leaks from flanges, and 33% of mass leaks from heavy service valves will occur at concentrations greater than or equal to 1000 vppm. It would not be economically or technically feasible to attempt to repair leaks detected below 1000 ppm.

3.37 Comment: Page C-29. Why will only some of the hydrocarbon storage tanks have floating roofs? (Commenter: 46, p. 6)

Response: Hydrocarbons can be stored safely in either fixed-roof or floating-roof tanks; emissions from either will be insignificant because the tanks will have inert-gas blanketing, vapor recovery, and flaring. Floating-roof tanks are safer for storage of volatile hydrocarbons such as naphtha.

Sulfur Recovery and Control

3.38 Comment: Reduced sulfur species, H_2S and COS, are referred to as "noncriteria pollutants" (p. C-30). Since the heart of the SRC-I process for the removal of sulfur from coal depends on the generation of large quantities of these materials, should not some criteria be established as to safe limits for these gases? Or, is this a matter to be decided by the demonstration plant? (Commenter: 3, p. 1)

Response: The term *noncriteria* means that insufficient information on adverse effects of these pollutants on human health or the environment has been collected to set national ambient air quality standards (NAAQS). However, other regulatory agencies have established standards for H_2S, with which the SRC-I plant will comply. Emissions will be limited to:

1. H_2S: Less than 0.01-ppm ground-level concentration, which is the Kentucky Air Quality Standard (odor detection level).

2. COS: Less than 10-ppm ground-level concentration. This is the Occupational Safety and Health Act (OSHA) standard for H_2S, which will be used because COS and H_2S have similar toxicities and because there are no COS standards.

3.39 Comment: How corrosive is H_2S (and COS) under process conditions (temperature and pressure) to valve systems, pipelines, etc., which might cause the worst scenario described? (Commenter: 3, p. 1)

Response: Sulfur compounds will cause only moderate corrosion rates, which can be tolerated through the use of corrosion allowances in specified metal thickness. Valves, pumps, and other components subject to corrosion will be replaced on a predetermined timetable.

3.40 Comment: Since the Selexol unit has large sulfur emissions, alternative control methods should be considered in the FEIS (see Sect. C.3.1.1). (Commenter: 12, p. 8)

Response: The selection of an acid-gas treating process depends upon the acid-gas pressure, the ratio of CO_2 to sulfur compounds, feed-stream impurities, hydrocarbon content, and the treated-stream purity requirement. The shifted syngas from the shift unit has about 360 psi acid-gas partial pressure and contains no heavy hydrocarbons. Physical solvent processes such as Selexol and Rectisol are considered more favorable for treating this kind of gas stream than are chemical absorption processes. However, of the chemical processes, a hot carbonate process such as Benfield's Hi-Pure System is considered the most likely.

A screening study of these processes was conducted by Lummus and Parsons. Lummus had been designing a Rectisol process for American Natural Resources to treat the syngas from a Lurgi coal gasifier and had also completed a design for a Canadian H_2 plant, using Texaco partial oxidation and nonselective Lotopro-designed Rectisol. However, Lummus believes Selexol is more economical than Rectisol on a nonselective acid-gas removal basis. According to the screening selection, both Lummus and Parsons recommended Selexol or Benfield's Hi-Pure process; therefore, Rectisol was eliminated.

Selexol and Hi-Pure processes were considered in a proprietary trade-off study. The cost estimates from that study show that the Selexol process is economically preferable to Benfield's Hi-Pure process: annual operating costs of $19.75 and $22.01 MM (1979), respectively. Therefore, Selexol was selected for gas treating of the makeup stream (see revised Appendix C, Sect. C.3.1.1).

3.41 Comment: Page 2-9, first paragraph. The DEIS indicates that an ammonia-burning Claus plant will be employed. How will the ammonia oxidation be conducted in a manner which will not disrupt the H_2S/SO_2 ratio (through simultaneous oxidation of H_2S)? Also, will ammonia-sulfur salts be formed which could impact Claus plant operation? (Commenter: 56, p. 8)

Response: An ammonia-burning Claus unit treats both H_2S and NH_3. To avoid plugging by ammonia-sulfur salts, which would be typical of a Claus unit that was designed to treat H_2S alone, the reaction is staged in two thermal reaction zones in series. Before reaction, to avoid salt formation, ammonia-rich and ammonia-free gases are segregated up to the first zone of the thermal reactor. Furthermore, the line containing the ammonia acid gas is steam-traced to keep the temperature above the salt-precipitation temperature.

Air and ammonia-rich acid gas are fed to the first zone with sufficient ammonia-free acid gas to provide an oxygen-deficient atmosphere. The temperature is high, promoting the decomposition of ammonia to nitrogen and hydrogen. The reaction products from the first zone are combined with the balance of the acid gas in the second reaction zone, which is operated at a lower temperature. Here the H_2S and SO_2 react to form sulfur.

Operating the first thermal conversion zone with a deficiency of oxygen prevents the formation of ammonia-sulfur salts due to the essentially complete reduction of ammonia to nitrogen. The second zone, operated in combination with the first, aids in thermally converting formed sulfur trioxide to sulfur dioxide.

3.42 Comment: The DEIS suggests that nearly all sulfur and ammonia will be removed. Actual coal-conversion-process performance records indicate that complete sulfur/ammonia removal is impossible because of the presence of organics and metals. The FEIS should discuss the problem and provide an effective solution. (Commenter: 12, p. 5)

Response: The DEIS does not state that nearly all sulfur and ammonia will be removed from the coal. Sulfur removal from the coal is 92%; nitrogen removal is 70%. The residual sulfur and nitrogen are present in the solid SRC or liquid products. This statement refers to removal of the sulfur and nitrogen which has been removed from the coal. Individual process streams may experience nearly complete removal of sulfur or ammonia impurities. This removal may be accomplished when the gas or liquid carrier streams containing these acid gases are sent to the gas treatment section of the plant (diethanolamine unit, Selexol unit, ammonia/sulfide water-stripping unit, Claus unit, and Beavon sulfur removal unit).

3.43 Comment: Page C-52, last paragraph. The DEIS addresses emissions of SO_2 during upsets. One "upset" has not been considered, i.e., the contingency that the Beavon unit might go down. The FEIS should estimate the increased sulfur emissions (from sulfur recovery tail gas and from heaters fired with plant gas) that might result if the Beavon unit goes off-line. (Commenter: 56, p. 8)

Response: If the Claus tail-gas-treating portion of the Beavon unit goes off-line, approximately 125 g/s of sulfur will be emitted to the atmosphere. The Claus tail gas stream will be burned in a thermal oxidizer; thus, the sulfur will be emitted as SO_2 (250 g/s of SO_2).

The impact of flaring the Claus tail-gas was determined by simulating the dispersion of the plume, using the Industrial Source Complex (ISC) model (see Sect. 4.2.3.1 of the FEIS). The predicted second-highest 3-h and 24-h average SO_2 concentrations were 149.9 and 29.3 $\mu g/m^3$, respectively. These concentrations account for 29.3 and 32.2% of the allowable Prevention of Significant Deterioration (PSD) Class II increments and 8% of the NAAQS. Thus, this upset condition does not violate the standards.

If the fuel-gas-treating portion of the Beavon unit goes off-line, the fuel gas will be sent directly to the fuel header from the DEA unit, bypassing the Beavon unit. The H_2S content will be 0.02 wt % (200 ppmw). This stream will have gone through sulfur removal in the DEA unit and will contribute about 30% of the total fuel gas. Therefore, mixing this with the remaining sulfur-free fuel gas will give a fuel gas of 60 ppm H_2S, 12 times greater than normal. This increase in fuel-sulfur content would cause a 0.7 $\mu g/m^3$ (maximum 24-h average) SO_2 impact.

The 24-h average impact due to all sulfur emissions from the SRC-I plant, including this upset condition (Beavon unit down), would be 32 $\mu g/m^3$ SO_2. This is 35% of the PSD increment and only 9% of the NAAQS for SO_2.

3.44 Comment: Page C-34, last paragraph. The DEIS indicated that Claus tail gas will be incinerated (oxidizing H_2S to SO_2 prior to emission) if the Beavon unit goes off-line. DOE/ICRC should indicate in the FEIS whether they would be willing to incinerate the tail gases, even when the Beavon unit is operating, if the H_2S concentration exceeds 10 ppm. (Ten ppm H_2S is a level considered in connection with New Source Performance Standards for conventional refinery sulfur recovery plants). (Commenter: 56, p. 8)

Response: Incineration of the tail-gas from the Beavon unit does not appear to be necessary, except during shutdown. The tail-gas has a design concentration of less than 5 ppmv H_2S. A simulation of the dispersion of this plume, using the ISC model, indicates that there will be no violation of Kentucky H_2S standards (odor threshold) as long as the H_2S levels are below 50 ppm. If the H_2S in the tail-gas should reach 50 ppmv, this would indicate a major problem, requiring that the Beavon unit be shut down for repair; the Claus tail-gas would then be incinerated. The effluent will have sulfur compounds other than H_2S such as COS and SO_2. The total sulfur concentration in the effluent is expected to be between 50-100 ppmv (as SO_2).

Coker-Calciner Scrubber and Incinerator

3.45 Comment: The PSD application includes more specific information concerning the soda-ash-scrubber design and projected performance than does the DEIS. The PSD information should be incorporated into the FEIS by reference. (Commenter: 56, p. 17)

Response: The coker/calciner scrubber is discussed in Sect. C.3.1.1 of the FEIS. The PSD permit is mentioned here as containing sufficient information to determine BACT acceptability. Additional information could be found in the permit application. The complete citation for the PSD permit application is the U.S. Department of Energy, *Kentucky Department for Natural Resources and Environmental Protection, Permit Application for Air Contaminant Source, SRC-I Demonstration Plant, Newman, Kentucky,* November 21, 1980, Appendix B, BACT (Best Available Control Technology proposals) (see Area 13).

3.46 Comment: The PSD application indicates scrubber design for 85% SO_2 removal and 92% particulate removal. The FEIS should present the rationale for not designing for higher removal efficiencies, especially since the coker-calciner is such a major contributor of SO_2. If the selection of the scrubber system and its performance is less finalized than inferred from the PSD application, then the FEIS should indicate the schedule by which the decision on scrubber design/performance will be made. (Commenter: 56, p. 17)

Response. The 85% SO_2 and 92% particulate removal efficiencies are conservative estimates judged to be appropriate for air quality impact analysis. More design information will be available during detailed engineering, when more accurate, revised estimates will be made. The actual efficiencies are expected to be higher than those listed above.

3.47 Comment: Page C-36, first paragraph. The DEIS indicates that the hydrocarbons and reduced sulfur species in the coker-calciner off-gas will be incinerated. If at all possible, the FEIS should indicate a performance goal for this incinerator. As a minimum, the FEIS should indicate on what assumptions (stream composition, incinerator performance) the coker-calciner emissions in Table C.7 were estimated, and the schedule by which further information will be available concerning incinerator design, feed-gas composition, and performance. (Commenter: 56, p. 17)

Response: The performance goal for the incinerator is 99+% combustion of hydrocarbons and reduced sulfur species. The coker/calciner emissions listed in Table C.7 were based on the following design data for the incinerator: excess air, about 30%; average temperature, about 1800°F. Further information on incinerator design, feed-gas composition, and performance will be available about 8 months after vendors are contacted for bid packages.

3.48 Comment: Since the soda ash scrubber presents a solid waste problem and has a venturi with large energy requirements, alternative control methods should be considered in the FEIS (see Sect. C.3.1.1). (Commenter: 12, p. 8)

Response: Section C.3.1.1 of the EIS's Appendix C presents a list of alternative control devices which were evaluated. The wet soda-ash scrubber was chosen as the currently proposed alternative. Both the energy requirement and the waste disposal requirements were included in the evaluation of alternatives.

Coal Handling

3.49 Comment: I would like to highlight what probably is the most serious problem at the commercialization stage. The EIS clearly states that 73% of the PSD increment for particulates will be consumed in the demonstration plant. While the EIS agrees that particulate emissions will not grow linearly with plant expansion, it suggests that this could be "a significant limitation to commercialization."

A linear projection would result in 350% of the allowable increment being used. EPA realizes that the emission estimates used in the draft EIS are based on emission factors taken from EPA guidance publications. Our initial judgment is that the emission factors are not that far off. We believe that a heavy burden of proof rests with DOE and ICRC to demonstrate that this place can be expanded five times without violating PSD increments. (Commenter: Speaker 28)

Response: The DEIS stated that an estimated 73% of the PSD 24-h increment for particulates will be consumed by the demonstration plant. However, updated Industrial Source Complex (ISC) dispersion modeling analyses have recalculated that figure to 18.3%. The earlier calculation predicted a maximum 24-h ground-level concentration of 26.9 $\mu g/m^3$; the new estimate is 6.74 $\mu g/m^3$ for the demonstration plant alone and

8.1 $\mu g/m^3$ for all PSD sources in the area. The new estimated average annual concentration for all PSD sources in the area is 1.26 $\mu g/m^3$.

Based on overly conservative emissions estimates and an incomplete assessment of the nature of fugitive-type emissions, the earlier calculation indicated that 20 of the 26.9 $\mu g/m^3$ maximum 24-h concentration was due to fugitive emissions alone. New results have reduced this contribution to 2.4% of the 6.74 $\mu g/m^3$ demonstration plant's total concentration.

The reduction in fugitive particulate air quality impact resulted by considering three key factors — the effect of wind speed on SRC-product storage piles and coal-pile wind-erosion losses, the impact of scheduling SRC-product and coal-loading and unloading operations for only 8 out of 24 h, and the effects of using prewashed coal, which has a very low silt content. Each factor is discussed in more detail in revised Sect. 4.2.3.1.

The preliminary modeling results indicate that the commercial plant can be constructed within the 24-h and annual increment restrictions. The commercial-plant model was based on a fourfold increase in point-source contributions (coker/calciner capacity will not significantly increase during commercialization) and a conservatively estimated fivefold increase in fugitive emissions. Results indicate that a maximum 56% of the 24-h particulate increment will be consumed by the commercial plant and other PSD sources within the impact area of the SRC-I plant. Extensive ambient air quality monitoring will be conducted during the demonstration phase to assess the accuracy of the ISC modeling predictions.

3.50 Comment: The DEIS, in one place, indicates that dust suppression of the active stockpile will be chemically accomplished. Another place indicates that it will be done with water. What effects will result from the chemical treatment and from the polymer used for dust suppression in the two fifteen day stockpiles? How much acreage will be used for the entire stockpile of coal? How will it be kept from smoldering and giving off noxious and toxic smoke? How much of the manufactured product will be stockpiled? Will it smolder also? (Commenter: 32, p. 1)

Response: Dust from the active coal piles and the SRC piles will be controlled by prewashing coal, which essentially eliminates silt, the source of airborne (≤ 75 μ) particles in wind erosion losses, and by equipping the coal- and SRC-product handling with water spray capability. Originally, chemical-wetting agents, or surfactants, were considered for use on the active piles. No data exist to indicate that adding surfactants to water sprays will further reduce dust emissions. Surfactants will, however, reduce overall water consumption due to their wetting characteristics. If a reduction in water consumption is desired at the SRC-I plant, surfactants can be added to the water spray system.

The inactive or reserve coal piles will be covered with a seal substance that will virtually eliminate fugitive emissions. Polymer coatings used in railway shipment are subjected to considerable vibrational and wind velocity stresses not expected in storage situations. The choice of a coating for the reserve piles will be based on manufacturers' guarantees and on demonstrated effectiveness.

The total area for coal storage will be about 20.5 acres (8 acres active, 12.5 acres inactive).

Standard industrial practices will be used to control coal pile smoldering. These practices include proper layering and compaction of piled coal and temperature- or other monitoring systems to detect smoldering areas. Unlike coal, SRC does not tend to spontaneously combust.

3.51 Comment: Current plans call for polymer coatings to be sprayed on coal reserves to reduce fugitive emissions. I assume this spray will be similar to what is sprayed on coal hopper cars to reduce transport shrinkage. If this is true, I recommend your figures to be reconsidered, because at

least one recent study in Railway Age found the sprays to be ineffective. (Commenter: 46, p. 6)

Response: See response to comment 3.50.

3.52 Comment: Page C-7, third paragraph. The DEIS mentions that coal might also be received by barge, although the design envisions a unit train. The coal unloading emissions control discussion (e.g., on DEIS page C-36, and in the PSD application, area 11) addresses only the unit train case. The FEIS should discuss, at least briefly, the controls that would be utilized in coal receiving if coal were delivered by barge. How will it be loaded? What environmental impact will occur from loading and shipping? What stockpiling will occur at the loading sites? (Commenters: 56, p. 6; 32, p. 1)

Response: It is not intended for coal to be received by barge during the demonstration phase of the plant. This is a contingency plan in the event that coal is purchased from a mine which does not have rail access. If barges are used, BACT controls will be employed to control fugitive emissions during coal handling. Appendix Y of the FEIS discusses the barge facility and the pollution control systems that would be used.

3.53 Comment: Page C-37, second paragraph from bottom and elsewhere in the DEIS. The DEIS indicates baghouse collection efficiency (99+%) only for one baghouse in the coal handling system, viz., the baghouse on the coal dryer/pulverizer. The PSD application states a control efficiency of 99.5% or greater for this and the other baghouse in the system. The FEIS should clearly state the performance goal for all of the baghouses. If this goal is at least 99.5% for each, this performance would be considered BACT, although slightly higher efficiencies would theoretically be possible. (Commenter: 56, p. 6)

Response: The expected collection efficiency of all baghouses in the demonstration plant is at least 99%, which is consistent with typical baghouse collection efficiencies. Without detailed design information, it is impossible to predict the efficiency to an accuracy of ±0.5%. Collection efficiency is a function of many parameters that are not always constant. The more important parameters that determine collection efficiency are the following: particle size, density, and velocity. Because this is a testing facility, many different coals and operating conditions may be encountered. The baghouses will ultimately be designed to operate at maximum efficiency under the most frequently expected particle conditions. A ±0.5% error in prediction of control efficiency will not significantly change the result of the impact analysis.

3.54 Comment: Page C-49, general comment. DOE/ICRC should advise EPA regarding the tests for hydrocarbon and acid gas emissions from the coal dryer/pulverizer, and regarding any planned adjustments to dryer temperature/residence time in order to reduce these emissions. Also, hydrocarbon emissions from this source should then be added to Table C.7. (Commenter: 56, p. 6)

Response: The DOE/ICRC has planned a coal-pulverizing-drying test to measure hydrocarbon emissions; however, the test will not measure acid-gas emissions because literature indicates that these will not evolve in significant quantities. Literature also indicates that the hydrocarbon evolution will be small, especially non-methane hydrocarbons. The results will be made available upon test completion and data reduction. If the results indicate that a minor change in the present design-operating conditions is required to reduce hydrocarbon emissions, then it will be reported with the test results. If major design changes are required, they will be reported as the information becomes available.

3.55 Comment: The final environmental statement should refer to the documents prepared by the Federal Office of Management and Budget that state that it is the intent of this project to use Kentucky No. 9 coal or its equivalent. (Commenter: Speaker 64)

Response: Appendix C, Sect. C.1.1 of the FEIS states the intent of the project is to use Western Kentucky No. 9 coal or its equivalent.

3.56 Comment: It should be noted that only a 30-d backup supply of coal is planned. Ninety days supply is a more customary back up – this would triple the amount of stored coal (approximately 540,000 tons), increase the leachate, and further stress the waste water treatment system. (Commenter: 18, p. 7)

Response: Sixty days of reserve coal storage is now planned for the plant. The two 30-d reserve piles will be covered with a crusting agent, which essentially eliminates wind erosion emissions. The piles are not expected to be disturbed, except during a coal-supply cut-off situation. Total reserve coal pile capacity will be approximately 420,000 t (wet basis). The pile will be equipped with a liner, will be located above the 100-year floodplain, and will include rainwater runoff collection. Runoff will initially be directed to a surge basin. The basin will be designed for a 24-h, 10-year frequency storm. Effluent from the basin will enter the metal precipitation stage of the wastewater treatment plant. The wastewater treatment plant will be designed for the anticipated loading.

Liner Selection

3.57 Comment: Page C-12, first paragraph. The DEIS indicates that efforts are underway to select the liner material for collecting runoff from the coal pile (and presumably from the process area, product storage area, and disposal area as well). If further information is available regarding the nature of the results from these testing efforts, it should be included in the FEIS. (Commenter: 56, p. 23)

Response: Testing with compacted onsite clay indicates that its permeability is on the order of 10^{-7} cm/s. Consequently, subject to other testing for compatibility, this material will be used for liners to the maximum extent practical. The process area will also include curbed concrete pads for areas likely to be contaminated. Additional evaluation is being made in the disposal areas regarding the use of synthetic liners and/or clay liners.

Synthetic liners such as high-density polyethylene, reinforced hypalon, butyl rubber, and neoprene will be evaluated and tested. The EPA document *Lining of Waste Impoundment and Disposal Facilities*, Report SW-870, Office of Water and Waste Management, Washington, D.C., September 1980, will be used as a guide.

Dikes are expected to be constructed with compacted clay. Synthetic liners, where applicable, will be extended from the bottom (within the diked areas) over the inside face of the dike and will be fastened at the top.

3.58 Comment: The FEIS should indicate the schedule by which a decision is expected regarding liner material/design for runoff collection and regarding estimation of runoff composition and treatment step design. (Commenter: 56, p. 23)

Response: Compilation of the list of liner materials to be tested will require one month; selection of a subcontractor to conduct the test program will take three months. The actual testing program will last eight months to one year; the deciding factor in timing is the liner material coupon test, which involves subjecting the coupons to wastes and periodically running a series of chemical/physical tests to determine adequacy. The tests will include, but not be limited to, thickness, hardness, tensile and tear strength, volatility and extractability, seam strength, and

puncture resistance. Total time required for this program appears to be 1.0 to 1.25 years from initiation.

Leaching tests have already been conducted on coal and SRC products; results were provided in Appendix P in the DEIS. Runoff will be collected and treated in the wastewater treatment plant. Final design of this treatment plant is expected to be available in 1983.

3.59 Comment: Page C-15, first paragraph. The DEIS does not clearly indicate the effort under way to select the liner material for the dikes in the product storage areas. This effort should be referenced, and the anticipated schedule by which the liner selection decision will be made should be specified. (Commenter: 56, p. 24)

Response: See responses to comments 3.57 and 3.58.

Cooling System

3.60 Comment: The possibility of phenolics being emitted from the cooling tower could be a problem. The phenolics are reported to be present in the treated wastewater that will be directed into the cooling towers at a rate of 608 gal/min. If this treated wastewater were directed into the Green River, it would cause borderline compliance with the water quality standards. By directing this treated wastewater into the cooling towers, the process will only be redirecting these phenolics into the air instead of directly into the river. Further treatment of the wastewater to remove the organics should be performed or alternative methods of disposing of the treated wastewater should be used in order to mitigate the release of the phenolics and any other volatile organic compounds from the cooling towers. (Commenter: 18, pp. 4, 6)

Response: See response to comment 3.8. Treated wastewater will be monitored prior to use as cooling tower makeup. If monitoring results indicate unacceptable phenol removal, this stream will not be used in the cooling system. See also the response to comment 3.61.

3.61 Comment: The cooling towers will evaporate treated wastewaters containing not only organic compounds but also significant amounts of cadmium, chlorine, cyanide, and selenium, all of which are potentially toxic.

If the treatment is less efficient in degrading the hazardous chemicals than expected, this would create a significant potential for widely dispersing a variety of toxic agents. (Commenter: 18, p. 4; Speaker 38)

Response: The conceptual wastewater treatment design described in the EIS represents a viable method for removal of contaminants from the wastewater generated at the demonstration plant. This treatment scheme is based on past wastewater treatment experience in the refining industry and the coking industry and at the SRC pilot plant at Wilsonville, Alabama. Wastewater will be subjected to metal removal, biological treatment, activated-carbon adsorption to remove organics not degraded in the biological treatment system, and possible ozonation before entering the cooling tower. Therefore, significant quantities of toxic substances and organic compounds would not be expected to be present. The water used as cooling tower makeup will be monitored, as will the effluent from the wastewater treatment facility.

3.62 Comment: DOE/ICRC should evaluate at least one alternative cooling system in the FEIS in respect to both the cost-effectiveness and environmental acceptability. (Commenter: 56, p. 19)

Response: Plant cooling will be accomplished primarily by a central evaporative cooling system; the exception is the air separation unit, which will use a direct-contact, after-cooling (DCAC) system. Individual process areas having streams containing >5% 500°+bp hydrocarbons will be either aerially or indirectly cooled to prevent contamination of cooling water in the central evaporative cooling system. The system type selected for each process area will depend upon the nature of its process streams; such selections cannot be made until additional process information is available.

3.63 Comment: Rough calculations indicate that enough waste heat will be generated to heat more than 17,000 houses (1.7 x 109 Btu/hour) (p. C-14). Can some constructive use be made of this heat? (Commenter: 46, p. 6)

Response: This waste heat is low-level heat and cannot be economically recovered in a demonstration scale plant or for outside plant use. This heat must be rejected to the atmosphere through air cooling and evaporative cooling. The demonstration plant does recover heat through generation and preheating of process streams, thus increasing the overall thermal efficiency of the plant.

Miscellaneous Comments

3.64 Comment: The draft EIS outlines a number of major impacts associated with air and water quality and hazardous waste disposal. It is unknown at this time whether final designs will be able to meet the established standards and permitting processes. (Commenter: Speaker 21)

Response: Detailed design plans will be developed in accordance with all established standards and permitting processes, as required by law. Primary control systems chosen for the plant are based on developed technology. The selection of types of control systems to be used can be based on conceptual plant design and preliminary heat and material balances. Detailed design of these control systems cannot be carried out until detailed design of the main process reaches the appropriate stage. Because the control systems are developed technologies, emissions estimates can be made based on performance history of these systems, along with preliminary heat and material balances for the plant. As detailed design for the plant proceeds, both control-system design and emissions estimates are continually updated. See the DOE/EPA/KDNREP Work Plan in revised Appendix EE.

The EPA approval of many of the processes as "Best Available Control Technology" (BACT) is required. Selection of process types as BACT can be approved at this level of design without specifying details of final design or operating conditions for those processes. As detailed design continues, EPA approval is required as part of the permit-approval process. Thus, detailed design and operating parameters will be reviewed to ensure BACT as designs are finalized.

In addition to primary controls, which are developed technology, many redundant and backup control systems are being evaluated for inclusion in the plant. Some of these are developed technologies; others are highly promising and developmental-stage technologies. As these are evaluated and recommended for inclusion, they will also be evaluated by regulatory agencies as part of the permitting process and by EPA as part of a continuing NEPA process as discussed in response to comment 2.2.

Emissions estimates upon which this FEIS is based are from guidelines and emissions factors from EPA, NIOSH, and other organizations. The estimates are based mainly on historical performance data for developed technology. Conservative estimates have been used in all cases, as is consistent with this stage of engineering design for any major chemical-processing facility. Where enough detailed design data have been available, they have been used to give more precise estimates. As further information becomes available, other emissions estimates will also be updated. These will be reviewed as part of the permitting process and continuing review process (Appendix EE).

3.65 Comment: This proposed plant will produce a broad range of materials that are carcinogenic and mutagenic compounds, including aromatic amines, aromatic and heterocyclic compounds, phenols, and other compounds. There is considerable doubt in my mind that control technologies for these compounds are adequate. (Commenter: 39, p. 1)

Response: Fugitive emission source control has been addressed to the fullest extent feasible in the EIS, Appendix C. See also the responses to comments 3.26 and 3.35.

The Statement discusses available design controls such as double mechanical seals with a barrier fluid system on light liquid hydrocarbon pumps, nitrogen purging of reciprocating compressor distance pieces, and subsequent flaring of purged materials. These systems represent essentially 100% control of organic leaks. Although a few valve designs have been shown to reduce leakage, these designs are not applicable to all process conditions. No particular flange design has been substantially proven to reduce leak potential. Therefore, a directed inspection and repair program will be adopted for valves and flanges handling hydrocarbons in the plant. The program will involve instrumental monitoring of these components for leaks, and repair within 15 days of leak detection, if possible.

The Radian study published in the EPA document *Assessment of Atmospheric Emissions from Petroleum Refining,* Report EPA/600/2-80075c, and the proposed New Stationary Source Performance Standards for the Synthetic Organic Chemical Manufacturing Industry (SOCMI) provided the basis for the design controls discussed above. The EPA, in response to the fugitive organic emission control section of the EIS, has judged these controls to represent "Best Available Control Technology" (BACT) as it exists today, and in some cases, to go beyond BACT requirements.

In addition, evidence of the plant's ability to control hazardous compounds is found in the results of the air-monitoring program conducted at the Wilsonville Pilot Plant by Enviro Control, a subcontractor of NIOSH (see revised Appendix Z). Portable air samplers were worn by plant operators as they conducted their daily activities. The samples were then analyzed for polyaromatic hydrocarbons. Nearly 90% of the samples collected consisted of noncarcinogenic, two-ring (more volatile) compounds. Most of the remaining samples were weakly carcinogenic, three-ring compounds; and extremely small quantities of the potentially mutagenic/carcinogenic four-or-more-ring compounds, which are very low in volatility, were detected. Pyrene, which is noncarcinogenic/nonmutagenic, was the only compound detected in the four-or-more-ring compound group.

3.66 Comment: What provisions will be made to prevent flooding of the coal and solid product storage areas? (Commenter: 18, p. 7)

Response: The coal and solid SRC product will be stored in piles on a portion of the site located below the 100-year floodplain. The bottoms of these storage piles will be filled to above the 100-year floodplain. In the unlikely event that a 500-year flood would occur, leachate carried from the piles by flood waters would be greatly diluted.

3.67 Comment: What measures will be taken to prevent the bottoms of the various landfills from being bulged up by high groundwater during floods? Since these landfills must serve as long-term containment facilities, absolute care must be used in their design. (p. C-34) (Commenter: 46, p. 6)

Response: The base of the hazardous landfill is above the 500-year flood level, and also above the historical high water table. Because the bases of slag/ash ponds (which are expected to be nonhazardous) are below the 100-year flood level, liner floating will be prevented by weighting the pond with water and/or the solid waste against uplift pressures. Monitoring will track groundwater levels, and the ponds can be weighted accordingly to prevent upheaval.

3.68 Comment: Zero discharge is the preferred wastewater treatment alternative for the facility. This alternative would result in the least damage to Green River water quality. Severe groundwater contamination from carcinogenic organic and heavy metals may, nevertheless, result unless considerable care is taken in landfilling all solids generated from the evaporative cooling system associated with the zero-discharge option. In addition, the DEIS should be revised to explicitly address the buildup of high salt concentrations caused by continuous recycling if the zero-discharge alternative is selected. (The salt problem is not addressed in the DEIS.) (Commenter: 12, p. 4)

Response: Landfill design will meet all KDNREP and USEPA requirements to ensure the safe, secure disposal of all hazardous materials. (See also response to comment 13.7.)

Because the proposed zero-wastewater-discharge system reuses only treated wastewater as cooling tower makeup water, any buildup of high salt concentrations will occur in the cooling tower recirculating water. The dissolved-solids level of the recirculating water can be controlled by the cooling-tower-blowdown rate. The salt in the blowdown will be concentrated in the evaporator and then deposited in a secure landfill. Therefore, there will be no unacceptable buildup of salt within the SRC-I facility. The project sponsors will continue to investigate technologies for the stabilization of evaporated salt cake.

3.69 Comment: What is the anticipated frequency of plant start-ups? Significantly higher air pollution occurs during this 50-h phase than during normal operation. Does the 150 ton/year figure for SO_2 include only normal operation or start-up emissions as well? (Commenter: 64, p. 5)

Response: There will be an annual scheduled start-up and shutdown. Frequency of unscheduled start-up and shutdown events cannot be accurately determined at present. The 150-tons-per-year SO_2 emission rate pertains to the commercial-phase normal operation. The emission rate of the demonstration phase under normal operation is 92 tons per year of SO_2. These figures do not include start-up emissions. Approximately 15 t of SO_2 will be emitted during start-up. Appendix C, Sects. C.4.1.2, C.4.1.3, and C.4.1.4 discuss demonstration plant emissions during start-ups, shutdowns, and emergencies.

3.70 Comment: The DEIS states: "... discharge of cadmium, chlorine, chromium, phenol, and selenium would substantially degrade water quality and could require occasional plant shutdown during low flow to maintain water quality standards." What should be considered occasional plant shutdown? (Commenter: 21, p. 7)

Response: Shutdown may be required by KDNREP and EPA when the plant discharge is in noncompliance with the effluent limits and when the river water is below the $_7Q_{10}$ low flow. The limits will be specified in the NPDES permit as would any requirements for reduced plant operation or plant shutdown to maintain compliance with the limits.

3.71 Comment: Page C-44, Section C.3.2.5, and page C-45, Section C.3.2.7. DOE/ICRC should identify the schedule by which the decision will be made whether or not to employ incineration for slop oil and spent activated carbon, and — if incineration is to be used — the schedule by which information on incinerator design and tail-gas cleanup will become available. If this information becomes available prior to the FEIS, it should be included in the FEIS. In particular, any tail-gas treatment performance goals and emission factors would be of interest. (Commenter: 56, p. 18)

Response: See Sect. EE.2, item D-14, of the status of the DOE/EPA/KDNREP Work Plan, which is in revised Appendix EE.

3.72 Comment: Page C-15, first paragraph. The FEIS might indicate how any spilled oils will be handled (e.g., recycled or incinerated). (Commenter: 56, p. 23)

Response: The Spill Prevention Control and Countermeasure and Best Management Practices plans will be developed by DOE/ICRC. These plans will be reviewed and approved by EPA and KDNREP as part of the NPDES permitting process for the entire wastewater treatment system.

3.73 Comment: DOE/ICRC should estimate the schedule by which they should be able to provide the specific key combustion, modification design information on individual in-plant heaters and boilers. (Commenter: 56, p. 16)

Response: The requested information will be provided within the framework of the DOE/EPA/KDNREP Work Plan (Appendix EE Sect. EE.2, item D.10).

3.74 Comment: A number of sections in the DEIS (particularly Appendix C) indicate that many important decisions regarding emission controls have yet to be made. When will these decisions be reached, and what opportunity will the public have to participate in these decisions? (Commenter: 46, p. 6)

Response: Decisions regarding emission control will be made at the time of final design. The DOE/EPA/KDNREP work plan presented as Appendix EE of the EIS identifies DOE's commitment to consult with EPA and KDNREP and make available to the public the results of final design plans for emission controls. Sect. EE.2, item D, presents schedules for developing decisions regarding equipment selection. See also response to comment 2.1.

3.75 Comment: Ground-level fogging and icing are two local problems that were mentioned in the DEIS, but there was no solution given and there were no plans given for finding a solution. Both can be safety hazards, especially for local traffic. These problems need to be addressed and solutions worked out. (Commenter: 39, p. 3)

Response: The impacts from cooling tower operation will be localized and have been reduced by siting the cooling towers at the southern portion of the site. Impacts to traffic are expected to be minimal. Actual experience on cooling towers at a large commercial complex in western Kentucky suggests that no noticeable icing condition exists at more than 76 m (250 ft) from the tower at ground elevation. The maximum known distance for appreciable fogging effects was 305 m (1000 ft). The complex contains six chemical plants with at least 12 boilers, having a combined generating capacity of approximately 13 MM lb/h; at least 10 cooling towers; 35-40 large furnaces and incinerators; and numerous steam and other condensible plumes within a 1.5-mile distance along the Tennessee River. This represents a much worse set of conditions than those of the plant and environment at Newman, Kentucky. In addition, because the conservative model for the cooling tower plume developed by Dames & Moore may be more accurate in determining a worst-case condition than in precisely defining normal conditions, it is suggested that the specific model results be viewed as a worst-case analysis, and not be expected to occur in the lifetime of the plant.

3.76 Comment: Page C-42. Since the plant produces sulfur, why is an external source of H_2SO_4 required? (Commenter: 12, p. 8)

Response: Sulfuric acid (H_2SO_4) is used to control pH in the cooling tower (p. C-42). However, the small quantities required (i.e., about 10 gpd) would not economically justify the addition of a sulfuric acid plant.

3.77 Comment: Page C-18. Who serves as an independent judge of the safety of proprietary catalysts? (Commenter: 46, p. 6)

Response: The catalysts to be used in the demonstration plant are those commonly employed in many other similar process operations. No catalysts were developed specifically for the production of SRC-I. Although parties connected with the manufacture and use of such catalysts may exercise their right of confidentiality, the safe transportation, use, and disposition of these substances still comes under purview of and is regulated by appropriate Federal and state agencies.

4. SAFETY AND ACCIDENTS

4.1 Comment: No description is given for emergency preparedness for fires or explosions on the site. It is unclear whether crews on the site will be trained to handle such mishaps and whether there will be appropriate equipment on site to respond to the problem. (Commenters: 17, p. 7; 65, p. 44: 57, p. 2)

Response: The plant will have fire-fighting equipment on hand and trained personnel on duty during operation. It would be expected that outside assistance might be required and will be available should a major incident occur.

After detailed design is substantially complete, as part of the preparation for start-up and operation of the plant, detailed emergency procedures will be developed. These procedures will be used to train plant personnel in methods to handle emergencies such as fires and explosions at the site.

4.2 Comment: Provide a detailed scenario of the full impact of a major fire or explosion including number of deaths, effect on Owensboro and compensation for victims. (Speaker 1)

Response: While major fires have occurred in related industries (e.g., petroleum, petrochemical, and refineries), no major fires or explosions have occurred at SRC pilot facilities. DOE recognizes the potential for fires and explosions during the operation of the proposed SRC-I demonstration facility. The possibility of these occurring will be minimized through the Preliminary Hazards Identification System and Hazards Evaluation Program as discussed in Appendix AA of this FEIS. These analyses will culminate in a formal Safety Analysis Report. Because of the distance involved [26 km (12 miles)], Owensboro would not be affected.

4.3 Comment: There is no discussion of what emergency controls are available, and what damage might result, if retaining walls fail and the liquid storage, SRC product storage, and coal storage areas and the ash ponds are all inundated by flood waters. (Commenter: 17, p. 7)

Response: The bases of the coal storage and SRC solid product storage areas are above the 100-year flood elevation. These areas will not be diked. If a flood event greater than the 100-year flood occurred, these materials will be released into the floodplain. The base of the hazardous waste landfill is above the elevation of the 500-year flood and is diked to an elevation of 390 ft; it should not be affected by floods of this magnitude. The base of the slag/flydust landfills will be below the 100-year flood elevation, but the dikes will be above the 500-year flood elevation. If the dikes failed during a 100-year flood, some portion of the slag and its leachates would be released to the floodplain.

4.4 Comment: There are no procedures established to deal with a breach in the landfill liners. According to the DEIS, "avoidance strategies" are being evaluated, but there seem to be no studies designed to address the problem should the event occur. (Commenter: 17, p. 7)

Response: Accidental breaching of landfill liners is discussed in the Contingency Plan included as Appendix HH of this FEIS.

4.5 Comment: The discussion of transportation impacts (accidents) in the Draft EIS addresses only rail transportation of SRC products. Appendix Y of the Draft EIS contains a discussion of SRC products being moved by barge. This conflict should be resolved and if barge transportation of SRC products is proposed, an analysis similar to that provided for a rail scenario should be provided in the final EIS. (Commenter: 55, p. 2-3)

Response: The scenarios included in Appendix Y were intended to provide the basis for a worst-case analysis. However, no products from the SRC-I demonstration facility will be transported by barge.

4.6 Comment: The DEIS contains no Spill Prevention Control and Countermeasure (SPCC) plan and no detailed designs for any storage facilities. It is absolutely essential that a SPCC plan be prepared and provided for review as soon as possible. Without this information, a decision on the adequacy of spill control and response capabilities cannot be determined. This information should be prepared and included as an appendix to the FEIS. (Commenter: 12, p. 4, Speaker 19)

Response: The SPCC plan is being developed and will be submitted as part of the NPDES permitting process. This will require review and approval by both the USEPA and KDNREP.

4.7 Comment: Estimates of worst-case transportation spill assumes a spill of one tank car at Spotsville, Ky., which would cause water supply emergencies for Evansville, Henderson, and Nashville. If there were a train derailment, more than one car might spill into the river — multiplying the long- and short-term adverse effects. (Commenter: 18, p. 7)

Response: The quantity of liquid spilled during an accident was based on data presented in Sect. DD.3.2 of the DEIS. The average rail spill was 8780 gal and only 5% of the spills exceeded 20,000 gal (the capacity of a tank car). This quantity may be derived from the leakage of several cars in a train. Therefore, the contents of one tank car would be a worst-case example. It is recognized that an increase in the quantity spilled would increase adverse effects.

4.8 Comment: The railroad route from Newman, Ky., to Lake Charles, La., passes through more than 100 towns and communities with a combined population of over 2.5 million people. Is this "careful selection of markets and routes"? (Commenters: 65, p. 65; Speaker 102)

Response: Careful selection of the rail route involves consideration of the capacity and condition of the route to minimize the potential for accidents. The specific route from Newman to Lake Charles described in the EIS was selected by a computerized routing analysis. The analysis took these factors into consideration and identified a route between the two points which used only prime segments of track. Such a route would likely to be used to span these points. In the EIS, the analysis of impacts looked at worst-case spills along this route.

The demonstration product users which are demonstrating the product markets have been selected from large industrial concerns, for the most part, which have the people, facilities, and expertise to safely handle organic hydrocarbon materials, such as SRC products. ICRC, in conjunction with these demonstration product users, will define and implement those educational programs, operating procedures, and facilities necessary for the safe handling of these products.

The point of origin for product shipment is defined by the SRC-I demonstration plant location (Newman, Daviess County, Kentucky) and the final destination is defined by the specific product user. The specific routing, mode of shipment, and handling of the SRC products during transportation will be in accordance with all regulations and safe practices used in the transport of other industrial products and materials such as chlorine, ammonia, gasoline, propane, benzene, and vinyl chloride monomer.

4.9 Comment: Although transportation spills are dealt with at length, plant site spills are given rather short shrift. (Commenters: 18, p. 7; Speaker 19)

Response: All process areas will be paved and diked and any spills routed to a retention basin (see Appendix C, Sect. C.1.2.5 of the FEIS). See also response to comment 4.6.

4.10 Comment: The DEIS does not address the potential dangers of chemical spills in conjunction with hazardous chemical transport. (Commenter: 23, p. 3)

Response: The chemicals transported to the project are not unique to the plant and the quantities will be small.

4.11 Comment: The FEIS should include a contingency EMS plan for on-site and highway accidents; a summary of on-site medical personnel and equipment; projected additional hospital costs for emergencies related to SRC-I; and mitigation sources. (Commenter: 65, p. 44)

Response: Detailed emergency procedures will be developed after detailed design is substantially completed. The procedures will be defined as a result of the Hazards Evaluation Program described in Appendix AA.

4.12 Comment: Section 1.4.3.8, Occupational Safety and Health, mentions physical hazards common to any large-scale construction site. It does not address the need for an internal plant safety program to deal with specific hazards. (Commenter 23, p. 3)

Response: There will be a site-specific industrial and process safety program, supervised and administered by professionals, during both the construction and operating phases of the plant. See also responses to comments 4.1 and 4.2.

5. HEALTH EFFECTS

5.1 Comment: The approach to be taken by DOE is unwise and directly contravenes the requirements of NEPA. The Council on Environmental Quality's NEPA regulations indicate the course to be taken by an agency facing uncertainty over risk:

> "When an agency is evaluating significant adverse effects on the human environment in an environmental impact statement and there are gaps in relevant information or scientific uncertainty, the agency shall always make clear that such information is lacking or that uncertainty exists."

It is clear that DOE has not complied with this requirement. Plainly, research on the health and occupational risks from the proposed plant are "essential to a reasoned choice among alternatives." Moreover, the DEIS indicates that it is possible to obtain the necessary information (Appendix Z). In these circumstances, DOE's proper course is to complete further studies before approving a large demonstration or commercial plant. Even assuming that the costs of obtaining the necessary information are exorbitant or beyond the state of the art, DOE has failed to comply with the NEPA regulations by not including a worst-case analysis in the DEIS or weighing the need for the action against its risk. (Commenters: 38, pp. 54-55; 60, pp. 1-5; 64, p. 2; 65, p. 4; 44, p. 5; Speaker 40.)

Response: The major thrust of the EIS is that long-term health and environmental protection will be ensured through design and comprehensive occupational safety and health, industrial hygiene, and environmental monitoring programs (Sect. 4). Such programs are preferred over present speculative worst-case analysis. Furthermore, the industrial hygiene program will ensure that worst-case exposures under normal operating conditions will not exceed threshold limit values (TLVs) as specified by the Occupational Safety and Health Administration (OSHA) or as recommended by the National Institute for Occupational Safety and Health (NIOSH). The TLVs do exist for many of the materials of concern (see refs. 2-5 of Sect. 4, and Appendix Z.3). Potential skin contamination is also discussed in Sect. 4. Abnormal conditions will be brief in duration and will be covered by detailed emergency procedures. Upset and emergency conditions were discussed in Sect. 4.1.3 and Appendix C.4.1.4. Even maximum release for a short duration during emergencies, start-up, and shutdown are not expected to produce concentrations in ambient air exceeding TLVs. Public exposures will be much lower than maximum predicted short-term exposures, thus adverse effects in the general population are not expected (Sect. 4.2.3.1 and Appendix S). See additional discussion in the response to comments 5.2 and 5.4.

5.2 Comment: There is every reason to expect increased cancer rates to occur because of the development of coal conversion plants. We think that the SRC-I DEIS is insufficient both legally and technically in assessing the increased cancer risk. The SRC-I DEIS does not contain enough information to assess the risk due to the SRC-I demonstration plant, the SRC-I commercial-sized plant, or the combined effect of the SRC-I plant and other synfuel plants planned for this area. (Commenters: 65, p. 9; Speaker 22)

Response: Given adequate industrial hygiene and environmental monitoring programs, there is little reason to expect increased cancer rate due to modern coal conversion plants.

The EIS, in Sect. 1, outlines DOE's approach to synfuels risk assessments and the ongoing programs to obtain data in support of risk assessment. There appears to be, at this point, no single, accepted, scientifically valid way to quantify risk, as measured by mortalities and morbidities in occupationally and environmentally exposed populations or as measured by loss of habitat, ecological productivity, etc., for the SRC process or established technologies such as petroleum refining, petrochemical synthesis, or coal coking. In recent years, it has become apparent that there is a risk of cancer to workers associated with the coal-coking and petroleum-refining industries. Based on epidemiological data, changes in work-force practice

and in industrial hygiene and personnel monitoring are continually being developed and upgraded in these industries. Regulation as to specific hazard is either in place or being considered by Federal and state agencies. In the case of SRC-I, a research program in progress is attempting to define elements of biomedical and ecological risk and will aid in assessing the magnitude of that risk and in developing controls to ameliorate the risk (Appendix Z). The SRC-I process, like all technolgoies involving chemical and physical agents, is not devoid of risk. Where it differs from established technologies is in the ongoing attempts to ameliorate risk before the SRC-I process becomes a larger-scale supplier of energy needs.

5.3 Comment: In July 1978, the U.S. EPA released a document for external review. This document discussed how the increase in lung cancer can be calculated based on a lifetime exposure to airborne polycyclic organic materials. These types of calculations should be carried out and an estimate of the increased cancer risk included in the FEIS. (Commenters: 65, p. 10; Speaker 40)

Response: Determination of risk requires an exposure assessment and health effects assessment. Exposures in the case of SRC-I are expected to be much lower than in any of the studies treated in the EPA document because of the particular attention given to rigorous industrial hygiene and environmental monitoring to detect exposure early and prevent long-term exposures. Sections 4.5 and 4.6 discuss the monitoring and mitigation programs for SRC-I. See also response to comment 5.2.

5.4 Comment: The description of occupational and health effects provided in the DEIS is inadequate for KDNREP's evaluation purposes as it provides little meaningful data upon which to understand the health risks associated with the project. KDNREP has the responsibility under KRS 224.033 to provide for the control of emissions of potentially hazardous matter and toxic substances. Evaluations of facilities with the potential to emit substances that may be harmful to health and welfare of humans, animals, and plants will be made on an individual basis by KDNREP (see 401 KAR 63:020).

Information is needed on the toxicity and other hazards of the compounds to be emitted from the plant during both normal operations and upset conditions. An analysis of the individual hazards of the hundreds of minor compounds is not required for, for example, phenols, benzene, heterocyclic sulfur, etc., with those compounds of major health concern identified. For each emission stream, the estimated concentration of the toxic materials of concern in time and place at its interface with the target populations (occupational and surrounding populace). If insufficient data are available, a range should be provided using best available estimates. (Commenters: 12, pp. 9-10; 64, p. 2; Speaker 89)

Response: Health risk assessment will be essential to determine priorities concerning the materials of concern and for providing guidance for the health protection program. However, because there is no reason to expect other than very low exposures under existing guidance (e.g. TLVs), it is preferable to base risk assessments on actual data as the SRC-I plant itself. Such data and risk assessments will be essential to provide a basis for expansion to commercial-scale operation. See also responses to comments 5.1 and 5.2.

5.5 Comment: The DEIS does not provide a detailed enumeration of the potentially harmful substances likely to be present at the SRC-I plant. Both the decision makers at DOE and the public are entitled to DOE's present best estimate of which substances will be found at the proposed plant and what evidence exists concerning the potential harm from exposure to those substances. Both the light and middle distillates as well as the gases generated in the SRC-I plant contain numerous chemicals which are known to be carcinogenic or genotoxic, or to be developmental toxics or potent neurotoxins.

For this reason, we believe that the DEIS should attempt to quantify the amount of possible human exposure to these toxics and should also address specific measures which will be taken to mitigate exposure. (Commenters: 38, pp. 42-49; 57, p. 1; 11, p. 1; 47, p. 1)

Response: It is inappropriate to list every chemical species likely to be present in the materials thought to be of toxicological concerns. The classes of compounds and process materials have been identified and discussed in the DEIS (see Sect. 4.1.2 and Appendix Z). For a discussion of specific mitigating measures, see Sect. 4.6.

DOE recognizes that any complex hydrocarbon material such as petroleum or process and product streams from SRC will contain literally tens of thousands of compounds, ranging from harmless to harmful as single entities. A definition of harm based on properties of single agents may not cover the actual and observed effects of a mixture of those agents because both positive and negative biochemical and biological synergistic interactions among agents may occur. Chemical entities of greatest concern are discussed in the assessment methodology sections (Sects. 1 and 4.1 and Appendix Z) of the FEIS.

5.6 Comment: The DEIS fails to provide any monitoring data on the substances actually found to be present at the two SRC plants and the PDU. Surely, after more than 5 years of operating small-scale SRC facilities, DOE has actual data on substances present at those plants. Such data should be included and analyzed in the EIS. (Commenter: 38, p. 49)

Response: Section 4 of the DEIS provided an overview of this information, with reference to the pertinent literature as well as a discussion of the general applicability of the information to SRC-I. A revised Appendix Z in the FEIS provides a summary of experience at the Fort Lewis and Wilsonville pilot plants. Exposures at Wilsonville (ref. 1, Sect. 4) have generally been low (<TLVs) and, where higher than TLVs (one upset condition), have been remedied. The existence of the industrial hygiene efforts will ensure such results.

5.7 Comment: What were the results of the industrial hygiene program conducted at the Wilsonville pilot plant? What were the results of plant ambient air monitoring? How do the predictions in the DEIS for this pilot plant compare with what actually occurred? (Commenters: 64, p. 6; 57, p. 1)

Response: Based on monitoring results from the Wilsonville pilot plant, concentrations of fugitive emissions within the demonstration plant are expected to be well below TLV (see added discussion in Appendix Z.1). Although the DEIS did not include ambient air quality concentrations from Wilsonville, concentrations outside the plant boundary are expected to be even less than the measured concentrations in the worker environment. See revised Appendix Z.

5.8 Comment: The DEIS informs us that higher molecular weight polycyclic aromatic hydrocarbons and amines were found in the work environment by monitoring at Exxon Donor Solvent pilot facilities. The observed concentrations should be included in the final EIS. (Commenter: 64, p. 2)

Response: The observed concentrations at the Exxon Donor Solvent pilot facilities can be found in ref. 1, Sect. 4.

5.9 Comment: The heart of DOE's plan to deal with the admittedly significant occupational and health hazards of the proposed plant is a four-phase research effort (see DEIS, Appendix Z). However, the DEIS offers no plan for funding that research. This is a serious omission in light of the DEIS's own admission that "financial constraints may prevent all of the proposed research from being completed" (DEIS, p. 4-3). The omission is even more serious in light of President Reagan's recent proposals to trim DOE's funding of environmental studies (President of the United States, *America's New*

Beginning: A Program for Economic Recovery, February 18, 1981, pp. 4-18). The FEIS must include a concrete plan for funding the research effort proposed in Appendix Z. In light of the President's proposed budget cuts, that plan will doubtless have to include a binding commitment on the part of the private participants in the project to fund most of the proposed research. (Commenter 38, p. 55)

Response: Although DOE cannot ensure that the research programs are carried out if it is no longer responsible for the work, the plant will have to adhere to existing and future regulations enforced by OSHA, EPA, and other regulatory bodies. Other federal agencies, such as NIOSH and the Department of Human Health Services and private concerns could be expected to continue to conduct supporting research and analyses. Should the project proceed with DOE involvement, DOE will place high priority on carrying out these research programs (Sect. 4.1.2). In the absence of DOE's involvement, ICRC is not committed to the full four-phase research program (Appendix Z.2) beyond those requirements for complying with regulations. The EIS refers to work by other agencies.

5.10 Comment: If the government continues to bear responsibility for the required health studies and implementation of any changes indicated by those studies, some method has to be developed for assuring timely and full response of the DOE to research results. (Commenter: 38, p. 56)

Response: If DOE continues its involvement in the project, timely and full response to research results will be ensured through the risk assessment program (Sect. 1).

5.11 Comment: The DEIS implies that whatever risk does exist will be dealt with adequately through plant design changes and reduction in worker exposure through training and protective clothing. Without considerable additional detail on the proposed measures and further research, this implication is unsupported and, indeed, unsupportable. (Commenters: 38, p. 53)

Response: Section 4.5 has been expanded to provide additional information on the occupational health and safety monitoring and mitigation program for SRC-I. See also responses to comments 5.4 and 5.9.

5.12 Comment: The failure of the DEIS to include an explicit consideration of the short- and long-term local and regional environmental health impacts represents one of the single largest deficiencies in the environmental assessment document for the proposed facility. Instead of developing community health baselines for both the immediate impact area and the region and proposing long-term (10-year minimum) epidemiological studies to assess the effect of the proposed action on human health, the health-maintenance strategy offered in the DEIS is limited to toxicological testing for acute animal response and biomedical/clinical studies for acute worker or occupational exposure. Utilization of this proposed approach completely eliminates the possibility of being able to quantitatively determine the health risk or effects (biological or economic) truly associated with the proposed action. The overall monitoring strategy for the project should be significantly expanded to provide for an epidemiological study that will define and clarify current local and regional health characteristics, analyze health effects, and eventually serve as part of the basis for helping to determine the environmental significance of the project in terms of both benefits and costs associated with maximizing local and regional societal and individual well-being. (Commenters: 12, p. 2; 18, p. 6; 65, pp. 5, 14, 70, 71; Speakers 40, 54, 38, 89, 103)

Response: As stated in Sect. 4.1 of the EIS, exposure of workers is expected to be of more concern even though fewer persons are involved. The occupational health and industrial hygiene programs are intended to detect any exposures or clinical symptoms early before cumulative effects develop. Detection and mitigating exposures at the source is the best way to ensure long term health protection. Information from one plant will not provide epidemiologically significant data to confirm negative or positive projections. Thus medical and exposure data on all synfuels workers should

be combined into a single medical registry. Both industry and the National Institute of Occupational Safety and Health are investigating the design and execution of a synfuels industry-wide medical worker registry. Epidemiological studies on the general population might be justified based on total exposure from all sources in the region but not on the potential incremental exposures from this single plant where thorough attention is devoted to detecting and mitigating exposures. Monitoring is discussed in Sect. 4.5 of the FEIS.

5.13 Comment: It is suggested that the expected emission levels be compared with those found in petroleum refineries, coke ovens or other facilities with similar emissions to provide some perspective on the relative hazards associated with plant operation. Potential health effects should be described and safe exposure limits (both acute short term and trace long term) should be provided so that a risk assessment can be determined. (Commenter: 12, p. 10)

Response: The information on coke ovens, other facilities, and petroleum refineries is summarized in Sect. 4 and Appendix Z and C of the EIS. Emissions, including upset conditions, were estimated. The overall approach to risk assessment was given in Sect. 1. Limits do exist in the form of TLVs for most of the materials of concern (see Appendix Z, Sect. Z.3). Adherence to these limits with special precautions and research for others, such as complex mixtures, should ensure that a quantitative risk assessment can await needed data specific to the SRC-I facility itself. A recent report by the Kentucky Department of Energy (Coal Conversion Projects Summary, April 1981) provides further discussion of the projected comparative impacts of the synfuels industry in Kentucky relative to other uses of coal. See also responses to comments 5.1, 5.2, and 5.3.

5.14 Comment: A major purpose of the demonstration plant will be to evaluate health and environmental risks. "One of the purposes of the SRC-I demonstration program is to identify health and environmental risk associated with the demonstration plant itself and a future commercial SRC industry" (p. xv). The long induction time often associated with cancer agents should be kept in mind. Will the decision to expand to commercial size be made before an accurate assessment of the demonstration plant's health impacts can be made? According to the DEIS, this decision may be made in only two years. (Commenters: 18, pp. 4, 7; 64, p. 2; Speaker 32, 38, 69, 92)

Response: An accurate risk assessment must be based upon operational data on the SRC-I facility itself. The data on the carcinogenic potential of SRC-I materials from pilot plant studies on mutagenicity and carcinogenicity in animals and other short-term data will help to place SRC-I materials in the context of the total body of information on carcinogenic materials and in context of existing standards for synfuels facilities. Research on pilot plants is the only way to provide a reasonable basis for a decision. The requirements for occupational and public health protection programs can be more specific to SRC-I-type facilities. Risk assessments based on data from the demonstration plant can be completed before a decision to expand to commercial scale.

5.15 Comment: The DOE has absolutely no basis to conclude from the Fort Lewis experience that its industrial hygiene practices have been effective and that workers were not subject to serious risk. Most cancers have an average latency period of more than 20 years between the onset of exposure and the diagnosis of disease. Five years of experience is simply too short a time from which to draw any conclusions, especially considering the known hazards of the chemicals involved. (Commenter: 38, p. 51)

Response: The discussion in Sect. 4.1.1 does not conclude that workers are not subject to serious risk. However, the discussion does point out that the experience at Fort Lewis has not been equivalent to earlier experiences at Institute, West Virginia, as regards skin cancer. Major credit should be given to the industrial hygiene program. It is now recognized that carcinogens are present in process

streams. This alone requires major emphasis on industrial hygiene procedures to detect and mitigate exposures before exposures accumulate and convert serious risk to actual effects. See response to comment 5.14.

5.16 Comment: The EIS provides no details on the methods of industrial hygiene that are followed at Fort Lewis, the kinds of monitoring exposure being done, and the kind of medical surveillance being performed. Without such data, there is no basis for evaluating the Fort Lewis experience. (Commenter: 38, p. 52)

Response: The EIS does provide discussion of the proposed occupational safety, industrial hygiene and environmental monitoring and mitigating programs for the SRC-I facility. A new Appendix Z.1 has been added to the statement, and Sect. 4.5 has been revised.

5.17 Comment: The industrial hygiene program is expected to be much better than prior programs, but the details seem no different than those at Institute, West Virginia. The same type of measures were used in a coal conversion facility in Institute, West Virginia, during the 1950s, and there the workers still suffered cancer rates as much as 37 times that of the general population. (Commenter: 18, p. 8; Speaker 89)

Response: Knowledge about the toxicological properties of the materials associated with synfuels has been much improved by the experience at Institute, WestVirginia, and further testing, such as at Ft. Lewis and Wilsonville, Alabama. Guidance on occupational safety, exposure limits, and monitoring guidelines has evolved considerably (see references, Sect. 4) since the 1950s. Thus, the occupational health and safety program at the demonstration plant will be more comprehensive and more effective than the program at Institute, West Virginia. Concerns about potential exposures to toxic materials and remedial measures are discussed in Sect. 4.1 of the EIS.

5.18 Comment: The DEIS also mentions the study conducted by Richard J. Sexton, M.D., at a coal conversion plant located in Institute, West Virginia. The SRC-I DEIS unfortunately misinforms the public about the severity of the cancer risks found in that study. The DEIS is inconsistent in stating that "an increased incidence of skin tumors (about five-fold) was found in the work force . . . ." The actual study by Sexton, however, states, "The incidence of cancer in these men was between 16 and 37 times that reported in the literature" (R. J. Sexton, "The Hazards to Health in the Hydrogenation of Coal: IV. The Control Program and the Clinical Effects," *Archives of Environmental Health*, vol. 1, pp. 208-31 (1960). (Commenters: 65, p. 6; 18, p. 6; 38, p. 52; Speaker 40)

Response: The comment is correct based on the specific reference cited. The text of Sect. 4.1.1 of the FEIS has been changed.

5.19 Comment: The DEIS fails to include some of the existing evidence on the risk of harm from coal hydrogenation plants. Included among the missing evidence is the EPA study of a Yugoslavian hydrogenation facility. See R. K. Patterson, "Ambient Air Downwind of the Kosovo Gasification Complex: A Compendium," unpublished Environmental Protection Agency paper.

The Environmental Protection Agency did an air monitoring study downwind from the Kosovo, Yugoslavian plant. Their monitors 2 km downwind found benzo(a)pyrene, a very potent chemical carcinogen, in concentrations over a thousand times what is normally considered to be safe.

They found benzene concentrations ten to a hundred times what is considered to be safe. Plant sponsors argue that the United States will use better control technology, but it should be realized that this plant in Yugoslavia is only one-tenth the size of any proposed commercial-sized U.S. facility. (Commenters: 38, p. 53; 65, p. 8; Speaker 40)

Response: Kosovo gasifier represents an uncontrolled situation. Personnel monitoring data analyzed for 28 individual polycyclic aromatic hydrocarbons from the pilot plant in Wilsonville, Alabama indicates that few high-molecular-weight compounds can be detected in the air (see new Appendix Z.1). Benzo(α)pyrene was not detected (0.01 $\mu g/m^3$ detection limit), and only pyrene (noncarcinogenic) was detected in the potentially carcinogenic four-ring and greater compound group and it was detected at levels of less than 0.1 $\mu g/m^3$.

Personnel monitoring data for benzene at Wilsonville showed 21 samples with concentrations less than 0.01 ppm. Both sets of samples were taken during normal plant operation and reflect concentrations within plant boundaries. It should also be noted that Wilsonville has a very dense clustering of potential sources and, therefore, these results probably represent maximized average values. Other potential pollutants were at similarly low concentrations. The concentrations indicated are well below any health standard and would be many times less concentrated outside the plant boundary due to normal dispersion by air currents.

5.20 Comment: The DEIS still does not adequately relate or address why there were not sufficient studies conducted either in pilot projects or research programs that would have led, at this point in time, to:

(a) better chemical characterization of toxic materials;

(b) essential biological testing of materials, including dermal and inhalation carcinogenesis, teratogenesis, and male reproductive effects; and

(c) basis assays, which indicate mutation and chromosomal alteration in microorganisms and which would have identified materials to be assayed for long-term chronic effects. (Commenters: 65, p. 64; 60, p. 6; 18, p. 6; Speakers 7, 102)

Response: These points are discussed in the EIS in Sect. 4 and Appendix Z. A new Appendix Z.1 has been added to the FEIS which provides additional information. One cannot directly characterize a facility that does not yet exist. The process will contain materials known to be carcinogenic, mutagenic, teratogenic, and otherwise toxic. This is the major reason (see responses to comments 5.1, 5.2, and 5.3) for rigorous protection programs.

5.21 Comment: A reasonable timetable is needed for the proposed four phases of the Health and Ecological Studies Plan: For example, it is stated (p. 2-34) that most of the studies in the first three phases will be completed before operation of the plant begins. However, it states repeatedly that Phase II will determine long-term effects of chronic exposures. How long is long-term if studies in Phase II are to be completed before plant operation? Also, a number of studies in Phase II are dependent on results from Phase I studies. It seems improbable, given the complexity of the studies and the proposed timetable, that these studies will be completed before plant operation. (Commenter: 65, p. 64; Speaker 102)

Response: Based on the schedules, Phase I and II work will be essentially completed by plant start-up. Phase III work has already started and a similar time for conclusion of work is planned. As defined, Phase IV takes insights from the first three phases to develop useful methods, assays, and procedures. Phase IV is also expected to be completed by plant start-up.

5.22 Comment: Considering the long latency periods for carcinogenic effects to become apparent, and considering that Phase II is supposed to study "long term effects of chronic exposures," it is beyond belief that these two phases can be completed before 1984. (Commenter: 60, p. 6; Speaker 102).

Response: Long-term toxicology tests (such as carcinogenic) are usually completed within two years on laboratory rats or mice. However, up to one year of additional time is needed to calculate proper test conditions (e.g., doses) to gain the maximum amount of information from the tests. Therefore, up to three years may be needed to complete a long-term test in animals. As it is currently scheduled, these will be completed before plant start-up. These studies will help to better define the carcinogenic potential of SRC-related materials.

5.23 Comment: It is difficult to comprehend how Phase III, which deals with altered plant operating conditions, can be completed before the plant experiences normal operating conditions (p. 2-35). (Commenter: 60, p. 7)

Response: The intent of the statement on p. 2-35 of the DEIS was directed at tests on pilot plants such as Fort Lewis and Wilsonville, Alabama, where operating conditions can be altered. Studies will continue after start-up of the SRC-I demonstration to directly confirm conclusions based on the pilot plant data. See also response to comment 5.22.

5.24 Comment: The DEIS should indicate that other agencies besides DOE are involved with health related synfuel activities. (Commenter: 57, p. 3)

Response: See response to comment 5.9.

5.25 Comment: Page 4-7, Sect. 4.1.3.3, paragraph 4, line 12. "The DOE program . . . should be in concert with HHS, EPA, and OSHA expertise and know how. In fact, these agencies should be called upon to assist DOE in the selection/prioritization of compounds with the greatest potential health effects. (Commenter: 57, p. 2)

Response: The agencies mentioned do have input to the program. The specific reference to DOE has been deleted from the sentence in question.

5.26 Comment: The DEIS presents a proposed occupational health protection program (p. 4-9) that includes medical monitoring, protective equipment, specific work practices, industrial hygiene monitoring, special procedures and equipment, etc., but mentions only a safety engineer and a safety and health director as personnel responsible for the program. In other words, the personnel requirements for such a comprehensive program do not seem to be adequately addressed. (Commenters: 65, p. 65; 57, p. 4; Speaker 102)

Response: Plant staffing requirements have not been finalized. However, the Occupational Health and Safety Director is expected to report directly to the plant manager. Reporting to the Director will be a safety engineer and an industrial hygienist (Sect. 4.1.3.6, p. 4-10, and Sect. 4.6.9, p. 4-143 in the DEIS). Also reporting to him from an administrative standpoint will be two plant nurses, who will report functionally to the plant physician (Sect. 4.1.3.6, p. 4-10, and Sect. 4.6.9, p. 4-142 in the DEIS). The plant physician will be available as required but is expected to spend approximately 50% of his time on the plant medical/industrial hygiene program on an ongoing basis.

Supporting these professionals will be several clerical personnel, technicians, and laboratory people for monitoring, inspection, etc. Also supporting them will be the plant control laboratory, which is expected to be staffed with about 40 professionals and technicians.

5.27 Comment: Page 4-9, Sect. 4.1.3.6, Paragraph 1. Will a full-time industrial hygienist and an occupational nurse and/or physician be physically located at the plant? This is not addressed. (Commenter: 57, p. 2)

Response: See response to comment 5.26.

5.28 Comment: Page 4-10, paragraph 4, line 6. The records should also contain information on the employees' eating, drinking, and smoking habits. (Commenter: 57, p. 3)

Response: Smoking and drinking habits are, and will be, information collected as part of the physical examinations. Eating habits may vary too much to be a useful diagnostic tool in this type of a plant.

5.29 Comment: In the last paragraph on p. Z-5 of Appendix Z, there appears to be some confusion in this particular paragraph between NIOSH and OSHA. NIOSH is a part of the Department of Health and Human Services and is basically a research agency. OSHA is a part of the Department of Labor and is a regulatory agency. Line 4 mentions OSHA-sponsored data base projects. Although OSHA has been working closely with NIOSH in terms of offering counsel and advice of a general nature in the areas of control technology and industrial hygiene surveillance related to the energy technologies, NIOSH, through an interagency agreement with EPA, has been sponsoring the data base projects cited in this paragraph. (Commenter: 57, p. 3)

Response: Appendix Z has been completely revised and the paragraph in question has been omitted.

5.30 Comment: Page x, line 2. A medical surveillance program should also be included. (Commenter: 57, p. 1)

Response: Medical surveillance is the equivalent of medical monitoring mentioned on p. x, lines 3 and 4 of the DEIS.

5.31 Comment: Many of the properties of SRC products are unknown. There are no standards, there are no federal environmental regulations for almost all of these compounds. Contrary to what we might be led to believe by anti-environmental rhetoric, there simply are not regulations for these compounds as far as emissions go. (Commenter: 38, p. 21; Speaker 22)

Response: Although properties of some specific chemical components are unknown, properties of the classes of chemical compounds present are well documented. These properties have been verified by operating experience of the Wilsonville pilot plant.

Compounds for which emission standards are lacking require a scientific judgment to determine safe concentrations. This judgment may be based on recommendations or health standards by such groups as the Occupational Safety and Health Administration (OSHA), the National Institute of Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH).

Many PAHs and heterocyclics do not currently have established standards. However, the OSHA standard for coal-tar pitch volatiles incorporates most, if not all, of the high-molecular-weight compounds in question. Although this standard may not result in zero risk for the industries presently using it, a significant decrease in risk will probably result.

5.32 Comment: There is too little research available about the effects of some of the emissions, products, by-products, and wastes of the SRC-I process. We question the health risk to the people in the area, including residents of Evansville and Vanderburgh counties, and we question the ability of present agencies and regulations to adequately monitor and/or eliminate these risks. (Commenters: 60, p. 10; Speakers 19, 38)

Response: Plant design, operating procedures, and monitoring programs both in and around the plant will all be more stringent than will be required by currently existing regulations. When designing these aspects of the plant, guidance is being taken from laws and regulations in other industries than synfuels. Designs are being carried out under the assumption that eventual regulations for synfuels will be as strict as the most stringent of these comparable regulations for other industries.

One objective of the project is to develop a body of information upon which to base regulations to be written for the commercial industry. A carefully designed and thorough monitoring program will be carried out to develop this information.

The approach being taken in the design of this plant is not to ignore unregulated areas, but to take extreme care in those areas identified as having potential to cause a significant health problem. One example of this approach is the care taken with the controlled combustor system. The design goals for this system exceed those which would be required merely to meet regulations on allowable hydrocarbon emissions. The goal is maximum possible protection that can be achieved in a combustor designed so that it can be confidently predicted to function properly. This design approach is being used in the design of the wastewater treatment and reuse, solid waste disposal, fugitive hydrocarbon emission controls, and other systems in the plant where health hazards are expected to be significant and direct pertinent regulations do not exist.

5.33 Comment: Paragraph 4-7. "Engineering controls . . . will be designed with the intent of limiting concentrations of fugitive hydrocarbons to within the permissible exposure limits (PEL) for coal-tar-pitch volatiles in all process areas." Are the limits appropriate for the SRC process streams (i.e., are the heavy distillates not more mutagenic/carcinogenic)? (Commenter: 18, p. 7)

Response: Coal-tar-pitch volatiles include components of the heavy distillates such as polynuclear aromatic hydrocarbons. Thus the limit, as applied to heavy distillates, is applicable.

5.34 Comment: Page 4-10, paragraph 5, line 3. What NIOSH methods are being referred to here? A reference is needed. NIOSH has not specified methods for evaluating potential indicator compounds — although there is a discussion on using the indicator-monitoring concept in NIOSH's Coal Gasification Criteria Document (Publication No. 78-191, 1978). (Commenter: 57, p. 3)

Response: The reference number has been added to the text. It was included as ref. 3 for Sect. 4 of the DEIS. The word *specified* has been changed to *discussed*.

5.35 Comment: Ambient monitoring in the plant and the surrounding area should be conducted for those compound classes found to be of major concern and/or "indicator" compounds to ensure maximum protection of public health. (Commenters: 12, p. 10; 11, p. 2)

Response: See Sects. 4.1.3.6 and 4.5.3, which describe the ambient monitoring at the plant site. Occupational health monitoring will provide direct input for estimates of public exposures.

5.36 Comment: Page 4-3, Sect. 4.1.2. The use of indicator compounds must be pursued with extreme care. Processing of different coal types under one or more operating conditions may result in such complex mixtures of chemicals as to question the usefulness of the indicator compound. Much research will be needed to establish suitable confidence levels for each indicator compound. In general, indicators may be more useful for planning comprehensive experimental monitoring programs and for identifying emission sources of coal-derived materials than for estimating inhalation and dermal exposures. (Commenter: 57, p. 2)

Response: The potential problems associated with the use of "indicator compounds" are documented. Potential "indicator compounds" will be evaluated during initial comprehensive area monitoring. If they are used, periodic spot checks will be made to ensure the accuracy of their predicting abilities.

5.37 Comment: Will people in Evansville and Vanderburgh County become ill as a result of a synfuels plant development in the area? The question is not addressed or even raised in the DEIS document. (Commenters: 18, p. 5; Speaker 38)

Response: Section 4 discusses the potential health effects and the necessary rigorous occupational health and safety, industrial hygiene, and environmental monitoring programs to ensure protection. Because exposures will be held to very low levels, the probability of health effects is also very low.

5.38 Comment: The text of the DEIS contains a confusing series of references to the various mechanisms by which cancer may be fostered. The mechanisms by which cancer is encouraged are irrelevant to the design of the SRC-I plant. Whether cancer comes earlier or later, whether it is encouraged by a "potentiator" or a carcinogen, is largely irrelevant. Preventing exposure to any of these substances is likely to reduce the ultimate risk of cancer. (Commenter: 38, p. 52)

Response: Cancer mechanisms, promoters, cocarcinogens, etc. are very important in establishing exposure limits. Minimizing exposures is the purpose of the monitoring programs discussed in the EIS.

5.39 Comment: Page 4-9, Sect. 4.1.3.6, paragraph 3, line 4. It should be noted that there are other occupational diseases besides cancer that may result from exposure to process materials. (Commenter: 57, p. 3)

Response: Sections 4.1.3.6 and 4.1.2 of the EIS discuss potential health effects in addition to cancer.

5.40 Comment: The 53 pages of Appendix Z are entitled "Health Effects" but say nothing about human disease. Most of the appendix consists of columns of x's indicating which materials will be tested, in which systems, and by which laboratories. We can thus learn that naphtha, coal dust, gasifier fly ash, green coke, and heavy oils will be instilled into rabbits' eyes to see if they cause irritation. (Commenter: 18, p. 7)

Response: The proposed health, environmental, and assessment programs are much broader than indicated by the commenter. Potential human health effects and prevention measures were discussed in Sect. 4 and Appendix Z of the DEIS and are revised in the relevant sections of the FEIS.

5.41 Comment: Page 4-2, paragraph 2. In addition to carcinogenicity, mutagenicity, and teratogenicity, what about effects on reproduction? (Commenter: 57, p. 2)

Response: Reproductive effects are included in studies of teratogenicity.

5.42 Comment: In the event of an accident of discharge of these chemicals into the Green and Ohio rivers, or should that theoretically feasible zero-discharge feature of the plant fail to do in reality what it was supposed to do on paper, how would those chemicals and organic compounds affect us?

How long can a human body tolerate these chemicals before death occurs? And what are some of the physical symptoms short of death that a body would encounter if the chemicals were adversely affecting him? Nausea? Vomiting? Diarrhea? Headaches? Vision disturbances? (Commenter: Speaker 69)

Response: Large releases from the plant are unlikely. The expected frequency and duration of liquid effluent discharge is discussed in Appendix C, and the impacts are discussed in Sect. 4.2.2.3 of the FEIS. However, Sect. 4.1.3.8 of the DEIS addressed potential spills of toxic chemicals during transportation. As discussed in the DEIS, SRC materials appear to be of moderate acute toxicity, that is, no more toxic than many chemicals in commercial use. On ingestion of sufficient quantities of the materials, a wide array of symptoms are possible, including those listed.

5.43 Comment: Will residents downstream of the plant be given adequate warning that discharges will occur so that the chemists at the filtration plant can take emergency measures? (Commenter: Speaker 69)

Response: The filtration plant will be provided with adequate warning of such a discharge.

5.44 Comment: Page 4-5, *Wastewater and Spills*, paragraph 1, line 8. Total water recycle will concentrate trace materials to potentially toxic concentrations — possibly creating worker exposure problems particularly during maintenance and repairs. (Commenter: 57, p. 2)

Response: The occupational health and industrial hygiene programs will develop procedures to minimize worker exposure during routine maintenance and repair.

5.45 Comment: Page 4-9, Sect. 4.1.3.6, paragraph 2. Laboratory personnel who analyze samples represent another group of workers who will be exposed to process materials. (Commenter: 57, p. 2)

Response: The industrial hygiene program to be instituted includes laboratory personnel as part of the work force included in the occupational safety and health program. The occupational health protection program is included in Sect. 4.1.3.6. A source of potential exposure does exist at the sampling locations within the plant. Sampling point controls are described in Sect. 4.1.3.3.

5.46 Comment: There are no provisions for bacteriologic monitoring or disinfection of the cooling tower water and as a matter of fact, infectious problems are not even touched any where in the DEIS document. (Commenter: Speaker 38)

Response: Provisions will be made for bacteriological monitoring and disinfection of the cooling tower water.

5.47 Comment Page 4-32, Sect. 4.1.2, paragraph 1. This paragraph tends to lose sight of the acute hazards (e.g., CO and H_2S). (Commenter: 57, p. 2)

Response: These materials are discussed in Sect. 4.1.3.8. Such materials have established industrial hygiene exposure limits and monitoring procedures.

5.48 Comment: How toxic are hydrogen sulfide (H_2S) and carbonyl sulfide (COS) at the temperature and pressure (40 psi) of the proposed process? (Commenter: 3, p. 1)

Response: According to the threshold limit values (TLVs) recommended by the American Conference of Governmental and Industrial Hygienists, hydrogen sulfide is about 5 times as toxic as carbon monoxide (10 ppm TLV as compared to 50 ppm). There is no recommended TLV for COS, but it occurs at much lower concentrations in process streams. Temperature and pressure would influence leak rates but not allowable exposures.

5.49 Comment: What about continuous monitoring/alarm systems for hazardous gases (e.g. H_2S, CO, CH_4). Such systems are not addressed. (Commenter: 57, p. 2; 11, p. 2)

Response: The potential use of indicator compounds is addressed in Sect. 4.1.3.6 of the EIS. One factor in the choice would be the availability of continuous multipoint monitors for the candidate materials. In any case, continuous monitoring/alarm systems will be incorporated into the industrial hygiene program. The central control system will link alarms with prompting messages to the operators to notify specific officials and agencies should an emergency arise. In addition, operators will be trained from and have access to published contingency plans.

5.51 Comment: In a worst scenario, what impact (deaths and injuries) would be expected from a catastrophic situation where release of H_2S and COS occurred? How far would their effects be felt to the surrounding area (wildlife and people)? (Commenter: 3, p. 1)

Response: Major emergency upset conditions were discussed in Sect. 4.1.3.2 and Appendix C.4.1.4. The postulation of a "worst scenario" is of little practical value unless some consideration is also given to the probability of occurrence of the event sequence postulated. Consequently, both subjects will be discussed. Since COS is present in very small quantities compared to H_2S in all parts of the process, the H_2S presents the overriding problem. The area in the plant with the highest concentrations of H_2S is the acid gas line from the outlet of the DEA H_2S stripper to the Claus sulfur recovery unit. A loss of containment (vessel or pipe rupture or large leak) in this piping circuit could release a maximum of 3600 lbs of H_2S into the atmosphere before the breech is isolated. Such a catastrophic release would occur only if protection systems such as pressure control valves, relief valves, rupture discs, etc. failed to divert the acid gases to the flare when an overpressure developed. Under the most unfavorable wind conditions (Class F atmospheric stability) dispersion calculations predict that quantities of H_2S immediately dangerous to life and health (300 ppm-h potential exposure) could drift a maximum of 2 miles from plant boundaries before dispersion. The only way the H_2S could pose a danger at such great distances is if the release drifted in a slowly dispersing cloud. Under this assumption, the cloud would be only about 50 yards in diameter and would thus affect only a very small area at any point in its path.

The probability of the above occurrence is on the order 1×10^{-7}/year or once every 10 million years. Past industrial experience indicates that probability of rupture of vessels and low pressure piping of this length and diameter is about 1×10^{-5} events/year. The above scenario assumes some human error causing a delay in responding to the emergency (probability approximately 10%) and the probability of Class F atmospheric stability is about 30% in the Newman area.

Because of the presence of fired heaters, boilers, etc. within the process areas, there is a strong probability that the flammable H_2S cloud would ignite close to the point of release, which would prevent toxic levels of H_2S from drifting any distance. The probability of all events occurring simultaneously gives the extremely low likelihood of an H_2S release affecting third parties.

If the "worst scenario" did occur, the low wind speed present under F stable conditions would allow plant personnel to warn and evacuate affected areas. Monitors will be located within process areas to alert plant personnel to the presence of H_2S vapor and as part of the plant emergency response program, procedures will be developed to warn third parties in the event plant upsets could endanger surrounding areas. Also, such an acute exposure to H_2S would be immediately preceded by a noxious odor (detectable at 0.2 ppm) which would serve to warn residents. Population density near the plant site is low, so only a small number of people would be at risk and would require warning and evacuation. In view of these facts, no third-party injuries or deaths are expected from H_2S exposure.

5.52 Comment: Page 4-10, paragraph 3. Will fertile females be prevented from working in the demonstration plant as they have at the SRC-II, Fort Lewis pilot plant? If so, for what reason will they be excluded from working in the plant? (Commenter: 57, p. 3)

Response: Females of child-bearing age will not be prevented from working in any areas of the plant, unless there is reasonable scientific evidence demonstrating added risk. In the absence of the demonstration of such risk, the available information concerning risk will be discussed with males and females before employment so that the individuals in question may make their own decisions.

5.53 Comment: Page 4-10, paragraph 1, line 9. As the optical fiber method is still developmental, what method will be used if this method is determined not to be safe? (Commenter: 57, p. 3)

Response: It is not clear what effects UV light might have on tumorigenesis, nor is it clear that it detects all carcinogens that might be present in complex hydrocarbon mixtures such as SRC. However, UV light is useful for detecting surface contamination due to spills, and low-level UV may also be useful to monitor skin contamination. Low-level UV monitoring will be assessed as a technique for improving worker hygiene. If this is concluded to be a safe and effective practice, it will be made available to workers as they pass through the change facility. Otherwise visual examination will be relied on.

5.54 Comment: Section 1.4.3.8, "Occupational Safety and Health," mentions physical hazards common to any large-scale construction site. It does not address the need for an internal plant safety program to deal with specific hazards. (Commenter: 23, p. 3)

Response: Detailed emergency procedures will be prepared as part of the preparation for start-up and operation of the plant. These procedures will be used to train plant personnel in emergency-handling methodologies. See further discussion in revised Appendix Z.

5.55 Comment: The process will produce many tons per day of material contaminated with very hazardous chemicals (carcinogens, mutagens). This situation is not comparable to the crude oil industry whose liquid products seem to be less hazardous (e.g., much weaker mutagens in the Ames test). Exacerbating this problem is the lack of proven control technology in what will be a very demanding environment. Although recent news reports suggest more strict controls than discussed in the DEIS, this was not presented in the formal document and relies on advances not yet tested on a large scale. The combination of thousands of valves and the realities of human nature suggest that seal aging and accidents might well cause the release of significant amounts of hazardous materials. The major spill at the SRC pilot plant reinforces this concern. (Commenter: 29, p. 2)

Response: The EIS discusses these concerns and lays out programs and plans to protect against such risks. See Sect. 4 and Appendixes C and Z.

5.56 Comment: Simply stated, the plans of the plant are not completed; the exact operating conditions are not known; the exact products and by-products are not known; and therefore it is impossible to determine what the occupational and public health effects will be! (Commenters: 6, p. 4; 18, p. 6; Speakers 7, 79)

Response: There are commitments in the EIS for a vigorous occupational health, industrial hygiene, and environmental monitoring program throughout the life cycle of the facility. See responses to comments 5.1, 5.2, and 5.3.

6. WATER RESOURCES

6.1 Comment: The DEIS contains insufficient ecological, physiochemical, and toxicological information on which to reach conclusions about probable discharge impacts. Furthermore, the preponderance of this information will not be fully available until after the demonstration facility begins operation. (Commenter: 12, p. 6)

Response: Sections 4.2.2.3 and 4.2.2.4 of the FEIS have been revised to utilize EPA's data base developed to support the recent (1980) water quality criteria for toxic elements and compounds. This is the best available data base for toxicological information. Further ecological and physiological data will be collected as part of the monitoring program.

6.2 Comment: This plant is designed to operate 90% of the time as a zero discharge system of treated wastewater. In this operation the treated wastewater is used as makeup water for the evaporative cooling tower. It would thus appear that many volatile compounds in the treated wastewater will be evaporated off into the atmosphere and may later condense onto the surface. Similarly, nonvolatile wastewater pollutants will be carried out by the drift of small droplets of water and will eventually wash into the river. Thus, the plant is not truly operating in a zero-discharge system but is merely indirectly discharging the treated wastewater into the river by way of the atmosphere. (Commenter: 18, p. 5)

Response: Transport of potential pollutants in cooling tower drift will not short-circuit the zero-discharge goal. Dissolved solids that build up in a cooling water will be removed in a bleed stream (blow down) that will be evaporated to solid residue and landfilled. Less than 3% of the dissolved solids entering the cooling tower will leave as drift. Volatile compounds will be almost completely removed from wastewater prior to use as cooling tower makeup (see Appendix C, Sect. C.3.1.5).

6.3 Comment: When is the 10% discharge to be in effect? When the river is at flood stage? At low flow? The dilution capabilities of the river at and between these two extremes is quite great and could result in severe degradation of water quality if the 10% discharge occurs more often at low flow. (Commenter: 21, p. 6)

Response: Discharge could occur during any of the periods mentioned. Worst case analyses examined the potential impact during each of the periods. See the operational impacts discussion in Sect. 4.2.2.3 and in Appendix C, Sect. C.2.1.8.

6.4 Comment: Page 2-20, Sixth Paragraph. Our analysis shows that the Green River's average ambient concentrations of copper and silver, in addition to those chemical parameters discussed in the DEIS, exceed water quality standards formulated by the State of Kentucky or Federal water quality criteria. In addition, zinc was found to exceed the criteria at maximum ambient concentrations. In determining criteria for the above parameters, the data base from the 1980 EPA Water Quality Criteria Documents would be helpful. This data base is much more extensive than the one used in the DEIS (Table 4.12). We suggest the FEIS use this data base and the discussions in the FEIS be modified accordingly. (Commenter: 56, p. 1a, Speaker 28)

Response: The text in the FEIS has been revised in Sects. 4.2.2.3 and 4.2.2.4.

6.5 Comment: The proposed discharge of cyanide, phenol, zinc, and silver would significantly increase current maximum and/or average instream concentrations. Additional treatment may be required for these parameters. (Commenter: 56, p. 2a)

Response: The design of the treatment system will progress with input from the U.S. EPA and the Kentucky Department of Natural Resources and Environmental Protection to ensure sufficient treatment to meet developed effluent limits, be they water-quality or technology limited.

6.6 Comment: Page 3-22, Table 3.6. This table should state which parameters violated the Kentucky toxic criteria.

Where possible, the fathead minnow, bluegill, or other indigenous species should be used as the representative aquatic organism and the 1980 Water Quality Criteria Documents used as a data base. (Commenter: 56, p. 1a and p. 2a)

Response: Table 3.6 has been revised to indicate violations for toxicity-based standards, using the data base for fathead minnows or bluegills from 1980 water quality criteria documents.

6.7 Comment: Page 4-42, Table 4.13 and Page 4-43, Table 4.14. The 1980 Water Quality Criteria, together with the fathead minnow or other indigenous species, should be used to determine toxicity criteria. (Commenter: 56, p. 1a)

Response: Table J.7 indicates the derivation of toxicity-based standards. Tables 4.13 and 4.14 have been revised as suggested.

6.8 Comment: Page 4-41, Table 4.12. The 1980 Water Quality Criteria Documents should be used as a data base for determining compliance with mixing zone criteria. (Commenter: 56, p. 1a)

Response: Table 4.12 has been revised as suggested.

6.9 Comment: Page 4-34, Table 4.7. The Kentucky standard for cadmium is 0.012 mg/l. (Commenter: 56, p. 1a)

Response: Tables and text have been corrected.

6.10 Comment: The 7-d, 10-year low flow must be considered as the critical flow. Accordingly, water wihdrawals will not be permitted if this flow level is reached at mile 19 on the Green River. While an availability problem is not expected in association with pilot scale operation, the probability of a raw water supply problem occurring is greatly enhanced with operation of a commercial-size facility. To avoid adversely impacting any other existing beneficial use, an explicit study of instream and offstream flow impacts will be required prior to the development of a commercial scale capability and permitting initiation of start-up operations. The FEIS should specify that such a study will be conducted. (Commenters: 12, p. 3; 9, p. 3)

Response: A study to assess the severity of impacts due to cumulative water consumption needs to be performed prior to the development of a commercial-scale facility at the Newman site.

6.11 Comment: If insufficient discharge mixing results under 7Q10 conditions, the project sponsor must apply to have a mixing zone established under Kentucky's water quality standards. In that event, only up to one-half of the 7Q10 may be allowed for wastewater dilution. (Commenter: 12, p. 6)

Response: Currently, the industrial partner proposes to discharge wastewater with a diffuser to ensure complete mixing and preclude the need for a mixing zone. If, however, this does not prove possible, a mixing zone permit will be obtained.

6.12 Comment: Page 4-32, last paragraph. This is the beginning of a description of the "simple model" used in developing the analysis presented in Table 4.7. Major decisions are to be based on this work which, when given a closer look, turns out to be the design equation for effluents entering streams which are rapidly flowing and completely mixed. The Newman plant effluents will enter Green River backwaters held by an Ohio River mainstem high-lift dam. The reach forms a long, narrow lake, not the bubbling, flowing stream upon which the DEIS calculations are based. The assumption of complete mixing, as applied to this system, is without a semblance of scientific credibility. (Commenter: 48, p. 1)

Response: As indicated in Sect. 3.2.2.1, the SRC-I site is located 16 km upstream from Lock and Dam No. 1 on the Green River (not a backwater of an Ohio River dam as the commenter states). Although the Green River is impounded, it is more like a river than a lake in character; significant mixing occurs as a result of river flow and barge traffic. Furthermore, wastewater discharge will employ a diffuser to maximize mixing.

The text and tables explicitly state that the model used to analyze the discharge of SRC-I wastewater assumes complete mixing of discharged effluent with the flow of the Green River. Use of such a model is legitimate, since compliance with standards is evaluated under fully mixed conditions. The results indicated by the analysis (Tables 4.7 and 4.9) apply to the far-field (i.e., that part of the river downstream from the mixing zone). Analyses of the impact of wastewater discharge typically consider both the far-field (fully mixed conditions) and the near-field (mixing zone). Impacts within the mixing zone are considered in terms of effects on aquatic biota, discussed in Sect. 4.2.2.4.

6.13 Comment: How is it possible to say that the liquefaction facilities will meet existing effluent limitation standards when the EPA, DOE, and the Commonwealth of Kentucky have not even developed effluent limitations for the plants? (Commenter: 21, p. 6)

Response: Although effluent limitations have not been developed for the SRC-I demonstration plant, standards do exist for similar industrial facilities, such as petroleum refineries, iron and steel industries and coking plants. A work plan has been outlined to develop these effluent limitations for the SRC plant jointly with these agencies (see Appendix EE). These limitations will in part be based on the effluent contaminant concentrations achievable in the wastewater treatability studies. Thus, the wastewater treatment system will be designed to meet standards that will be developed as the design is developed.

6.14 Comment: Page 2-18, Second Complete Paragraph. The "effluent limited" classification refers only to dissolved oxygen and is not applicable to the discharge of toxics. (Commenters: 56, p. 1a; Speaker 28)

Response: Effluent limits will be either water quality or technology limited. The technology based limits will represent the best available treatment technology economically achievable for toxic pollutants.

6.15 Comment: Page 3-17 (3.2.2.3) Green River: Kentucky does not designate stream uses for food processing and industrial use. (Commenter: 12, p. 6)

Response: Section 3.2.2.3 and Table 3.4 have been revised to reflect this comment.

6.16 Comment: Page 3-17 and Tables H.1 and 4.7. It needs to be stressed that the mainstem of Green River and all other tributaries in the project area fall under the jurisdiction of Kentucky's Water Quality Standards and not ORSANCO's standards or EPA's Redbook limits. (Commenter: 12, p. 6)

Response: Section 3.2.2.3 and Table H.1 have been revised accordingly.

6.17 Comment: Table 4.7, BOD_5: Minimum allowable treatment of secondary level assumes a maximum BOD of 30 mg/l and not 40 mg/l as reported. (Commenter: 12, p. 6)

Response: Tables 4.7 and C.16 have been corrected to reflect a 30 mg/liter BOD concentration in the wastewater effluent.

6.18 Comment: Page 3-19. Recent physiochemical data does not support the statement that Pond River is a low pH stream. The DEIS and any decisions based on this misinformation should be revised accordingly. (Commenter: 12, p. 6)

Response: Section 3.2.2.3 has been revised to reflect the comment.

6.19 Comment: What about spilled SRC-I liquid contaminating municipal water supplies along the pathway of the contaminated slug? (Commenters: 21, p. 1; 60, p. 2)

Response: Appendix DD considers municipal water systems for cities with populations greater than 100,000. Smaller towns including Henderson, that withdraw raw water would also be susceptible to water supply emergencies if SRC-I liquid products are spilled upstream from water intakes. See also Sect. 4.1.3.8.

6.20 Comment: It would seem that implementation of the emergency procedures listed in Section D.D-6 of the DEIS would be so time consuming that the liquid would have had time to pollute the aquatic environment of the Green and Ohio Rivers for several miles downstream before clean-up was initiated. In that time most water soluble items and volatile organics would have dispersed into the ecosystem. (Commenter: 21, p. 3)

Response: Spill control and cleanup measures are unlikely to prevent the dispersion of water-soluble compounds. However, with the establishment of emergency coordination, notification of water supply systems should greatly reduce exposure of human populations. See also the response to comment 6.21.

6.21 Comment: In 1977 a series of chemical spills into the Ohio River illustrated the lack of communication and coordination between governmental agencies, and the lack of ability to predict spill travel time. If the potential for spills which may create "water supply emergencies" exists as stated in the DEIS, then the operators of the plant should have on line a river flow modelling program which could be fed current river conditions at the time of a spill and result in predicted spill arrival times for use by water supply agencies for timing additional filtering or water intake shutoffs. (Commenter: 64, p. 6)

Response: In response to the 1977 spills, the Ohio River Sanitation Commission (ORSANCO) and its member agencies undertook several measures including improvements in notification procedures and capabilities for predicting time of travel and instream concentrations of pollutant slugs. River models must be developed and calibrated to a specific water body. It is not reasonable for the plant operator to have an on-line model for every water body along the transportation route where a spill could occur.

6.22 Comment: Water Availability. The DEIS mistakenly considers withdrawal and consumption use impacts only if they represent a portion of the seven-day once in ten-year flow (7Q10). (The EIS reports that up to 30 percent of the 7Q10 may be consumed by energy production facilities in the area.) Unfortunately, this approach overlooks the environmental and cultural

impacts on competing instream (e.g., navigation, aquatic biota, etc.) and offstream uses of consuming 3.6 mgd at demonstration scale project level. (Commenters: 12, p. 3; 9, p. 2)

Response: Water use is considered as a fraction of the 7-d, 10-year low flow in order to assess worst-case impacts. A 7-d, 10-year low flow typically accompanies a severe drought. Under almost all other flow conditions other instream and offstream uses will be completely unaffected. Because the SRC-I demonstration project will consume less than 2% of the Green River's 7-d, 10-year low flow, no significant impacts to other water uses are anticipated. (See also response to comment 6.10.)

6.23 Comment: The DEIS aptly points out the "potentially serious cumulative impact" of water consumption in the area. It notes that two synthetic fuel plants and two coal-fired generating plants alone could exceed 30% of the Green River's 7-day, 10-year low flow. This does not take into account the other area energy-development needs nor the competing agricultural, navigational, domestic, and other industry demands. These factors should be carefully weighed in the FEIS. (Commenters: 12, p. 1; 46, p. 5; Speakers 19; 39, p. 1)

Response: Cumulative water consumption will pose problems only during drought conditions that cause very low streamflows. Such conditions can be expected relatively infrequently, on the average of one to three times per decade. During such events, agricultural, municipal, navigational, and industrial water use may be affected as well as navigation and in-stream flow needs of fish and wildlife. In water supply emergencies such as this, municipal (i.e., domestic) uses will take precedence over industrial use. Also, Federal jurisdiction over navigation in the Green River could theoretically permit the Corps of Engineers to require industrial and/or agricultural users along the Green River to reduce or stop consumptive withdrawals to preserve the flows necessary for navigation.

There are many uncertainties which make it impossible to completely predict cumulative impacts on water availability. Unknown factors include (1) whether all of the projects currently under study will be developed, (2) actual rates of water consumption of the proposed projects, (3) changes in water consumption without the new projects, and (4) changes in the amount of barge transport with or without the new projects. Further information is needed to assess the severity of impacts under drought conditions. See also the response to Comment 6.10.

6.24 Comment: Even assuming "zero discharge" mode of all energy-related projects, occasional waste water discharge due to the failure of recycling systems of the plants and spills would result in release of significant amounts of pollutants and subsequent direct cumulative effect on water quality of the Ohio River, which is the main source of the drinking water for Evansville and its vicinity. (Commenter: 65, p. 53)

Response: Failure of recycling systems will result in the discharge of highly treated wastewater, which under worst-case conditions, described in Sect. 4.2.2.3, would cause little or no measurable effect on Ohio River water quality, including the Evansville water supply. The Ohio River could only be affected by a spill of SRC product during transit to market. The EIS assumes that one of the products will cross the Ohio River three times en route to market and discusses the environmental impacts in Sect. 4.1.3.8 and Appendix DD.

6.25 Comment: It is reasonable to assume that the wastewater recycling equipment might cease to function properly from time to time. The DEIS stated that during such times quantities of manganese, iron, phenol, and cadmium would need to be discharged into nearby Green River. This river already has quantities of these and other heavy metals that exceed water quality standards at times. There should be no discharge of these metals into Green River by this SRC-I plant. (Commenter 39, p. 1)

Response: "No discharge" of metals to the river (when the wastewater recycling equipment is inoperative) cannot be economically achieved. The treatment system for toxic metal removal as proposed will be the best available control technology economically achievable (see the response to Comment 3.2). Also, the EPA does not agree with the commenter and has taken the position that the effluent does not have to be cleaner than the river water taken into the plant. The EPA and KDNREP do provide for variances in cases where the ambient river is already exceeding the water quality standard but the treated wastewater discharge will not significantly further degrade the river.

7. AIR QUALITY

7.1 Comment: The impact of heavy nonmethane hydrocarbon emissions may exceed the ambient allowable — one-hour average.

The projected impact (10.5 $\mu g/m^3$) exceeds the guideline (4.8 $\mu g/m^3$) by more than a factor of two. The FEIS should re-evaluate the impact of these emissions to include an analysis of the expected NMHC emissions from the coal dryer, and fugitive emissions resulting from leaking valves, pump seals, flanges, cooling systems, and wastewater treatment. (Commenter: 12, p. 8)

Response: The guideline of 4.8 $\mu g/m^3$ average hourly exposure was extrapolated by KDNREP from the eight-hour worker exposure concentration limit for OSHA coal tar pitch volatiles (CTPV) to a "one-hour" average public exposure limit:

Ambient allowable one-hour average

(A) = (TLV/10)(40/168 h/wk of operation)

TLV for coal tar pitch volatiles = 0.2 mg/m^3 for eight hours daily exposure

Therefore, (A) = 4.8 $\mu g/m^3$

The equation assumes that the public will be constantly exposed during the total operating time of the plant (168/h/week) and not just during the forty hours per week that a worker is exposed. The equation also adds a safety factor of ten, which assumes that members of a community affected by a regulated substance may not be as healthy as the average worker in a plant and, consequently, will have a lower dose tolerance.

This TLV-related ambient allowable "one-hour" average exposure limit should not be compared with the maximum one-hour average associated with ambient air quality simulations. The maximum one-hour simulation computes the one hour out of the 8760 h in the year having the highest ground level concentration outside the plant boundary. The other hours of the year average considerably lower. The "one-hour" average developed from OSHA standards is on a constant exposure basis. The above equation assumes the community will be constantly exposed to a concentration of contaminant, and calculates the average hourly allowable exposure. The ambient allowable "one-hour" standard therefore should be compared to the annual average concentration associated with dispersion modeling. The allowable Kentucky coal tar pitch volatile standard (4.8 $\mu g/m^3$) assumes the public cannot be exposed to more than an average of 4.8 $\mu g/m^3$) in each hour of a 24-h day. The annual average dispersion estimate is itself an "average" hourly exposure.

To this end, the average annual concentration of heavy (BP $\geq$ 500°) nonmethane hydrocarbon emissions, or PNA components, was simulated with the EPA Industrial Source Complex (ISC) model. The maximum annual-average concentration beyond the plant boundaries was simulated at 1.8 $\mu g/m^3$ for heavy PNA components. The simulation included some of the nearby communities such as Stanley, Spotsville and Hebbards, and the average annual exposure to total NMHC was less than 0.4 $\mu g/m^3$ in these areas (less than 0.1 $\mu g/m^3$ heavy constituents).

It must be pointed out that the ISC model is not strictly applicable to hydrocarbons. The results of the ISC model should be very conservative because it assumes that the hydrocarbons remain dispersed. This assumption is questionable, especially for heavy hydrocarbons. Because of a high boiling point and low volatility some heavy hydrocarbons have a tendency to condense and settle out.

This simulation included both point and fugitive sources of NMHC. The coal dryer is not expected to emit NMHC compounds. Coal is pulverized and dried in a single step, in a single piece of equipment, the coal pulverizer-dryers. Coal is mechanically pulverized; it is dried by evaporation induced by passing hot flue gas through the pulverizer-dryer chamber. The flue gas temperature is 700°F when entering the chamber, and approximately 130°F when exiting the chamber with the coal. At these conditions, no NMHC compounds are expected to volatilize.

7.2 Comment: In the NO_x calculations for boilers having over 100 mmbtu/h of heat input, was the emission factor for power plant boilers used as recommended in AP-42, Table 1.4-1, footnote *i*? (Commenter: 12, p. 8)

Response: No, all NO_x emissions from heaters were assumed to evolve at 0.18 lb/10^6 Btu fuel fired, regardless of the firing rate. A single emission factor for all heaters was thought to be more appropriate at this stage of design, rather than making exceptions for possible, not yet finalized, variations in heaters.

Footnote *i* suggests that the NO_x emissions (per pound fuel fired) be made 2.5 times higher than the normal emission for all heaters, which are rated greater than 100 x 10^6 Btu/h. This assumption is only reasonable if the firebox temperature for heaters firing more than 100 x 10^6 Btu/h is much greater than the firebox temperature of heaters firing less than 100 x 10^6 Btu/h.

If footnote *i* were applied, it would affect two heaters, the boiler, and the heat transfer fluid heater. All other plant heaters fire less than 100 x 10^6 Btu/h fuel. Applying footnote *i* to the two heaters yields NO_x emissions that are 1140 tons per year. This is 40% greater than the current estimate. The resulting NO_x impacts using footnote *i* would be slightly higher than the NO_x emissions shown in Table 4.16. The NO_x emissions using footnote *i* would be as follows:

SRC-I plant NO_x impact	3.7 $\mu g/m^3$
SRC-I plus other PSD sources	3.7 $\mu g/m^3$
Projected air quality	19.7 $\mu g/m^3$
NAAQ standard	100 $\mu g/m^3$

In conclusion, both emission factors give NO_x impacts which are well below the NAAQ standard.

7.3 Comment: In Table C.9, p. C-51, the emissions from the equivalent power plant with flue gas desulfurization appear excessive. Emission calculations should be presented in the FEIS. (Commenter: 12, p. 8)

Response: The emissions for the 600-MW power plant were taken from the PSD application for the Rockport Generating plant. Emission calculations are in the PSD application.

7.4 Comment: Tables C.11 and C.12, and Fig. C.14 contain information on sulphur emissions during start-up and shutdown which is inconsistent with the PSD application (Tables 4.5.4 and 4.5.5, and Fig. 4.5.1). Table 4.16 contains information that is inconsistent with the PSD application (Table 10-6). These inconsistencies need to be reconciled. (Commenter: 12, p. 9)

Response: The information in the EIS is more recent and more accurately reflected the startup emission rates.

7.5 Comment: What are the modeled ambient impacts (including flaring) for start-up, shutdown, and emergencies for all pollutants including NMHC? How do the modeled impacts compare with the ambient standards, the PSD increments, and the adjusted TLV of question 6, above? Is vegetation damage possible? (Commenter: 12, p. 9)

Response: No meaningful attempt can be made either to produce more definitive emissions estimates or, therefore, to develop accurate projections of air quality impacts. The EIS and PSD permit application treatments of start-up and shutdown emissions are based on simplified, speculative scenarios of the anticipated startup and shutdown programs for the demonstration plant. These scenarios are intended only to roughly describe potential for essentially unmitigated emissions and not necessarily emissions that will actually occur. The models approved for calculating PSD increment consumption and impacts on ambient standards do not lend themselves to calculating variable, fluctuating emissions such as occur during startup, shutdown, or emergencies of unknown duration. Safety analysis and review activities will proceed in parallel with detailed design. Contingency measures will be designed with environmental protection as one of a number of important planning goals. It is expected that for the majority of upset conditions, provisions will be made to prevent any significant environmental releases. Only major failure events such as those listed in Table C.13 are expected to lead to emergencies during which materials may have to be released in a controlled manner through the flare system in order to protect life and property. Protection of air quality standards and increments during such extreme conditions cannot and is not intended to be a first priority and may not always be achievable. The possibility of vegetation damage is dependent on the type, severity, and duration of the emergency and the meterological conditions at the time of the event.

7.6 Comment: The DEIS (p. 2-12) states that refractory organics are present in the wastewater treatment system. Where else are refractory organics present in the SRC-I process? How will they affect combustion processes, such as start-up, shutdown, emergency flaring, the controlled combustor, etc? What are the hazards? (Commenter: 12, p. 9)

Response: The term "refractory organics" in the context of wastewater means non-biodegradable organics; it does not mean difficult to combust. Combustion of heavy hydrocarbons is addressed in the controlled combustor/flare system discussion. (See Sect. 2.2.1.2.)

7.7 Comment: Do the plant's emissions of SO_2, H_2S, and CO comply with the Process Gas Stream Regulation 401 KAR 59:105? (Commenter: 12, p. 9)

Response: 401 KAR 59:105 deals with the control of H_2S, SO_2, and CO from process sources. Following is an explanation of how this standard applies to SRC-I.

H_2S-laden gases come from three gas treatment operations: the DEA Unit, Selexol unit, and ammonia sulfide water stripper. These streams total approximately 9.19 t/h of H_2S. Following treatment in the Claus plant and BSR unit, the tail gas stream contains less than 4 ppm of H_2S, which is well within the standard.

Process-derived SO_2 comes from the rotary kiln, within the coking process, at a rate of 122 lb/h (1.46 t/d). This stream is passed through a Venturi scrubber system to yield an emission rate of 18.2 lb/h, satisfying the 85% removal requirement.

59:105 calls for CO emissions to be controlled through the use of a direct flame afterburner. However, this generic standard is not technologically applicable to the SRC-I process. The 158,648 lb/h of CO produced passes through treatment steps consisting of the shift converter, the Selexol unit, the Claus plant and the BSR unit for an emission rate of 168 lb/h, representing 99.89% CO removal.

7.8 Comment: What is the basis of the assumed 100% efficiencies of control for the inspection and maintenance of those pieces of equipment listed in Table C.5 as having 100% efficiency? (Commenter: 12, p. 9)

Response: The process line fittings listed as being 100% controlled for fugitive emissions are pumps, compressors, relief valves, and drains/sampling connections. The justification for 100% control under normal operating conditions is based on design considerations incorporated for these fittings. Valves and flanges, which rely on monitoring and maintenance control of leaks, cannot be 100% controlled. The following design controls explain the 100% efficiency assumptions.

Safety/relief valves: Relief valves required in the proposed SOCMI regulations are to be operated in a state of no detectable emissions, except during emergency releases. Most of the safety/relief valves will be vented to the flare system during emergency releases.

Pumps: Centrifugal and reciprocating pumps in light-liquid, hydrocarbon service will be equipped with double seals (centrifugal) or liquid film seals (reciprocating) and a compatible barrier fluid system held at a pressure higher than the pump discharge pressure. Any leaks in the seal system will result in barrier fluid being forced into the process stream because of the higher pressure of the barrier fluid. No losses to the atmosphere should occur during normal operation. Pressure sensors to detect failures in the seal systems will be checked daily.

Compressors: Distance pieces on reciprocating compressors will be enclosed and purged with nitrogen. The purged nitrogen containing any VOC vapors will be flared.

Drains, sampling connections: Double valving, caps, or blind flanges will be used to control sampling or draining from process lines. Drained liquids will be stored in closed containers, will be properly disposed, or will drop through a sump into the closed plant sewer system.

7.9 Comment: What are the results of the cooling-tower-drift deposition modeling discussed in Appendix S.4? (Commenter: 12, p. 9)

Response: The results of the cooling-tower-drift deposition modeling have been added to Appendix S of the FEIS.

7.10 Comment: Although the DEIS addresses PSD applicability, supporting information in the form of a PSD application that demonstrates PSD compliance is deficient. (Commenter: 12, p. 9)

Response: The PSD application was submitted in November 1980 to the State of Kentucky and is publicly available.

7.11 Comment: What are the expected emissions (type and rates) from the following sources: cooling tower (particularly chromates), wastewater treatment facilities (e.g., H_2S, NH_3, and NMHC) and the calciner? (Commenter: 12, pp. 8, 11)

Response: Chromate emissions from the cooling tower through the 60-gpm drift loss are about 7 lb/d expressed as Cr (see Table C-10, p. C-51, DEIS). The emission rates of H_2S and NH_3 of the wastewater treatment facilities will be negligible. The only wastewater streams that contain a significant quantity of H_2S and NH_3 are the sour water streams. They will be sent to the ammonia-sulfide water stripper for H_2S and NH_3 removal. After stripping, the residual H_2S will be 3 mg/liter or less; and ammonia, less than 300 mg/liter. There will be little emission of H_2S and NH_3 from the open tanks and ponds in the wastewater treatment system because of the high solubility of these compounds. Likewise, NMHC emission from the wastewater treatment facilities will be small because the waste streams that contain a significant amount of volatile NMHC will be pretreated before reaching the open ponds and tanks. The pretreatment process includes the ammonia-sulfide water stripper and the covered API oil/water separators. Table C.7 contains calciner emissions.

7.12 Comment: What are the emissions from the coal dryer, including NMHC, and sulfur compounds released as the pulverized coal is dried? (Commenter: 12, p. 11)

Response: No NMHC or sulfur compounds are expected to volatilize. The coal pulverizer-dryer exhaust is sent to a cyclone, the cyclone exhaust is sent to a baghouse, and the baghouse is exhausted to the atmosphere. This vents an estimated 50 t/year of particulates. See Response to comment 7.1.

7.13 Comment: Page 3-31, Table 3.11. The table shows a summary of monitored air quality values at several sites within the project area. Ozone values given for the Henderson station and onsite ozone data for the period 1/77–1/78 do not agree with values presented in the PDEIS. These discrepancies should be fully explained in the FEIS since onsite data in the PDEIS show violations of the ozone standard. Also, onsite data for carbon monoxide and reduced sulfur for the most recent sampling-time period do not agree with the PDEIS. This discrepancy should also be corrected in the FEIS. (Commenters: 29, p. 3; 56, p. 2a; 65, p. 14-16)

Response: Discrepancies in the ozone data were found to be due to an error during strip-chart reduction. The ozone instrument was initially operated in the 0 to 1 ppm range, and the site technician found the readings low enough to warrant switching to the 0-to-0.5-ppm scale. This change in the scale was noted on the chart and log book but was overlooked during processing of the chart. As a result, all the readings were reported as if values of ozone were twice as high as the actual values. Once corrected, it was found that the site-data values correlated well with the data from monitors reported in the DEIS. All charts have since been checked by the Kentucky Division of Air Pollution.

The changes in CO and reduced sulfur data are due to the updating of the data presented in Table 3.11 because of availability of more recent data from the onsite monitoring and from the State of Kentucky. Later onsite data than were available at PDEIS-compilation time were included. Whereas the PDEIS only included 5/79 to 7/79 data, the DEIS included results obtained during the entire yearly monitoring effort.

7.14 Comment: Page 4-48, Table 4.16. This table presents baseline air quality data which do not agree with that presented in Table 3.11 (p. 3-31) for 24-h and 3-h SO_2 time averages and for the 24-h TSP time average. This should be corrected in the FEIS. (Commenter: 56, p. 3)

Response: The baseline air quality in Table 4.16 (Table 4.18 in the FEIS) contained typographical errors. The 24-h SO_2 was incorrect and has been corrected from 490 $\mu g/m^3$ to 190 $\mu g/m^3$. The 8-h CO has been corrected to 2,000 $\mu g/m^3$ and the 1-h average CO to 4,000 $\mu g/m^3$. The 3-h SO_2 (842 $\mu g/m^3$) and 24-h TSP (54 $\mu g/m^3$) were correct. These two values do not agree with the corresponding values in Table 3.11 because the values in Table 4.16 are wind direction-dependent background values.

These remaining discrepancies between Table 3.11 and 4.16 (Table 4.18 in the FEIS) can be explained as follows: For the impact analysis, it was agreed upon by EPA and KDNREP to use the wind direction-dependent background values to account for the influence of nearby point sources. The monitored concentrations for each averaging period were assigned to one of 8 wind sectors based on average wind direction for the period. The concentration used as baseline for each sector was the highest concentration for that sector. However, for the sector containing the highest monitored value for the year, the second-highest concentration in that sector was used as the baseline value. The wind direction was averaged for the period of highest concentration predicted by the model to find the wind sector with the worst conditions. Then the baseline value for this wind sector was added to the highest concentration predicted. It is the baseline value for this wind sector that is recorded in Table 4.16 (Table 4.18 in the FEIS).

7.15 Comment: Table 4.16 is inaccurate and very misleading. In the second column, there is a series of values labeled highest 24 h, highest 3 h, etc.; all of these values are footnoted. The footnote says that they are really the second highest values, not the highest values. If one adds the "Baseline air quality" to the "concentration due to all PSD sources within 50 km," one should obtain the value obtained in the column entitled "Projected Air Quality." (Commenter: 65, p. 16)

Response: Table 4.16 has been revised; it is now Table 4.18 in the FEIS. See the response to comment 7.14 for explanation.

7.16 Comment: Table 4.16 projects that the SRC-I Demonstration Plant alone will produce an ambient air concentration of 0.82 $\mu g/m^3$ for lead. The ambient air standard for lead is 1.5 $\mu g/m^3$. A five-fold increase in plant size could conceivably produce an ambient level of 4.10 $\mu g/m^3$ for lead. This would exceed the human health standard by well over a factor of two. (Commenter: 65, p. 18)

Response: The lead impacts reported in the DEIS were based on a very conservative estimating procedure described below. Because of this conservatism, it is believed that scale-up to commercial scale will not increase lead concentrations beyond the standard. Prior to commercialization, more precise estimates will be made based on data accumulated during the demonstration phase.

The assumptions used to develop these impacts are discussed below so that the degree of over-prediction can be understood.

Concentrations of lead in the various vent streams of the SRC-I Demonstration Plant are not yet known. Therefore, a "limit-theory" type of analysis was performed to obtain this information for use in screening level analysis of lead emissions and impacts. The lead enters the plant in the coal. It leaves the plant in (1) products, (2) slag, (3) wastewater, and (4) atmospheric vents. The lead becomes airborne by (1) combustion of product fuel gas, and (2) atmospheric venting. These are the two sources for which estimates were made.

Because the only streams characterized for these elements (at this time) are the coal-feed and the solid and liquid products, it was conservatively assumed that all elements not contained in the products will be vented to the atmosphere (i.e., no lead will end up in the slag or wastewater). Furthermore, it was assumed that the entire amount of lead will be vented from both combustion vents as well as the atmospheric vents (thus double accounting). The lead emitted from combustion sources was apportioned among heater stacks according to heater-firing rate. The lead emitted from other vents was assumed to come from two vents (the two likely to produce the highest ground-level concentrations), the waste carbon dioxide vent, and the BSR Unit Vent.

The lead emission rate estimated in this manner is 3.2 lb/h (times two — for double accounting). As mentioned previously, this rate is a worst-case estimate to be used only for the purpose of performing a screening level analysis of lead emissions and its impact. This does not represent an estimate of expected actual emission rates. A more definitive characterization of lead emissions may be made during detailed design.

7.17 Comment: When one tries to add up the line for the 8-h carbon monoxide levels, he gives up. Even though one realizes that in one table the values are in micrograms and in the other table they are in milligrams, the numbers do not correspond. Not only do they not sum correctly, they do not even correspond. (Commenter: 65, p. 17)

Response: Table 4.16 (Table 4.18 in the FEIS) has been corrected and is now consistent with Table 3.11.

7.18 Comment: In Table 3.11, we note that the primary ambient air standards for particulates (TSP) has been broken in both Henderson and Owensboro, and the TSP secondary standard was exceeded on the proposed site. How can this site be selected in view of this data? (Commenter: 65, p. 14; Speaker 19)

Response: The data cited does not prohibit the selection of the proposed site. The proposed site is in Daviess County, not in the cities of Owensboro or Henderson and Daviess County is designated attainment for all air pollution categories (see p. 3-30, third paragraph). There was a possible exceeding of the TSP secondary standard at the proposed site, but exceeding the standard once in a year is not a violation of the standard. The standard is not to be exceeded more than once per year.

7.19 Comment: Because the demonstration plant is expected to consume about 70% of the 24-h PSD increment for TSP (p. 2-25), what effect will this have on Evansville's TSP problem (currently designated nonattainment for secondary standard) and future PSD-related development? (Commenter: 18, p. 4)

Response: The demonstration plant is now expected to consume about 18.3% of the 24-h PSD increment for TSP (see Sect. 4.2.3). This reduction from about 70% to 18.3% is due primarily to washing coal to reduce fugitive dust. The effect on Evansville's TSP nonattainment problem is very minor because of its distance from the site. The effect on PSD-related development will be very minor because the 24-h PSD increment consumption is very local in nature. See Appendix C, Sect. C.2.2.3.

7.20 Comment: The statement on p. 3-30 concerning a possible secondary standard violation measured at the site is inaccurate in my understanding of the fugitive dust clause of the Clean Air Act regulations. I don't believe that it has been normal procedure to void a violation based simply on a microscopic examination of the particle makeup. Instead, the fugitive-dust provision is used in areas that are considerably more rural than the Ohio Valley, such as the Southwest. (Commenter: 64, p. 4)

Response: The statement on p. 3-30 was not concerning a possible secondary standard violation, but a possible occurrence of exceeding the secondary standard once in a year's data. The standard is not violated until a second excursion beyond the standard has occurred, as provided for by the regulations.

7.21 Comment: Page 4-7. Fugitive particulates are said to be transported only a "short distance." This is vague — how short is short? With the proper winds, couldn't some light particulates (in the respirable range and coated with condensed hydrocarbons) be blown to Evansville and Newburgh? (Commenter: 18, p. 7)

Response: Some light particulates could be blown to Evansville and Newburg, but the amount would be quite insignificant. Both the point and fugitive-particulate levels together are estimated to be on the order of only 1 $\mu g/m^3$ for the worst 24-h average at the distance that Evansville is from the plant.

7.22 Comment: There are serious questions to be raised about the use of modified and probably not US EPA-approved computer models. (Commenter: 65, p. 17)

Response: The ISC model, used for predicted concentrations of pollutants, is now approved by US EPA and listed in the "Guideline on Air Quality" (AQPS No. 1.2080) list of models. The program MLTCRS, used for locating the preconstruction-monitoring site is based on the US EPA-approved program CRSTR with the addition of greater versatility through the ability of calculating multiple sources, instead of only a single source.

7.23 Comment: The hazards of sulfur dioxide emissions on plant life and crops were stated in Appendix K of the DEIS. I need not go into them, but there are many serious consequences involved. Since immense damages are already occurring, it does not seem logical to continue to add sources for the problem. Each plant facility appears to justify it by saying that their emissions add very little to the problem — but the problem is the *result* of these compounded little bits. This point needs to be treated more adequately in the FEIS. (Commenter: 39, p. 4)

Response: The National Ambient Air Quality Standards (NAAQS) are set at levels designed (with an adequate margin of safety) to prevent just such damage. Sulfur dioxide is a pollutant controlled under these regulations. As the effect of each plant's emissions are added together, the level of the pollutant rises, but is not permitted to exceed these standards. The compounding of the effect of the SRC-I plant along with existing sources of SO_2, causes the total SO_2 pollutant level near the proposed site to be but 55% of the NAAQS — well below the threshold level of known damage.

7.24 Comment: The National Weather Bureau on August 23, 1978, issued an ozone health-level warning for residents of Daviess County, but ozone monitoring taking place during that period, according to Table 3.11, did not show a violation. (Commenter: 65, p. 16)

Response: The Kentucky Department of Air Pollution Control (KDAPC) issues air pollution alerts (the National Weather Service does not). The KDAPC issued an alert at that time based on ozone data of 0.119 ppm recorded at a monitoring site near Route 60 at Wyndall Shopping Center in Owensboro, Kentucky about 19 km (12 miles) from the site. This amount was recorded in the afternoon of August 22, 1978. The monitor measures ozone only at its location at the shopping center, not at the proposed site out in the county.

7.25 Comment: Ozone levels have exceeded ambient health standards in Evansville during 1980 and in Henderson and Owensboro in past years. Because this plant will have liquid hydrocarbons as one of its major products and since compounds of this type are involved in the formation of ozone, an already bad situation may get worse. The very large size of the plant, coupled with the newness of the controls, again combines to give a troublesome situation. The proposed hydrocarbon emissions from the conceptually designed SRC-I Demonstration Plant needs to be carefully reevaluated. (Commenters: 29, p. 2; 65, p. 18; 18, p. 6; 64, p. 3; 60, pp. 8 and 11; Speakers 38, 22)

Response: The procedures for relating hydrocarbon precurser emissions to predictions of ozone formation is still in a very formative state as stated in the "Air Quality Criteria for Ozone and Other Photochemical Oxidants" (EPA criteria document April 1978), as well as in pp. 4-58 to 4-79 of the DEIS. There is no straightforward criteria for estimating such impacts other than the linear rollback procedure contained in 40 CFR Part 51 U.S. EPA Regulations on Preparation of Implementation Plans, especially since the U.S. EPA "Guidelines on Air Quality Models," AQPS No. 1.2080, recommends no ozone models.

The only alternative to actually being able to predict the ozone levels due to the projected 60 TPY hydrocarbon emissions from the SRC-I demonstration plant is by making a comparison with conditions in an actual ozone nonattainment area such as the Louisville Interstate Air Quality Control Region (AQCR) which consists of Jefferson County, Kentucky, and Clark and Floyd counties, Indiana. Ozone-monitoring hydrocarbons-emissions inventories have been compiled and analyzed by the State of Kentucky for this area. From the 1979 Kentucky State Implementation Plan (SIP), we find that the ozone levels were as high as 0.185 ppm, and the 1976 emissions were 86,510 t/year of hydrocarbons, of which 44% were from stationary sources, 46% from mobile sources, and 10% from area sources. The Modified Linear Rollback Model (MLRM) prediction required emissions not to exceed 52,710 t/year in order that the 0.12 ppm standard could be achieved. Therefore, a 34,000 t/year hydrocarbon reduction in the three-county area was needed to produce a 0.065-ppm reduction in ozone levels. Because background levels in the Daviess County/Henderson County/Evansville area tend to be around 0.10 ppm, the 60 TPY of SRC-I hydrocarbons emissions clearly poses no threat to the ambient standard for ozone in the area.

7.26 Comment: While cumulative air quality impacts are acknowledged in the DEIS, the detail of this analysis is limited. The KDNREP is cooperating with the Kentucky Department of Energy to perform air quality modeling in the area as part of a regional cumulative impact analysis. It is KDNREP's understanding that the Kentucky Department of Energy will hire a consultant

to do the analysis based on available data. These results, if available, should be incorporated into the FEIS. (Commenters: 12, p. 2; 3, p. 1; 64, p. 3; Speaker 19, 37)

Response: The Kentucky Department of Energy will do a cumulative impact analysis but at the time of the publication of the FEIS had not completed the study.

7.27 Comment: The DEIS states that, with respect to cumulative effects, air quality impacts "will add slightly to problems of nonattainment of TSP standards in the cities" (p. 4-101). Does this include Evansville? If so, what mitigation measures are proposed? In accordance with Sect. 126 of the Clean Air Act Amendments of 1977, would this put Kentucky in violation of its State Implementation Plan, if proper notice of opportunity to object is not offered to Evansville's air quality control region? (Commenter: 18, p. 2)

Response: The effect on Evansville is quite insignificant – about 1 $\mu g/m^3$ for a worst-case 24-h average. Mitigation measures are given in the DEIS, especially Sects. 2.2.1.2 and 4.6. The U.S. EPA is a cooperating agency in the EIS process for the SRC-I Demonstration Plant. Whereas the KDNREP, another cooperating agency, is concerned primarily with local and State environmental issues, the EPA is concerned with regional and national environmental protection issues, programs, and policies. The EPA Region IV office in Atlanta has accepted primary responsibility for all relevant EPA issues, including interstate air pollution impacts. The Region IV office can be expected to consult with the Region V office in Chicago in regard to this issue.

7.28 Comment: Will all of these plants increase the air quality index to the point that desirable, relatively clean industry will not be able to locate in this area? (Commenters: 22, p. 1; Speaker 93; Speaker 37)

Response: Future availability of PSD increments cannot be predicted, but the plants under consideration are not expected to prevent further development in the area.

7.29 Comment: The DEIS states that the demonstration plant will consume 73% of the 24-h PSD increment for particulates. We understand that these estimates were based on emission factors under worst-case conditions and that emissions will not rise in direct proportion to increased plant capacity. Nevertheless, we believe that the emission factors are reasonably accurate and that this problem may be a significant limitation to commercialization at the scale presently envisioned. (Commenters: 56, p. 1; 60, p. 11; 64, p. 4; 18, p. 4; 29, p. 3; Speakers 31, 19)

Response: The demonstration plant is now expected to consume about 18.3% of the 24-h PSD increment for TSP (see Sect. 4.2.3). This reduction from about 70% to 18.3% is due primarily to washing the coal to reduce fugitive dust. This should remove TSP as a limitation to commercialization.

7.30 Comment: The DEIS cites the particulate emissions as "a significant limitation to commercialization" (p. 2-26) and "suggests that the fugitive emission rate from the commercial plant would have to be less than the rate from the demonstration plant if the plant is to consume less than 100% of the allowable PSD increment" (p. 2-25). If expansion does occur, what will this mean for Evansville? (Commenters: 18, p. 4; 29, p. 3)

Response: Estimates for particulate emission for the demonstration plant have been reduced (see responses to Comments 7.19 and 7.29). If expansion occurs, the effect on Evansville will be insignificant, contributing less than 1% of the secondary 24-h TSP standard in the Evansville area.

7.31 Comment: With regard to the commercialization limitations associated with TSP, the DEIS states "there are not nearby sources to offset except for particulates generated during agricultural activities" and further suggests that the purchase of land for the cessation of agricultural activity could be an offset (p. 2-25). How much land would be required for this? If this is a serious consideration, shouldn't the impacts of such action be discussed? (Commenters: 18, p. 4; 29, p. 3; 60, p. 11)

Response: The TSP limitation on commercial expansion has been removed due to improved mitigation measures and updated analysis. Offsets are no longer foreseen as necessary.

7.32 Comment: What federal agency will be responsible for evaluating the air quality impacts to be expected on the Indiana side of the Ohio River? If it is the Environmental Protection Agency, will Region V in Chicago participate in the review of this DEIS? (Commenter: 18, p. 1)

Response: The U.S. EPA is a cooperating agency in the EIS process for the SRC-I demonstration plant. Whereas the KDNREP, another cooperating agency, is concerned primarily with local and State environmental issues, the EPA is concerned with regional and national environmental protection issues, programs, and policies. The EPA Region IV office in Atlanta has accepted primary responsibility for all relevant EPA issues including interstate air pollution impacts. They can be expected to consult with the Region V office in regard to this issue.

7.33 Comment: In light of the recent indictment of the Ohio Valley by EPA and the Ohio River Basin Energy Study with regard to acid rain, shouldn't any additional source of acidic sulfate formation in rainwater (as described on p. 4-49) be further studied and projected? Also, is in-depth monitoring of the occurrence of this phenomenon during operation of the demonstration facility and its relationship to the SRC plant being considered? If not, shouldn't it be? (Commenter: 18, p. 5)

Response: As stated on the cited page, the evaluation of the SRC-I plant's effect on acid rain would be unduly complex, with the SRC-I plant contributing a small fraction (less than 1%) of the SO_2 emitted within 50 km (31 miles) of the site. Monitoring of the pH is not being planned because it is a regional phenomenon and not local to the site.

7.34 Comment: A general air quality concern is the suggested location of this plant within 50 miles of almost a quarter of a million people and within 20 miles of about 100,000 people. (Commenters: 29, p. 3; 26, p. 1; 61, p. 1)

Response: The environmental analysis indicates that the air quality standards will not be violated because of the plant and therefore emissions from the plant should not adversely affect the population near the plant.

7.35 Comment: Discussion of exposure of the public to noise and odor is insufficient. The plant will produce several gaseous emissions that will create odors (e.g., H_2S, NH_3, and NMHC). Odorous emissions should be calculated and modeled to assure that they do not exceed odor threshold, levels, Kentucky's secondary standard for H_2S of 14 $\mu g/m^3$ — 1-h average, or the ambient odor standard of seven dilutions. (Commenter: 12, p. 10)

Response: As required for the PSD permit, the emission of H_2S was modeled to estimate ground-level concentrations. Five sources were modeled, the dominant being the vent stream from the Selexol unit, the second largest being the tail gas from the Beavon sulfur removal unit. Using an odor threshold of detection (TOD) of 10 parts per billion (PPB), modeling with the ISC model predicted that the ambient concentration of H_2S would not exceed this odor threshold or Kentucky's secondary standard. Ammonia was not modeled because there are no point sources. The NMHCs were modeled (Appendix S); however, the large variety of compounds with their corresponding variety of odors and TODs do not lend themselves to an analysis of odors, at this stage of plant design.

7.36 Comment: The noise sampling sites are not specifically located. Are any residences located closer to the facility site than the sites measured? What was the sampling time associated with the measurements recorded? It is unclear as to the cause of the high background ambient noise level for the Sauer Lane sites since it appears that the other sites which are closer to the impact range of surface transportation have lower values. Clarification is needed. (Commenter: 12, p. 10)

Response: The noise sampling sites are included on Fig. 3.14 of the EIS. Residences along U.S. 60 and two residences west of the plant on Sauer Lane are closer to the plant boundaries than the noise-sampling stations. Sampling was conducted on October 12 and 13, 1977, and made during the morning (7:00 A.M.–12:00 noon), afternoon (12:00 noon–6:00 P.M.), evening (6:00 P.M.–10:00 P.M.), and nightime (10:00 P.M.–7:00 A.M.). The high background ambient noise level for the Sauer Lane resulted from a farm tractor and grain dryers operating nearby.

7.37 Comment: Two major sources of noise include steam blowout and the railroad marshalling area. The FEIS should provide a description of their location, expected occurrence frequency, and predicted noise levels.

The predicted noise levels should include the effectiveness of the proposed muffler system for the steam blowout and the frequency of occurrence should include any night-time operations. Also, is this operation related only to the construction phase or will this occur when the plant is in operation? A description of railroad marshalling activities should include the plans for unloading coal from railcars. (Commenter: 12, p. 10)

Response: As discussed in Sect. 4.2.3.2 of the EIS, the steam blowout is a one-time (2.5 min) event used to clean the high-pressure piping system, that will occur after construction is completed. Noise levels from the rail-marshalling yard are discussed in Sect. 4.2.3.2 of the EIS. For the demonstration plant, it is estimated that 133 loaded coal cars will arrive daily.

8. SOCIOECONOMICS

Work Force and In-Migration Projections

8.1 Comment: Provide a projection of the impact of 5000 rather than 3500 construction workers at the peak of SRC-I construction. (Commenter: 65, pp. 43 and 50)

Response: This projection has been incorporated in revised Sect. 4.2.4. As a result, the text and tables have been revised to reflect this change.

8.2 Comment: The projected construction work force of 3500 is extremely low and even the worst-case projection of 5000 that will be used on the FEIS seems much too conservative considering the evidence that some nuclear power plants exceeded projections by as much as 300%. (Commenter: 38, p. 58)

Response: The projected peak labor force of 3500 is the current best available estimate of manpower requirements for construction of the SRC-I facility. The use of a 5000-worker case, almost 50% higher than the original projection, is an attempt to allow for the uncertainty in projecting labor demands for a relatively unknown technology. There are a number of factors that can influence this figure, including worker productivity, timing of materials deliveries, and the weather (see Sect. 4.2.4.1).

8.3 Comment: The in-migration to Vanderburgh, Spencer, Daviess, and Henderson Counties is seriously underestimated because of the assumption of a 70-mile commuting zone surrounding the proposed site. A more conservative estimate of the local availability of labor, possibly through the use of a 30- or 40-mile commuting zone, would be appropriate in light of projected transportation problems and escalating fuel costs. (Commenters: 38, pp. 58 and 59; 65, pp. 49 and 50)

Response: Recent experience with the construction of nuclear power plants indicates that 70 miles is the typical maximum daily commuting distance for construction workers but that most construction workers reside significantly closer to the site. Table 4.27 now indicates that about 80% of the commuters are expected to come from within 30 to 40 miles of the site.

8.4 Comment: All projected impacts of construction for SRC-I are seriously low because of the premises and assumptions on which they are made. Clarification is needed concerning the number of in-migrants coming to the area during the various construction phases and the methodology used to calculate this. (Commenters: 40, p. 1; 65, p. 50; Speaker 19)

Response: A discussion of the expected number of in-migrants and the probable settlement pattern is contained in revised Sect. 4.2.4. A discussion of the methodology used to calculate these figures is found in Appendix CC.

8.5 Comment: The number of in-migrating construction workers projected in the DEIS is too high. All peak period construction workers may not be available in the immediate area, but I'll assure you that we won't have to look too long and too far to gather the people that we need. (Commenter: Speaker 47)

Response: The projected in-migration figures are based on TVA's experience with nuclear power plant construction and an analysis of the local labor pool. It is expected that over 70% of the labor force will be prior residents of the 21-county area.

8.6 Comment: The EIS should clearly show the size of the secondary employment at peak construction, explain how it was computed, justify the assumption of 10% in-migration when the local labor market approaches saturation, and include these secondary in-migrants in all impact estimates. (Commenter: 65, pp. 44-46)

Response: Secondary employment at peak construction is discussed in revised Sect. 4.2.4. A discussion of how these estimates were derived is found in Appendix T. The assumed 10% in-migration is based on a level commonly observed for projects of this size. This in-migration is considered valid for this project because there is a sufficient pool of unemployed workers in the tri-county area (an annual average of about 5.5% unemployed in 1979 and a one-month unemployment rate of about 7% in October, 1980) to fill a significant proportion of those indirect jobs that will be created. Adding new entrants to the labor force and family members of in-migrant construction workers to those unemployed workers, it is reasonable to expect that all but 10% of new indirect jobs can be met from the local labor pool. This secondary in-migration has been included in the total in-migration level reported in Table 4.28.

8.7 Comment: Explain and justify the method used for computing family population of imported workers and display computation for SRC-I demonstration plant, SRC-I commercial-scale plant, and cumulative energy-related employment. (Commenter: 65, p. 46)

Response: In-migrant family population calculations are based on the TVA experience with the construction of nuclear power plants. This experience indicates that about two-thirds of the in-migrating workers will be accompanied by their families of an average size of 3.2. An example of the computation used in this analysis is as follows. Daviess County, Kentucky, will receive 520 in-migrant direct workers (local plus distance movers/travelers), with a peak construction work force of 5000, as is shown in Table 4.28 of the FEIS. An additional 113 indirect workers are expected to move into Daviess County (Table 4.29). Of these 633 in-migrant workers (direct plus indirect) two-thirds (424) are expected to bring families, with an average size of 3.2, representing a total of around 1360 individuals. Adding to this the one-third (209) in-migrant workers expected to come to the area alone, a grand total of about 1570 in-migrants is reached for Daviess County (Table 4.28). This same methodology was used to calculate total in-migration for all the counties in the 21-county area and is applicable to both demonstration- and commercial-scale plants. In-migration and associated socioeconomic impacts for cumulative energy-related projects in the region are discussed in Sect. 4.2.5.6.

8.8 Comment: Explain the importance and purpose of including the material presented in Table 3.16 and 3.18. We must wonder if information of this type that is this old (5 years and 2 years respectively) is reliable. (Commenter: 65, p. 47)

Response: The information presented in Tables 3.16 and 3.18 is intended to provide some idea of the number and type of workers currently residing in the impact region. This information is useful for discerning whether the necessary labor skills are available and at sufficient numbers to satisfy the construction and operating requirements of the SRC-I facility. The information provided in both tables is the most current available. This information, however, should not be viewed as providing definitive numbers, but rather as giving a relatively accurate estimate of the quantity and relevant skills of workers available in the region.

8.9 Comment: Estimate the number of high school dropouts attracted to construction projects during peak period. (Commenter: 65, p. 45)

Response: High school dropouts are considered part of the local labor pool and could potentially be employed at the facility. It would be extremely difficult, however, to separate dropouts from the rest of the labor pool. In any event, it is unlikely that the project will induce a higher than normal rate of attrition from local schools.

8.10 Comment: The need exists for DOE to make public any data available concerning socio-economic impact assessment models as they relate to either Henderson, Kentucky, and/or Evansville, Indiana. (Commenter: 15, p. 1)

Response: A labor force survey was conducted on the SRC-I impact region by Oak Ridge Associated Universities. The resulting data were used as a basis for projecting in-migration into the area. In-migration, in turn, was used as a basis for analyzing impacts on the region. A discussion of the model used for analyzing labor supply is contained in Appendix CC.

Housing

Should its involvement continue, DOE will monitor the housing situation to identify any project-related housing shortages so that appropriate mitigation strategies and mechanisms can be implemented if necessary. In the event that DOE withdraws from this project, however, ICRC has not committed to carry out any housing monitoring and mitigation measures.

8.11 Comment: It is assumed that the current housing vacancies will be available during peak construction in 1982. Some analysis of this assumption is needed since the recent trends indicate that production may be dropping substantially (e.g., by 17 percent in 1979 and by 66 percent in the last 12 months). If this rate drop continues, present vacancies may be consumed by new households (normal growth) prior to the arrival of synfuels workers. (Commenters: 65, p. 44; 23, p. 5)

Response: The peak period of construction is now projected to occur in 1983. It is not assumed that current vacancies will be available during the period of peak construction 1983. For the purpose of estimating available housing at the time of peak construction, it was assumed that vacancy rates in the three-county area are relatively stable and that normal population and household growth/decline would conform to locally developed population projections (see Table 3.14). If current trends in the supply of new housing continue, a shortage may develop. However, it is also possible, given an anticipated growth, that developers will begin to increase the supply of new housing. See also Sect. 4.6.2.

8.12 Comment: Although the report accurately estimated transient units available in the three counties (i.e., 3,300) some analysis of how many of those units would be available to construction workers is needed. Presently, about a third of those units are vacant on a given night, and only about 10 percent would be acceptable to construction workers in terms of price. (Commenters: 23, p. 5; 65, p. 48)

Response: The above information on the availability of transient units has been incorporated into Sect. 3.2.4.3 of the FEIS. This indicates that roughly 1100 units would be vacant on any given night. Though only 10% of those units (110) may be acceptable to construction workers in terms of prices charged on a nightly basis, it is expected that many workers will contract for a substantially less expensive rate on a weekly or monthly basis. This could significantly increase the number of units available and acceptable to construction workers. Because the combined total unit demand for apartments, sleeping rooms, hotels/motels, and trailers is only expected to be between 158 and 303 in the tri-county region (Table 4.32), it is considered likely that there will be sufficient transient accommodations for workers during the peak construction period.

8.13 Comment: Housing tenure preferences of construction workers should be more carefully analyzed in relation to the the available vacancies. Since incoming construction workers will be either weekly commuters or residents for less than a period of two years, it is doubtful that they will choose to purchase single-family homes. Yet, more than two-thirds of the existing vacancies identified are owner, rather than rental units. Also the plan projects that 50 percent of all the commuters and in-migrants will select single-family residences; 25 percent will select mobile homes, and 25 percent will select apartments, sleeping rooms, and transient homes. This needs to be further analyzed. (Commenter: 23, p. 4)

Response: Even for the high labor force construction requirements scenario (i.e., 5000 workers), available housing supply is more than adequate to satisfy SRC-I related housing requirements (see Sect. 4.2.4.1). (See also Sect. 4.6.2.)

8.14 Comment: The housing requirement sections on p. 4-74 are much too general and vague, particularly in terms of "other types of residences." Much more specific data are needed on the type of housing available. Are they public housing or low-income apartments or luxury condominiums, or what? For example, in September of 1980, there were 197 apartment vacancies in Vanderburgh County — 99 of these or approximately one-half of these are vacancies in housing owned by the Evansville Housing Authority or reserved for low income tenants. There are almost literally no vacant apartments here. (Commenter: 65, pp. 48 and 51)

Response: "Other types of residences" refers to apartment houses, sleeping rooms and transient residences. The project may induce some shortages in the availability of apartment housing.

8.15 Comment: The mobile home zoning ordinance in Owensboro and Daviess County should be further evaluated as to the number of units that are allowed in the city itself. Although the ordinance gives the names of zones where new mobile homes or mobile home parks are permitted, the existing zoning maps should be reviewed to determine how many units could be placed in those designated areas. Also, the assumption of a mobile home occupancy rate of 25% should be reconsidered in light of the short, 12-month construction period. (Commenters: 23, p. 5: 65, p. 43)

Response: The construction period is projected to last 38 months. The occupancy rate of 25% is taken from surveys at a number of recent TVA construction projects and is considered reliable for construction activities of this kind. A recent housing survey by the Green River Area Development District indicates that there are 31 existing lots available for mobile homes in Daviess County. Though this is clearly inadequate for the projected SRC-I related demand (i.e., 80 to 155), there is sufficient land in designated zones to accommodate this demand through the development of new mobile home parks or the expansion of existing mobile home parks (Mr. Rick Hiten, Green River Area Development District, personal communication, April 23, 1981).

8.16 Comment: Analysis of the impact in the rental sector should be provided in relation to the impact it will have on low- and moderate-income and elderly families who predominantly use this sector. Vacancies available to this group may be substantially reduced, assuming that construction patterns established over the last 10 years continue. Also, the impact of the Big Rivers Electric Corporation's development in Ohio County, when added to the SRC construction plant, reduced these vacancies by half. (Commenters: 23, p. 4; 65, p. 44)

Response: The project may induce some shortages in the availability of apartment housing for all population groups and may induce housing price increases, which could particularly affect elderly and low-income groups. Cumulative impacts are discussed in Sect. 4.2.5.6.

8.17 Comment: Some analysis of the growth impacts in the rural areas outside of the Evansville and Owensboro standard metropolitan statistical areas should be provided in terms of impact on current vacancy rates and land use controls. Given differences in existing zoning practices, the ease of development in these areas in relation to the more controlled urban areas could generate considerable growth in bordering rural areas. (Commenter: 23, p. 5)

Response: As is noted in Sect. 4.2.4.1 of the DEIS, it is anticipated that substantial traffic-related impacts will accrue to the rural areas outside Owensboro and Evansville and particularly to those communities near the project site. The possibility of the additional impacts described above has been added to the FEIS. It will be essential that the project sponsors, regional planning commissions, and State and local governments cooperate fully to minimize these impacts.

8.18 Comment: I know from experience that the cost of relocating families from the project area can be extremely expensive. These costs for the 24 affected families were not projected in the DEIS. These should be stated in the FEIS. (Commenter: 39, p. 4)

Response: The costs of relocation shall be borne by the seller.

Public services

Should its involvement continue, DOE will monitor the public services situation to identify any project-related problems so that appropriate mitigation strategies and mechanisms can be implemented if necessary. In the event that DOE withdraws from this project, however, ICRC has not committed to carry out any public services monitoring and mitigation measures.

8.19 Comment: Since the primary impact area consists of small, rural communities without sophisticated urban/regional planning capabilities, induced primary growth and secondary impacts could be haphazard. This would not auger well for housing, water, and sewer facilities; public safety; education; and recreation. The Kentucky Department of Local Government and the Green River Area Development District, together with their counterparts in Indiana, should be directly involved and consulted at every stage. These bodies should make special provision in planning for non-disruptive growth. (Commenter: 58, p. 1)

Response: To minimize adverse socioeconomic impacts to the region, it will be essential that local, regional, State, and Federal authorities work together in monitoring project development so that appropriate mitigation measures can be implemented where necessary. To ensure local and regional involvement in the process, a regional citizens advisory review board could be established (see Sect. 4.5.5).

8.20 Comment: Impacts on community-related utility services need additional evaluation. For example, no definitive consideration is given to the domestic water supply treatment and distribution system requirements necessary to support new residential development associated with project construction. Likewise, construction-related impacts on necessary wastewater treatment facilities have not been adequately addressed in the DEIS. The FEIS should contain a more complete discussion of localized and cumulative fiscal, physical, and institutional infrastructive impacts associated with construction and operation of the SRC-I and related facilities. (Commenters: 12, p. 1; Speaker 93)

Response: Because it is not possible to predict exactly where new project-related residential development will occur, water and wastewater distribution systems requirements cannot be projected at this time. However the local infrastructure was adequately described for the purpose of this analysis in Sect. 4.2.4.1 (see also Sect. 4.5.3).

8.21 Comment: P. 4-76. Several comments throughout the document seem to imply that the city of Owensboro will have to add to its municipal resources to accommodate the growth expected. Typically, a large amount of the growth has taken place in the urbanized area outside the city limits. I suggest that both Owensboro and Daviess County will have to add personnel to provide government services. (Commenter: 4, p. 2)

Response: To the extent that additional local resources are required to service project-related growth, these resources may be required from both Owensboro and Daviess County. As is noted in Sect. 4.2.4.1, the total level of services and their costs are not expected to increase substantially as a consequence of the SRC-I facility (see Sect. 4.5.3).

8.22 Comment: Provide a re-estimation of police and fire personnel needs based on realistic demographic data. (Commenter: 65, p. 44)

Response: As is noted in Sect. 4.2.4.1, the predictive model of labor in-migration used in this analysis has been revised. The output of this model represents the most realistic predictions currently available. TVA data, which are used as surrogates with respect to marital and family status, indicate that approximately two-thirds of all in-migrants will bring their families and, therefore, that one-third will be either single or married but in either case will not bring their families. Projections of project-related demands for additional fire and police personnel are based upon these in-migration estimates and upon the assumption that the current level of police and fire protection service afforded in the host region is adequate. Nevertheless, police and fire protection services and capabilities will be monitored so that any project-related demands for additional services and personnel can be promptly addressed.

8.23 Comment: Health problems and needs in the following categories have been identified by the Subarea Health Council for study but were not mentioned in the DEIS.

a. Prevention and Detection Services
b. Primary Care Services
c. General Acute Services
d. Specialized Acute Services
e. Long Term Care Services

Commenter: 23, p.4)

Response: The level of detail requested by this comment goes beyond what can be realistically expected in an environmental impact statement. For a discussion of area health care, see Sect. 4.2.4.1.

8.24 Comment: Section 3.2.4.4 outlines the health manpower and facility statistics for the three counties (Vanderburgh, Daviess and Henderson). These are regional centers for the Tri-State; however, the DEIS does not deal with the entire population of the Tri-State region. A more regional perspective of health care availability should be analyzed. (Commenter: 23, p. 4)

Response: The population-related impacts resulting from the SRC-I plant fall mainly within the 3-county area. For purposes of analyzing the health-related impacts, a discussion of the health manpower and facility statistics in the 3-county area is adequate.

8.25 Comment: Health care and medical facilities have been deleted in the public services section of DEIS dealing with alternative sites (3-63 Vol. I). (Commenter: 23, p. 4)

Response: The analysis of the alternative sites in the FEIS is sufficiently comprehensive, with its consideration of projected impacts on housing, public services (schools, water, and sewerage systems), transportation, the local economic base, labor and income, local government taxation and spending, and historical and archaeological resources, to allow a reasonable comparison of the proposed and alternative sites.

8.26 Comment: Page 3-44. Our Lady of Mercy Hospital serves the same region as does the Owensboro-Daviess County Hospital. Physicians in the community maintain privileges at both hospitals. Our Lady of Mercy Hospital is also projecting a 10.5 million dollar expansion and renovation program. (Commenter: 4, p. 2)

Response: This information has been incorporated into Sect. 3.2.4.4.

8.27 Comment: Page 3-45. The DEIS states that the number of ambulances at Owensboro-Daviess County is "currently unavailable". There are four ambulances based at Owensboro-Daviess County Hospital. The ambulances are staffed by emergency medical technicians (EMT). Currently 12 of these EMTs are attending paramedic training. Henderson County ambulances are staffed with paramedics.

In addition, the Henderson-Owensboro area is within the operating range of TIKI-MAST helicopter service from Fort Campbell, Kentucky, and the MAST operation at Fort Knox, Kentucky. Both units have standby crews available to aid the civilian community. (Commenter: 4, p. 2)

Response: This information has been incorporated into Sect. 3.2.4.4.

8.28 Comment: Paragraph 2 on p. 3-45 states that the "fire department in Owensboro is involved in the provision of emergency medical services." This is no longer true. The ambulance-rescue vehicle is no longer configured as an ambulance. The City Fire Department does continue to provide rescue and extrication services. Some of the fire fighters are EMT certified. (Commenter: 4, p. 2)

Response: This information has been incorporated into Sect. 3.2.4.4.

8.29 Comment: The DEIS states that "neither of these counties is insurance rated". This is incorrect. The Daviess County system has a 9 rating county-wide and a 7 rating for all structures within 1,000 feet of a hydrant. Fire stations are located at Stanley, St. Joseph, Utica, Airport, Sargho, Mosleyville, Masonville, Pleasant Ridge, Thruston, Philpot, Whitesville, Yelvington, and Knottsville. Typically, each station has a rated pumper and a rated tanker. In addition there is a variety of special service units, such as rescue vehicles and brush fire units, throughout the county. The entire system is dispatched by a centralized system. Each volunteer is radio dispatched in a system which provides automatic, pre-programmed back-up and support from nearby stations. (Commenter: 4, p. 2)

Response: This information has been incorporated into Sect. 3.2.4.4.

Transportation

Should its involvement continue, DOE will monitor the transportation situation to identify any project-related transportation problems so that appropriate mitigation strategies and mechanisms can be implemented if necessary. In the event that DOE withdraws from this project, however, ICRC has not committed to carry out any transportation monitoring and mitigation measures.

8.30 Comment: The EIS states, "In spite of low sufficiency ratings, the state has no plans to widen or upgrade US 60 between Henderson and Owensboro. This is caused in part (1) by the generally negative attitude of the state legislature toward new expenditures and (2) availability of a parallel facility (Aubudon Parkway) between the two cities." (Page 3-5). Item 2 is correct. Item 1 is misleading. At the time the EIS was prepared KYDOT had no plans to widen US 60 because of the current shortage of highway construction funds. Additional consideration is being given at this time because of the potential synfuels plants. (Commenter: 10, p. 1)

Response: Section 3.2.4.5 has been changed in response to this comment.

8.31 Comment: The EIS concludes, "Therefore, the widening of US 60 to four lanes west of Frontier Drive (1.1 miles) is mandatory, regardless of whether the SRC-I plant is constructed" (p. 3-52). The EIS also states, "The TAM analysis of Traffic Impacts . . . considered widening of US 60 to four lanes west of Frontier Drive (1.1 miles) as mandatory" (p. 4-81). The widening of US 60 to four lanes west of Frontier Drive, regardless of whether the SRC-I Plant is constructed, is not mandatory. Improving US 60 is a desirable project. Although no plans for improvement exist at the present time, additional consideration is being given because of the potential synfuels plants. (Commenter: 10, p. 1)

Response: Section 3.2.4.5 has been changed in response to this comment. The term "mandatory" was an overstatement; however, the potential traffic problem on this stretch of road is still significant.

8.32 Comment: The EIS states (p. 3-52), "Improvement of US 60 to a divided four-lane highway from the US 41 intersection to the eastern Henderson city limit is anticipated by 1986 because of normal traffic growth of local (not SRC-I related) traffic according to Kentucky DOT." The above statement is incorrect; KYDOT had no plans to four lane this section of US 60, particularly by 1986, at the time the EIS was prepared. Additional consideration is being given presently because of the potential synfuels plants. (Commenter: 10, p. 1)

Response: Section 3.2.4.5 has been changed in response to this comment.

8.33 Comment: Table 3.26 (p. 3-51) describes the level of service for a two-lane rural highway . . . not US 60 in particular. Therefore, the reference to US 60 in the heading should be eliminated. The source for Table 3.26 should probably be the 1965 Highway Capacity Manual. (Commenter: 10, p. 2)

Response: Table 3.26 has been changed in response to this comment.

8.34 Comment: In the discussion of transportation impacts on pp. 4-80 through 4-91 of the DEIS, service volumes for sections of US 60 are not given, nor are the existing peak-hour traffic volumes estimated as a base of comparison to alternatives discussed. (Commenter: 23, p. 3)

Response: Existing estimated service volumes and peak vehicle flow for US 60 are given in Sect. 3.2.4.5. The overall conclusion is that the sufficiency of the road is very low, and any additional traffic would create problems. With the exception of the alternative of reconstructing Highway 60 to provide for an increase in service capacity, the impact of the other alternatives on Highway 60 can be evaluated on the basis of the marginal increase in traffic volumes resulting from plant-related traffic and on the basis of potential delays to workers in driving to and from work.

8.35 Comment: In the table on p. 4-81, the description of the Section for the 1st Section should read "US 60 from US 1 to 0.2 mile east of the Henderson city limit." (Commenter: 10, p. 2)

Response: The table in Sect. 4.2.4.1 has been changed in response to the comment.

8.36 Comment: The FEIS may need to discuss why the highway bridge over the L&N tracks near Henderson is a major structural flow constraint. (Commenter: 10, p.2)

Response: Sect. 3.2.4.5 has been changed to explain the nature of the flow constraint.

8.37 Comment: The EIS states (1) "Finally, the Green River Bridge at Spotsville is very dangerous, . . .", and (2) "US 60 between Owensboro and Henderson is presently maintained to provide, at the minimum, a level of service (level D). . . ." We believe the above statements should be changed to say that (1) the bridge is geometrically substandard because of its pavement width of only 20 feet, and (2) US 60 is not maintained to provide any specific level of services. Level of service merely describes the quality of flow on the highway. (Commenter: 10, p. 1)

Response: (1) The statement in the DEIS that, "the Green River Bridge at Spotsville is very dangerous," was a direct quote from a report prepared by the Radian Corporation. The KYDOT classification of the Spotsville bridge has been added to Sect. 3.2.4.5. (2) Section 3.2.4.5 has been changed to reflect the comments.

8.38 Comment: Another area of unanswered questions involves the impact on our transportation system. The DEIS discusses quite a number of mitigating measures that could be taken for transportation. The Green River Area Development District has devoted extensive study to the traffic problem. Their conclusions are that none of the alternatives can be accomplished in time. (Commenter: Speaker 7, 50)

Response: The Green River Area Development District (GRADD) has endorsed a number of effective measures that could be taken to mitigate construction-induced traffic impacts. These recommendations include carpooling, compulsory van pooling, busing, and structural improvements to US 60. Though the GRADD recommendations for improving the existing road system could not, according to their estimates, be completed before construction begins, these improvements can be completed (with the exception of four-laning US 60 in Henderson) prior to peak construction activities. See *Green River Area Development District SRC-I Study* for a more detailed discussion.

8.39 Comment: No transportation alternatives address energy consumption or air pollution. (Commenter: 23, p. 3)

Response: Predicted traffic volumes would result in the inefficient consumption of energy because of traffic delays and stop-and-start traffic flows. To the extent that road improvements permit a stable flow of traffic at moderate speeds, the efficiency of energy consumption will be maximized. The alternatives of ride sharing and park-and-ride will, if effective, result in less energy consumption. Appendix C, Sect. C.4.5.6 discusses air emissions from highway vehicles during construction and operation of the facility. These represent worst-case emissions before implementation of mitigation measures for traffic congestion problems. The mitigation measures should reduce emissions to below these worst-case estimates.

8.40 Comment: The non-structural alternatives (i.e., split-shift/off-site fabrication, etc.) do not estimate the extent of impact, but rather-indicate "less than the 'do nothing' alternative." (Commenter: 23, p. 3)

Response: A discussion of nonstructural alternatives in the DEIS provided data on vehicle reduction. See Sect. 4.2.4.1.

8.41 Comment: No alternatives include the cost of funds used or debt service requirements. (Commenter: 23, p. 3)

Response: A traffic mitigation plan is presented in the summary of Sect. 4.2.4.1. This plan includes elements of the various alternative transportation strategies discussed in the body of that section. Costs for the plan would be borne primarily by the project sponsors and the state of Kentucky. Cost estimates for the specifics of the mitigation plan would be issued by the project sponsors prior to its implementation and the construction of the facility. The costs of funds and debt-service requirements will be taken into consideration in preparing these estimates.

8.42 Comment: We have three different statements and different routes that we think should be used.

One is designating the Audubon Parkway as a route to the site via a limited interchange at Road 1554. Tokens, script, or other toll-paying means could be provided for by the company.

Second, ride-sharing is a must, preferably van-pooling. Again, access would be via the Audubon Parkway and Road 1554.

Third, park-and-ride buses should be made a part of it, and used in conjunction with the ride-sharing alternates. (Commenter: Speaker 42)

Response: The above alternatives are included in the transportation alternative discussion in Sect. 4.2.4.1 of the EIS.

8.43 Comment: Park and Ride Bus: Estimates of the cost of commuter bus service appear to be quite high, representing a worst-case estimate. KYDOT's analysis of the Hughes proposals lead to an estimated service cost of less than $4,000,000 for the contract period in 1980 dollars. The use of competitive bids or the possibility of providing transit service in-house should also be considered. The final EIS should reflect most probable costs. (Commenter: 10, p. 3)

Response: The information provided in this comment has been included in the text of Sect. 4.2.4.1.

8.44 Comment: On page 4-84, in the next to the last line of the bottom paragraph, approximately 200 vehicles are identified as using US 60 at peak travel times if a "Park-and-Ride" Bus Program is used. Under the Section "Park-and-Ride Rail" on page 4-87, first paragraph, this number is 160 vehicles. Since the scenario is the same, the number of vehicles should also be the same. (Commenter: 10, p. 3)

Response: The scenarios are not the same; as a consequence, the number of vehicles would not be the same. The "Park-and-Ride" Bus program assumes that 90% of the workers will ride in buses, and 10% will use their own cars. The increase in the number of vehicles using the roads includes the number of buses (70 to 102) required to transport 90% of the workers as well as individual cars. With the Park-and-Ride Rail program, 90% of the workers will use the train, and 10% will drive their own vehicles. The increase in vehicles on the road under this alternative would be only from the vehicles driven by individual workers.

8.45 Comment: Park and Ride Rail: It appears that operating costs have been ignored. The cost of diesel fuel to run the locomotive will most likely be the largest cost involved. The final EIS should address this cost and assign responsibility for it. The cost figures shown in Tables 4.37 and 4.38 misrepresent the facts unless they include all costs. (Commenter: 10, p. 3)

Response: A rough estimate of diesel fuel costs is included in Table 4.40 of the FEIS under the category of "maintenance costs." The FEIS includes a final traffic mitigation plan that does not include the park-and-ride rail alternative.

8.46 Comment: It is possible to set up a vanpooling program whereby capital costs would be defrayed by program participants. The final EIS should include a discussion of the need for adequate park-and-ride lots in Henderson and Owensboro to facilitate car, van, and/or bus pooling. (Commenter: 10, p. 3)

Response: Capital costs can be defrayed if vans are purchased by program participants. The shifting of such costs from the applicant to the workers could substantially reduce participation in the ridesharing program. A discussion of the need for adequate park-and-ride lots in Henderson and Owensboro has been included in the text of Sect. 4.2.4.1.

8.47 Comment: Clarification is needed as to who is proposing a new interchange at Audubon Parkway and KY 1554 (p. 4-82). Also, costs shown in the table on p. 4-83 for KY 1554 are in error. The costs shown for "1554 to 24 feet" and "1554 three lane" include the cost of the interchange. These estimates should be revised as follows:

KY 1554 to 24 feet – $5,650,000
KY 1554 three lane – $7,700,000

All estimates should be identified as being based on 1980 costs. (Commenter: 10, p. 3)

Response: The new interchange is being proposed as a possible traffic mitigation measure by the sponsors of this project. Comments on costs have been incorporated into Sect. 4.2.4.1.

8.48 Comment: The cost of KY 1554 interchange does not include the cost of widening the bridge over the Audubon Parkway to accommodate turning movement onto the KY 1554. (Commenter: 23, p. 2)

Response: The cost of widening the bridge over the Audubon Parkway is not included because the interchange under consideration will handle only one-way traffic, and it is expected that the existing bridge will be adequate to handle the additional vehicles.

8.49 Comment: The statement on 4-96 that "US 60 will probably have been expanded to four lanes and alternate access routes improved" is erroneous. No plans have been made or project programmed in the Kentucky Department of Transportation's (KYDOT) five-year highway program. (Commenter: 23, p. 3)

Response: Sect. 4.2.4.3 has been changed to reflect the comment.

8.50 Comment: The EIS states (p. 4-82), "For this mitigation alternative to be practical, four-laning past (sic) US 60 would have to receive high priority from KYDOT." Even if four-laning of US 60 were given high priority by KYDOT, it could not be completed in time to accommodate the scheduled peak construction worker traffic. Therefore, four-laning of US 60 does not appear at this time to be the most practical alternative to pursue. (Commenter: 10, p. 2)

Response: KYDOT comments have been incorporated into Sect. 4.2.4.1.

8.51 Comment: One of the major problems with any US 60 reconstruction near Henderson is utility relocation. This should be addressed in the EIS. (Commenter: 10, p. 3)

Response: Section 4.2.4.1 has been expanded to recognize this potential problem.

8.52 Comment: Most alternatives do not include maintenance costs or increased accident frequency resulting from improvements. (Commenter: 23, p. 3)

Response: A traffic mitigation plan is presented in the summary of Sect. 4.2.4.1 which will be enacted should DOE involvement in this project continue. This plan includes elements of the various alternative transportation strategies discussed in the body of the section. Costs for the plan would be borne primarily by the project sponsors and the state of Kentucky. Cost estimates for the specifics of the mitigation plan would be issued prior to its implementation and the construction of the facility.

8.53 Comment: Sauer Lane will require widening and some new structures, if used as described in highway alternative #4 or #5. (Commenter: 23, p. 3)

Response: The comment is correct. Minimal widening would be necessary.

8.54 Comment: The DEIS does not address the alternative of a two-lane widening along the entirety of US 60 (2-9' lanes to 2-11' lanes with 2' shoulders) for safety and operating improvement. (Commenter: 23, p. 3)

Response: Such an alternative has been added to Sect. 4.2.4.1 of the FEIS. This alternative alone would not address the traffic problems predicted. This measure, taken in conjunction with ride-share and park-and-ride programs, would ease traffic problems substantially.

8.55 Comment: The rail alternative does not include overhead costs for system management, or profit, which a private operator would require. (Commenter: 23, p. 3)

Response: A traffic mitigation plan is presented in the summary of Sect. 4.2.4.1 which will be enacted should DOE involvement in this project continue. This plan includes elements of the various alternative transportation strategies, discussed in the body of the section. Cost estimates for the specifics of the mitigation plan would be issued prior to its implementation and the construction of the facility.

8.56 Comment: The L&N Railroad train number 761 offers the potential for traffic conflict to the commuter rail alternative as 5:00 a.m. is a crew call time rather than a departure time. (Commenter: 23, p. 3)

Response: The times presented in Table 4.36 of the EIS have been confirmed by the L&N Railroad Line. 5:00 a.m. is, in fact, a departure time for train No. 761.

8.57 Comment: The rail commuter alternative does not cite the current long delivery time required for rail passenger cars. (Commenter: 23, p. 3)

Response: The long delivery time required for rail passenger cars is a factor that has made this alternative less acceptable when compared to other alternatives.

8.58 Comment: A major problem has also arisen with transportation on US 60 between Henderson and Owensboro. That highway needs major improvements to handle the construction traffic for the SRC-I project. The source of the money for the improvements, plus the time to complete them, has not been adequately addressed. (Commenters: Speakers 19 and 7)

Response: The summary of Sect. 4.2.4.1 describes the proposed mitigation plan and provides preliminary estimates of costs as well as timing for construction. A detailed breakdown of estimated costs for the mitigation plan would be provided prior to construction and implementation of the plan.

8.59 Comment: Another area in which the DEIS is strikingly incomplete is transportation. Something is written about roads and railways, little about barges. Tasks 1 and 2 of the Phase Zero Deliverables (pp. iii and 4-44) give the impression that trains will be the major form of transportation for coal. At the 29,400 tons per day level of operation, 750 railway cars will go through per day, we are told. The DEIS is not so sure: "Coal will be transported to the demonstration plant in an 80-car unit-train . . . In the event that the coal is purchased from a mine that does not have rail access, coal will be barged to the demonstration plant" (p. 4-93); "All coal for the commercial plant will be transported by barge" (p. 4-96); and, under changes from Phase Zero, "A barge dock includes capability for construction equipment and possibly coal delivery" (p. C-3). Why is there a change from trains to barges for coal transportation and is barge transportation for 29,400 tons per day feasible? The final EIS should address these questions. (Commenter: 46, p. 4)

Response: The two most probable alternatives for shipping coal to the facility, given the present condition of US 60, are barge and rail. For the demonstration phase, the most probable alternative will be rail. Once a barge docking facility is constructed, the alternative of barging coal to the plant would be available. The barge docking facility will be designed and built to handle 29,400 tons of coal per day.

8.60 Comment: From the description of travel patterns of the work force, many small, rural communities will be adversely affected by heavy through traffic. There will be an even greater negative impact if plant operations expand from a demonstration to full-scale commercial production. DOE and the Kentucky Department of Transportation should make a definite commitment to ease the potential traffic burden on US 60. (Commenter: 58, p. 1)

Response: The summary of Sect. 4.2.4.1 presents the mitigation plan designed to ease the potential traffic burden on US 60.

8.61 Comment: The DEIS does not address the cumulative impact of mixing trucks for delivery of construction materials with construction traffic. (Commenter: 23, p. 3)

Response: Cumulative impacts are considered in Appendix C of the EIS. However, trucks for delivery of construction materials would exacerbate predicted traffic problems. The project sponsors will attempt to schedule delivery on off-peak hours or to use rail or barge for delivery to lessen the impacts.

8.62 Comment: The DEIS does not address the impact of coal truck traffic on US 60, which should be part of the worst-case analysis for the demonstration phase. (Commenter: 23, p. 3)

Response: US 60 cannot support coal truck traffic unless it is substantially upgraded. However, as is stated in the EIS, coal deliveries are expected to come by rail during the demonstration phase of the project.

8.63 Comment: Projected traffic origins and destinations are not provided for the project. (Commenter: 23, p. 3)

Response: General information on the origins and destination of workers is presented in Sect. 4.2.4.1 of the document. This general information was obtained from a detailed prediction of the residential location of workers for the project over a 21-county area. This prediction was derived from an Oak Ridge Associated Universities worker location model.

8.64 Comment: The source for a vehicle occupancy rate of 1.9 is not cited. (Commenter: 23, p. 3)

Response: This vehicle occupancy rate was obtained from Table 1.14 of the definitive *Transportation Energy Conservation Data Book, Edition 4*, by G. Kulp et al., ORNL-5654, September 1980, prepared at Oak Ridge National Laboratory for U.S. DOE (available from National Technical Information Service).

Economic Effects

8.65 Comment: What will be the effect of the SRC-I plant on future industrial development? What, if any, types of industry might find it difficult to locate here afterward? Would the massive scale of the Newman project prohibit, on a practical basis, the negotiation of environmental trade-offs or sell-offs with a more traditionally sized industrial prospect? (Commenter: Sp. 8)

Response: The placement of the SRC-I facility at the Newman, Kentucky, site is not expected to adversely affect future industrial sitings in the area. The future availability of air quality increments that would allow the location of new industries cannot be predicted, but the SRC-I plant itself is not expected to prevent further development. Concerning local water quality, the Green River is already classified as "effluent limited," but the placement of SRC-I will not necessarily preclude any new development. More detailed information on the water quality impacts of the SRC-I project would be provided in the study recommended in response to Comment 6.10.

8.66 Comment: There is concern that if synthetic fuel projects such as SRC-I prove successful, other ancillary industries that would utilize the products and by-products would be attracted to the area. This could affect the future development of more desirable industry here. (Commenter: Sp. 8)

Response: It is currently unclear to what extent, if any, ancillary industries would be drawn to the area to utilize SRC-I products and by-products. Because the well-developed transportation methods in the area would allow the rapid distribution of these materials to potential users, the need for ancillary industries to locate near the SRC-I facility should be minimal. Even if such project-induced development does occur, however, there is no reason to expect that the associated environmental effects would preclude future development. Any industries utilizing SRC-I products as a fuel source are expected to have low air emissions and are likely to be less polluting than industrial facilities that burn more traditional fuels.

8.67 Comment: Provide estimations of the impact of peak construction on employee turnover rates, productivity, and wage inflation in those local industries that will be supplying construction labor for the SRC-I project. (Commenter: 65, p. 45)

Response: Although the number of jobs to be generated by the SRC-I project is relatively small compared to the existing number of jobs in the three primary impact counties (Daviess, Henderson, and Vanderburgh), some competition for labor could still exist, resulting in a degree of wage inflation and slightly higher employee turnover rates for established companies.

8.68 Comment: Why does the DEIS use an annual average wage of $24,440 when calculating tax revenues occurring to Kentucky and Indiana from SRC-I employment, and significantly lower figures of $18,250 (for "operating labor") and $22,500 ("supervisory personnel") on p. 4-92? (Commenter: 65, p. 51)

Response: The wage rates cited above differ from each other because they are to be paid for the performance of three different kinds of jobs. The average annual wage of $24,440 will be paid to construction workers involved in building the SRC-I facility, and the other two wage rates are for operations workers: $18,250 for the plant operators themselves and $22,500 for supervisors. The wages to be paid for these last two job categories have been updated since the issuance of the DEIS, and the new rates are presented in Sect. 4.2.4.2. (Income sub-section) of the FEIS.

Public finance

Should its involvement continue, DOE will monitor the public finance situation to identify any project-related problems so that appropriate mitigation strategies and mechanisms can be implemented if necessary. In the event that DOE withdraws from this project, however, ICRC has not committed to carry out any public finance monitoring and mitigation measures.

8.69 Comment: The public finance impacts on p. 4-78 are too general. The cost of the public services for the cities and counties in GRADD needs to be identified in detail. In particular, the cost of transportation improvements and fire equipment and personnel should be estimated. (Commenters: 4, p. 2; 23, p. 1; 65, pp. 44 and 45)

Response: The public service needs that are expected to arise in the SRC-I primary impact counties as a result of project construction are discussed in depth in Sect. 4.2.4.1 (Public services and Transportation subsections). Detailed predictions of the costs of those improvements necessary to respond to the above service needs go beyond the scope of the present analysis. A traffic mitigation plan will be issued prior to the start of project construction detailing the costs for all measures that will be taken to mitigate transportation impacts. The cost of other project-induced public service impacts would be identified through a local monitoring program. Based on the findings of this monitoring program, an annual per capita cost-benefit analysis for the tri-county impact region would be conducted to identify potential deficits in the aggregate cost of each jurisdiction's public services and to identify sources of funds to offset such deficits.

8.70 Comment: Although there is "excess capacity" of 17% in the Evansville-Vanderburgh County Schools, there is a total lack of local and/or state money to finance instruction and instruction-related services to use any of that 17%. The increased student load would not be financed by the State of Indiana until one year later. What happens that first year? (Commenter: 65, p. 48)

Response: The FEIS (Sect. 4.2.4.1, Public services subsection) shows that the Evansville-Vanderburgh county schools are expected to receive only 90 to 170 additional students as a result of SRC-I related in-migration. Even with a lack of State funds during the first year of construction, it is expected that the impact of such a small number of students on a school district with a current enrollment of almost 25,000 will be extremely small.

8.71 Comment: The DEIS seriously ignores the impact of SRC-I on public services and public finances. Henderson and Vanderburgh counties would receive virtually nothing in tax revenues *and* would be expected to sustain substantial expenses in several public service areas. (Commenter: 65, pp. 51 and 52)

Response: It is true that Henderson and Vanderburgh counties will receive relatively small amounts of tax revenue as a result of SRC-I construction; these revenues will be limited to the extra property taxes that will accrue to the communities as a result of project-induced residential and commercial occupancies. It is not true, however, that Henderson and Vanderburgh counties are likely to sustain substantial expenses in the public service area. As is shown in Sect. 4.2.4.1 of the EIS (Public services subsection), both counties have sufficient water and sewage treatment facilities, schools, and health care facilities to accommodate the population increases expected to result from SRC-I construction by itself, though minor additions to police, fire, and emergency medical services may be necessary. The cumulative construction of all the power plants and synthetic fuel facilities planned for the area, however (much of which is scheduled to peak after SRC-I is completed), could result in much more serious impacts to area services. In any case, the project-sponsored socioeconomic monitoring program described in response to Comment 8.69 would identify the costs incurred as a result of any project-induced public service improvements and would serve as the basis for the design of any necessary mitigation measures.

8.72 Comment: Many inmigrants will move on when the construction phase is over. We could well have a vacuum then, which means we would have to gear down all of our overbuilt services, perhaps continue to pay for them with a reduced residential tax base. (Commenter: Speaker 93)

Response: Because the public service improvements projected to be necessary as a result of SRC-I in-migration alone are projected to be relatively minor (see response to Comment 8.71), it is considered unlikely that the communities of the tri-county area will find themselves stuck with overbuilt services at the end of the SRC-I construction phase. Such overbuilding is, however, more of a likelihood in response to the peak of cumulative construction activities. As is discussed in responses to Comments 8.69 and 8.71, a project-sponsored socioeconomic monitoring program would identify any project-necessitated public service improvements, and their costs and could be used as the basis for a mitigation plan.

8.73 Comment: We could easily put ten times the number of men to work in the 21-county area insulating attics and windows and walls, and for half the cost. That would be a genuine employment boom. It would require a less-skilled work force, too, so the unemployed could find pride again. (Commenter: Speaker 93)

Response: The conservation alternative is addressed in Sect. 1. See response to comment 1.9.

8.74 Comment: We want some reasonable estimates of the amount of money that will be lost to county government because prime farmland is being taken out of production by this plant, by plant-induced strip mining, and by plant-induced roads and railroads. (Commenter: 52, p. 2)

Response: Current tax revenues that would be lost as a result of SRC-I construction and operations are extremely small. As is described in the EIS, the proposed site will be removed from the local tax rolls, resulting in the loss of $4200 per year in property taxes. Balancing this will be an expected increase in local property taxes from plant-induced residential occupancies in Daviess, Henderson, and Vanderburgh counties of between $67,000 and $127,000 (Table 4.32, FEIS). No land is expected to be removed from the county tax base because of project-related road improvements, and only a very small amount would be removed if a dedicated rail commuter line were built. Local governments could lose tax revenues if prime farmland were taken out of agricultural production and strip-mined in response to project-generated demand for coal, but the likelihood of such conversion is slight because of the extensive coal resources in the region. If DOE withdraws from this project, it is expected that ICRC will pay property taxes on the unimproved site during the construction period and will pay taxes on the SRC-I facility when the plant is completed. Otherwise, property taxes would not be paid until DOE withdraws at the time of commercial plant operation.

8.75 Comment: Potential revenues to be received by cities and counties in the Green River Area Development District during the construction and demonstration phases must be identified in detail. (Commenters: 23, p. 1; 52, p. 2)

Response: The description of project-induced revenues for the three counties of the primary impact area provided in Sect. 4.2.4.1 of the FEIS (Public finance; General revenues and public finance; and Education subsections) and in Sect. 4.2.4.2 (Taxes subsection) provides an estimate of the direct fiscal benefits of SRC-I construction and operations to be balanced against project-induced impacts described elsewhere in the document and is sufficiently detailed for the purposes of this analysis. More detailed information on project-induced revenues would be provided through a project-sponsored local monitoring program.

8.76 Comment: The potential socioeconomic impacts for the rural counties are treated as "not substantial." This is true on a regional basis. However, the impacts for a small rural county could be substantial due to lack of existing public services and the lack of financial capacity to mitigate these impacts. (Commenter: 23, p. 2)

Response: The number of in-migrants expected to move to each of the individual rural counties of the impact region as a result of SRC-I construction is extremely small. Even with a projected peak construction work force of 5000, only one of these rural counties (Spencer County, Indiana) is expected to receive as many as 100 in-migrants (Table 4.25, FEIS). It is unlikely that these small numbers of new residents will result in substantial impacts to the counties' public service infrastructures. Still, the DOE monitoring program (Sect. 4.5) would identify the place of residence of all project-induced workers and, for those counties in which substantial numbers of workers settle, the impacts to public service systems resulting from this project-induced population growth would be cataloged. In response to these findings, mitigation measures would be taken as necessary.

Cumulative Impacts

Should its involvement continue, DOE will monitor the cumulative socioeconomic impacts to identify any project-related problems so that appropriate mitigation strategies and mechanisms can be implemented if necessary. If the event that DOE withdraws from this project, however, ICRC has not committed to carry out any monitoring and mitigiation measures for socioeconomic impacts.

8.77 Comment: Although the DEIS dismisses the isolated effects of the SRC-I project as "minor," the cumulative impacts of the nine energy projects under construction or proposed for construction in the vicinity of the Newman site are recognized to be severe. Yet the socioeconomic conditions likely to be produced by this simultaneous development are discussed only in the most general and uninformative manner. (Commenters: 38, p. 59; 23, p. 1; Speaker 8)

Response: The discussion of cumulative impacts that appeared in the DEIS has been revised to provide a much more detailed examination of potential socioeconomic effects (see Sect. 4.2.5 of the FEIS). Specifically, projections have been made concerning the number of project-induced in-migrants that will settle in the various counties of the impact region during the peak impact years (Table 4.47) and the resulting impacts on housing, water and sewerage services, schools, and transportation.

8.78 Comment: The DEIS posits an estimated regional work force demand of 28,000, requiring the importation of 21,000 workers along with 31,000 family members, and an additional population increase of 3,000 resulting from associated economic development. This amounts to a total projected population increase of 55,000, or 8% of the 21-county region (DEIS, p. 4-101). The DEIS recognizes that these projections are "very tenuous," but makes no attempt to describe the potential range of population growth. (Commenters: 38, p. 60; Speaker 21)

Response: The numbers of direct and indirect workers projected to move into the SRC-I region have been updated and changed slightly from those quoted above, but the total projected population increase is still approximately 55,000. Because some uncertainty exists regarding the actual number of workers that will move into the area, these projections are based on the worst-case assumption that 75% of all construction workers will be in-migrants. The actual proportion of in-migrants could be lower than this. Accordingly, the socioeconomic impacts described in Sect. 4.2.5 are the most severe that could reasonably be expected to occur and offers local citizens and governmental planners a view of the most serious disruptions that may have to be accommodated. For this reason, it is not considered necessary to describe the potential range of impacts. The impacts described in this document are the most severe of those that would be included in any discussion of a continuum of impacts.

8.79 Comment: What is the justification for assuming a baseline construction work force of 17,000 in 1981 in light of the actual employment of less than 10,000 in 1979. (Commenter: 65, p. 46)

Response: The baseline construction projections referred to in the comment have been deleted from the FEIS. The new analysis focuses on only the employment that will be generated by the major synthetic fuel facilities and power plants planned for this area (see Fig. 4.12).

8.80 Comment: In the DEIS, it is assumed that mining employment will not rise before 1985 (which would reduce the available baseline construction force) and that 25% of the peak construction force will be drawn from local non-construction sources. Justify these assumptions and identify any local industries that will be adversely affected. (Commenter: 65, p. 45)

Response: The FEIS does not assume that mining employment will not rise before 1985. In any event, peak cumulative labor requirements can be met by a worker in-migration rate equal to 75% of total direct employment. As is explained in the response to Comment 8.78, the 75% in-migration figure represents a worst-case analysis that is compatible with potential events that could reduce the available construction force.

In response to the second component of this comment, it is not assumed in the EIS that 25% of the peak construction force will be drawn from nonconstruction sources. Twenty-five percent of the peak work force will be drawn from local sources; a significant number of the peak period workers will come from the local pool of available construction workers, the remainder from nonconstruction sources.

It is not possible at this time to identify those specific local industries that will be adversely affected by the competition for labor that will accompany peak period construction activities. It is safe to assume, however, that certain area employers will be forced to raise wages or have some of their current employees bid away from them by higher paying construction jobs.

8.81 Comment: There is an estimate that the construction of these plants will bring a population growth of 55,000. This is a specific figure to work with. Yet, how accurate is it? Dr. Harry Enoch, of the Kentucky Department of Energy in a paper entitled *Environmental Consequences of Coal Conversion Industry in Western Kentucky* has estimated that the total population increase due to synfuels in 1985-86 is estimated to be 93,000, almost twice the U.S. DOE's figure. We want this discrepancy explained. (Commenter: 52, p. 3; 65, p. 46)

Response: The discrepancy between Dr. Enoch's projection of 93,000 in-migrants and the 55,000 figure presented in the DEIS is explained as follows. While both analyses start with initially the same number of new direct workers (25,000 in Dr. Enoch's report and 24,700 in the FEIS), Dr. Enoch posits 100% in-migration of this work force as the absolute worst case. The DEIS projects a 75% rate of in-migration as a realistic worst case, and the FEIS reaffirms the validity of this premise. Next, Dr. Enoch's analysis differs slightly from that in the FEIS by projecting 15,000 indirect jobs as opposed to the FEIS projection of 18,500. This relatively minor difference stems from the fact that Enoch used average figures for large construction projects taken from a 1976 HUD Report (*Rapid Growth from Energy Projects: Ideas for State and Local Action*) while the number in the FEIS is based on the RIMS multipliers discussed in Appendix T. A far more major departure between the two analyses is that Dr. Enoch posits, again as the most extreme worst case, that 80% of all indirect workers will in-migrate, while the FEIS uses the far more realistic figure of 20%, which represents a doubling of the 10% in-migration rate commonly observed for large construction projects to account for the abnormally great demand for indirect labor that will occur in the cumulative impact region. Because the indirect (service and support) jobs to be created generally require a much lower skill level than do the construction jobs that will stimulate them, it is reasonable to assume that the vast majority of these indirect jobs can be filled from the local ranks of the unemployed, by new entrants to the labor force, and by family members of in-moving construction workers. Twenty percent in-migration in this sector is a realistic projection. Dr. Enoch's analysis also differs slightly from the DEIS in the proportion of workers projected to bring their families to the impact region and in average family size (his source is the previously mentioned HUD Report while the DEIS relied on an extensive recent survey of TVA construction workers in this part of the country), but the major variance between our findings is accounted for by the previously mentioned difference in our assumptions concerning worker in-migration rates. The 55,000 figure presented in Sect. 4.2.5 of both the DEIS and FEIS is the most realistic worst-case estimate.

8.82 Comment: We want to know what basis DOE has for assuming that the cumulative population increase will be spread evenly over a 21-county impact area. By assuming the population increase will be spread evenly over this 21-county area, DOE has given us a meaningless figure of population increase of only 8%. (Commenters: 52, p. 3; Speaker 21)

Response: It is not assumed that the cumulative population increase will be spread evenly over a 21-county area. In the DEIS, it was pointed out that Daviess, Henderson, and Vanderburgh counties are likely to receive a disproportionately large number of in-migrants. In the FEIS, the projection is quantified, with the total number of in-migrants likely to come to these counties given for 1983, 1986, and 1989 (Table 4.47). The most heavily impacted county will be Henderson, which, in 1986, will receive over 18,000 new residents, a number equal to 45% of its current population. The 8% population increase mentioned in this comment is an accurate description of the average increase for the 21-county area, but it was never represented as a precise percentage increase for each of the counties and municipalities of the region.

8.83 Comment: We would like to have a reasonable, realistic estimate of the population increase in Henderson County. (Commenter: 52, p. 3)

Response: The FEIS has been revised to include the following information (Sect. 4.2.5). In 1983, the peak year of SRC-I construction, the population of Henderson County is expected to absorb 1160 project-induced in-migrants, a number equal to 2.8% of the 1980 population. In 1986, the peak year of cumulative construction, Henderson County will have to absorb 18,440 in-migrants, an increase of 45.2% over current population levels. In 1989, the peak year of SRC-I commercial-plant construction, Henderson County's population is expected to increase by 5480, increasing the 1980 population by 13.4%. In actuality, this number will represent a decrease from the peak population experienced in 1986 (see revised Table 4.47 in the FEIS).

8.84 Comment: The DEIS summarily concludes that "the region, as a whole, is not in danger of becoming overwhelmed by possible population increases" (DEIS, p. 4-101). No explanation is given for this conclusion, except that boomtown conditions are usually defined as an annual population increase of 8%, and the increase projected here is expected to occur over a longer, but unspecified, time frame. (Commenter: 38, p. 60)

Response: The definition of boomtown conditions as arising in response to an 8 to 10% annual population growth provides a good rule of thumb for predicting whether boomtown dislocations will result from any given construction project or projects. In the case of cumulative construction activities in the SRC-I region as a whole, project-induced in-migration between 1981 and 1986 is expected to increase total area population by 8%. Because there will be several years for the area to adjust to these increases, boomtown conditions are not expected to arise in the region as a whole. A more accurate picture, however, is provided by examining growth rates on a county-by-county basis, for which the socioeconomic infrastructure to accommodate this growth will have to be provided. As is shown in Table 4.47 of the FEIS, a few counties in the 21-county region — most notably Henderson — will increase their 1980 population levels by more than 8% (although not necessarily in one year).

8.85 Comment: The DEIS does note "the very real possibility that particular communities in the region may experience impacts on the order of boomtown proportions," but there is virtually no description of what these impacts will be (DEIS, p. 4-103). Provide:

- data on other places where similar boomtown conditions have occurred;
- reasonable expectations, based on these data, of increase in problems such as crime, drug abuse, alcoholism, and like problems;
- the effects of boomtown conditions on people with fixed incomes as costs of housing, food, and other necessities rise to meet increased demand; and
- data on what has happened to other areas after the boom was over. (Commenters: 38, p. 60; 52, p. 3)

Response: Revised Sect. 4.2.5 (Economic, social, and cultural subsection) presents a detailed discussion of projected cumulative construction impacts to the housing, water and sewerage, school, and transportation systems of Daviess, Henderson, and Vanderburgh counties. Henderson County will be the most seriously affected, with a projected increase to its 1980 population of 45.2% by 1986. Even with this extremely rapid rate of growth, however, there are still significant differences between Henderson County and those areas in which boomtowns have been observed and documented. Boomtowns generally occur in isolated, sparsely populated areas where no social infrastructure exists to handle significant population growth. In Sweetwater County, Wyoming, for example, extremely disruptive boomtown conditions occurred when the population doubled between 1970 and 1974, going from 18,400 to 36,900 (Gilmore and Duff, *Boomtown Growth Mngt.*, Westview Press, Boulder, Colo., 1975). This annual growth rate of nearly 20% occurred in a county with an average population density of three people per square mile (as opposed to the 85 per square mile in Henderson) where the combined populations of the seven surrounding counties is roughly 75,000, or less than half the population of Vanderburgh County alone.

In Sweetwater County, and in other boomtowns, the local quality of life was degraded in a number of ways. The demand for conventional housing far outstripped the supply, resulting in highly inflated prices and a proliferation of mobile homes. Health services proved inadequate to accommodate the rapidly growing population, and similar problems occurred with recreational facilities, area schools, and most other public services. The cost of living jumped sharply; local retail establishments could not keep up with the growing demand; crime rates jumped (particularly burglary and larceny); and drug use, alcoholism, and family conflict all increased. These negative conditions decreased the stability of the local labor supply and led to declining industrial productivity.

The above problems are neither inevitable nor insurmountable. They can be addressed and even prevented by adequate growth management and the timely provision of needed services and amenities. Such growth management can also prepare for any decline in population that may occur after the initial boom by providing for a mix of temporary and permanent service improvements to accommodate both transient and longer-term in-migrants. None of the problems observed in Sweetwater County are inevitable, they are particularly unlikely in the tri-county area in which existing population levels are much higher than in the traditional boomtown situation and projected growth is lower; where a well developed social infrastructure exists; and where growth-related problems are anticipated, and potential mitigation measures are under consideration. It will be extremely important, however, to closely monitor the cumulative construction period in-migration and to take preventive measures to avoid serious disruptions of local social systems.

8.86 Comment: The DEIS also states that, "should this situation (the tri-county region receiving a disproportionately large number of in-migrants as a result of cumulative construction) occur, the public services, housing, transportation, and local economic infrastructures would likely be faced with such adverse impacts that significant mitigation measures would be required" (DEIS, p. 4-103). At no point in the DEIS are these mitigation measures discussed. (Commenter: 38, p. 61)

Response: An expanded discussion of mitigation measures is presented in Sect. 4.6.2 of the FEIS.

8.87 Comment: Some serious questions are raised by the commentary on multipliers on page 3-39, which underlies the *assumed* effect of expenditure impacts of labor force households in Table 3.17 on page 3-40. The effect of the conservative impact is to downplay the possibility of the "boomtown" dislocations caused by the rapid increase in the demand levels of the labor force. (The various expenditure multipliers are noted in Table 3.17.) The problem with this table is that the demoralizing effect of the cumulative multiplier effect is ignored, as none of the other synfuel plants are built into their calculations. Aside from the boomtown effect of SRC-I, what about the vastly greater trauma occasioned by several plants? (Commenter: 65, p. 47)

Response: Though it is true that higher multipliers than those contained in Table 3.17 have been observed in some boomtown areas, it would be erroneous to assume that this will apply in the SRC-I impact region. As is pointed out in the section of text referred to in this comment (Sect. 3.2.4.2), boomtown levels of growth in indirect employment generally occur in small, isolated communities whose economic infrastructure development is far below average. In contrast to these conditions, the three primarily affected counties of the SRC-I impact area are heavily populated (a combined population of 300,000) and enjoy a well-developed community infrastructure. For these reasons, the multipliers presented in Table 3.17 are considered valid for the purpose of this analysis.

8.88 Comment: What is the justification for assuming that time-delays will not interfere in the construction of the 9 energy-related plants, thus magnifying the socioeconomic impacts? (Commenters: 65, p. 45; 38, p. 60; Speaker 19)

Response: The analysis of cumulative construction impacts has been performed by using the best available data on project schedules. To allow for unanticipated slippages, however, the FEIS (Sect. 4.2.5.6, the Economic, cultural, and social subsection) does include a brief discussion of the possible impacts that could arise as a result of project delays. The FEIS also suggests the coordination of construction schedules for all area synthetic fuels projects as a possible method of avoiding concurrent work force peaks and a resulting increase in the severity of project-induced impacts.

8.89 Comment: In terms of the cumulative nature of those impacts, the following must be addressed in the final E.I.S.:

What additional streets, water lines, police and fire protection, social services, and administrative, regulatory, and service personnel will be needed in affected communities, outlying areas, and State government?

Who will pay for these needs as well as other anticipated improvements, such as the improvements to Locks 1 and 2 on the Green River?

What portion of the costs will be paid by local, State, and Federal governments and, consequently, how much will taxes be increased in various jurisdictions?

What mitigative measures have been proven effective, and to what degree are possible outcomes unknown? (Commenter: Speaker 21)

Response: The FEIS discusses project-induced impacts to housing, water and sewage services, schools, transportation systems, police and fire protection, and health care for the three SRC-I primary impact counties of Daviess, Henderson, and Vanderburgh (see Sect. 4.2.5.6). Impacts in those few other subject areas specified above, while beyond the scope of the present analysis, would be identified through a local project-sponsored monitoring program. Based on the findings of this monitoring program, an annual per capita cost-benefit analysis would be conducted for the tri-county impact region to identify potential deficits in the aggregate cost of each jurisdiction's public services and possible compensation for these deficits. It is anticipated that local and state governments will continue to pay for any needed improvements that result from normal growth. The locks on the Green River are not the responsibility of these units of government; they fall under the care of the U.S. Army Corps of Engineers. In addition to possible compensation for project-induced expenditures, mitigation measures can also be taken to reduce the number of in-migrants who will move to the impact area through options such as local skills-training programs, preferential hiring of local residents, and provision of housing in those areas best able to absorb new growth. Though the outcome of individual measures always contains an element of uncertainty, it is reasonably sure that a combination of available mitigation measures would be sufficient to prevent or ameliorate project-induced impacts to a significant degree.

8.90 Comment: Provide an impact assessment of (1) SRC-I and (2) cumulative industrial development on the tourism and convention trade. (Commenter: 65, p. 44).

Response: It is impossible to predict definitively the impact of SRC-I alone and of cumulative development on the area tourism and convention trade, but certain possible future scenarios can be identified. It is unlikely that construction workers, even those requiring motel rooms or other transient accommodations, will compete to any significant extent for the kind of accommodations that will be sought by tourists and conventioneers. Should serious problems arise with the area transportation network or other public services, however, the SRC-I impact region may become less attractive to the tourist and convention trades. On the positive side, the increased economic viability that could result from a large-scale coal conversion industry and a revitalized mining sector could add to the attractiveness of the area, particularly for coal-related convention business.

8.91 Comment: Questions must be raised as to the willingness of the Indiana State Legislature to appropriate special funds to Indiana counties impacted by not only SRC-I but all other synthetic fuel plants. Where is the cumulative financial impact addressed? (Commenter: 65, p. 49)

Response: Table 4.47 in the FEIS shows that three Indiana counties in the 21-county impact region will increase their 1980 populations by more than 5% as a result of cumulative construction activities. The need for Indiana State funds to finance any public service shortfalls that may result from this in-migration is currently unclear. The socioeconomic costs and benefits of the facilities to the host region will be monitored, and an annual cost-benefit analysis could be conducted to identify potential deficits in the aggregate cost of each jurisdiction's public services and to identify sources of funds to offset such deficits.

Commercialization, Decommissioning, Mothballing

8.92 Comment: The introduction to the section on commercialization at an expanded capacity, p. 4-94, reads as follows: "At present the unavailability of sufficiently reliable information regarding construction and operations in the commercialization phases precludes an independent analysis similar to that developed for the demonstration phase."

Thus DOE claims that needed data are not available, then uses this as a justification for failing to address the problem in realistic terms. (Commenter: 52, p. 1)

Response: Every attempt was made to make a realistic assessment of impacts. Revised Sect. 4.2.4 now includes an analysis of a range of work force requirements between 5,000 and 10,000, which makes the subsequent analysis more conservative.

8.93 Comment: At commercialization, is there any doubt that Henderson County and the cities of Henderson and Owensboro will experience additional needs for public services as a result of workers migration? We want to know how these additional needs will be financed. We want a reasonable estimate of what they will cost. (Commenters: 52, p. 1; 65, p. 52)

Response: It is likely that during the construction phase of the commercial facility some additional public services will be needed in the Henderson/Owensboro area. This situation is discussed in revised Sect. 4.2.4. Because of the uncertainties involved in the commercialization phase, including the economic climate at the time, it is difficult to give an estimate of the likely cost. This burden may be eased by the mitigation assistance discussed in Sect. 4.6.2.

8.94 Comment: We wish to know what the specific economic benefits to be derived by commercialization are? We want a list of them with details and supporting data. We want a reasonable estimate of what the "large increase" to the local tax base will amount to. (Commenter: 52, p. 1)

Response: The chief economic benefit of the commercialization phase derives from the fact that the SRC-I facility would pass to private ownership and would be liable for taxation. Additionally, there would be a larger operating work force required, which, in turn, would create a number of indirect jobs. These benefits are discussed in more detail in revised Sect. 4.2.4.

8.95 Comment: We want to know if there is a possibility that Daviess County will receive no local tax money at all from the SRC-1 plant. On p. 4-95, we found this paragraph.

> Currently, Kentucky legislation exists for alcohol production plants that reduces the tax rate from the present rate of $0.66 per $100 of market value to $0.10 of market value within four years. It is expected that as of July 1, 1981, this exemption will be expanded to include coal plants, as well as other synfuel projects. If passage on July 1, 1981, of tax exclusions to energy production facilities is initiated, the land and buildings will not be subject to property taxes.

(Commenters: 52, p. 2; Speaker 43)

Response: When the SRC-I facility passes to private ownership it will be subject to taxation on its assessed value. This taxation is expected to result in an estimated $5.4 million in Daviess County general purpose and school district property taxes and about $3.9 million in state property taxes.

8.96 Comment: The statement on pages 4-95 and 4-96: "It is expected that as of July 1, 1981, this exemption will be expected to include coal plants, as well as other synfuel projects," is incorrect. (Commenter: 23, p. 2)

Response: This statement has been deleted from the FEIS. There are currently no tax exemptions available for synthetic fuel facilities.

8.97 Comment: We want to know about state taxes these plants will pay. What exemptions will be given to synfuel plants at the state level? Wheelabrator-Frye says that office furniture and equipment at the Newman plant will not be subject to state sales tax. What losses to state revenue would this represent? Will SRC-I be exempt from other state taxes? (Commenter: 52, p. 2)

Response: When the SRC-I facility passes to private ownership, it will be subject to State taxation, especially property taxes. At present, there are no tax exemptions for synfuel plants. Purchases made during the demonstration phase, when the Federal government retains title, will not be subject to tax. Because purchases were not subject to tax in the first place, they can not really be considered losses.

8.98 Comment: Provide a statement of SRC-I's likely contribution to local property taxes compared to manufacturing establishments of similar assets. (Commenter: 65, p. 44)

Response: A commercialized and privately owned SRC-I will be liable for State and county property taxes as would any other privately owned manufacturing establishment. Current estimates of the assessed value of SRC-I are in excess of $1.4 billion. This would mean a Daviess County general purpose and school district property tax of about $5.4 million, at current rates.

8.99 Comment: Include a summary of the likely adverse regional consequences of conversion or mothballing of SRC-I after the demonstration phase. (Commenter: 65, p. 45)

Response: A discussion of these impacts is found in revised Sect. 4.2.4.

8.100 Comment: Include a statement of the likely governmental costs of conversion or mothballing of SRC-I. (Commenter: 65, p. 44)

Response: The costs of conversion would depend on the nature of the facility to which the SRC-I plant was converted. The costs of mothballing are very difficult to project prior to final design and would be highly dependent on prevailing regulations at the time of mothballing.

Other

Should its involvement continue, DOE will monitor other situations to identify any project-related problems so that appropriate mitigation strategies and mechanisms can be implemented if necessary. In the event that DOE withdraws from this project, however, ICRC has not committed to carry out any monitoring and mitigation measures.

8.101 Comment: Assure utilization of data and informal estimates provided by local officials. (Commenter: 65, p. 44)

Response: Much of the data in the DEIS was obtained from local officials, and more yet was obtained and used in the FEIS. The project-sponsored monitoring program (see Sect. 4.5.3.5) would make extensive use of local data and estimates from local experts and authorities.

8.102 Comment: I believe the existing residents' concerns and best interest should be looked to here and now. We should be thinking now about how this population increase and industry of the petrochemical variety will affect us, particularly if they turn out to be a financial fiasco. (Commenter: Speaker 93)

Response: Implementation of the project-sponsored monitoring and mitigation programs (see Sects. 4.5.3.5 and 4.6.2) should alleviate adverse socioeconomic impacts associated with the facility. If the plant is not commercialized, the impacts will be those identified in Sects. 2.3.1.2 and 4.2.4.4.

8.103 Comment: The City of Evansville has thus far concluded that:

1. More attention should be given to various socioeconomic impacts of the proposed plants. Areas needing further attention include: a) behavioral science information, b) predictive case studies, and c) evaluative case studies.

The Draft Environmental Impact Statement presents an unclear picture in regard to socioeconomic impacts of the proposed plant. (Commenter: 15, p. 1)

Response: This predictive analysis of the socioeconomic impacts of SRC-I is based heavily upon appropriate literatures in the behavioral sciences, particularly that of social impact assessment (SIA). Discussions of the theoretical bases of this subdiscipline are not appropriate for this applied analysis. See Sect. 4.2.4 for a discussion of socioeconomic impacts.

8.104 Comment: Regarding growth management issues: mitigative measures should be spelled out, agencies identified, and precedents enumerated. (Commenter: 65, p. 43)

Response: Sections 4.5 and 4.6.2 have been modified to give additional information regarding plans for monitoring and mitigating socioeconomic impacts.

8.105 Comment: Include the public referenda or community receptivity studies of the 21-county area. (Commenter: 65, p. 43)

Response: The Department of Energy is not aware of any public referenda or community receptivity studies that have been carried out in the proposed host region.

8.106 Comment: To what extent will additional coal mining in the impact region add to the entire array of socioeconomic impacts? (Commenter: Speaker 21)

Response: See Sect. 1.4.3 for a discussion of regional coal mining impacts. Because there is currently a large unemployed mining work force and because much of the increase in mining activity will not occur until after the peak construction period is past, it is not expected that any miningrelated in-migration would add significantly to construction-induced population growth and the resulting socioeconomic impacts.

8.107 Comment: Section 4.2.4 (Economic, Social, and Cultural Impacts) does not clearly project how the quality of life could be affected in the region during construction and operation of the demonstration and commercial phases. Quality of life factors should be addressed, such as the sense of community, satisfaction with available recreational and leisure facilities, sense of responsiveness from local and national government, and generalized satisfaction with the human environment comprising work, leisure, and family activities. Social change and urbanization impacts, in particular the social disruption of seven small communities and the rapid urbanization of the 3-county area and the Ohio River flood plain, must be also addressed. (Commenters: 23, p. 1; 65, pp. 43 and 44; and Speaker 7)

Response: The construction of the SRC-I facility, by itself, is not expected to produce the rapid growth referred to in the comment. In the absence of rapid growth, it is unlikely that there will be any significant and lasting impact on the quality of life in the region (Sect. 4.2.4). There may be some temporary disruptions, but these can be expected to be minimal. More significant disruptions to community systems, however, may be anticipated if all the currently planned and proposed energy facilities are constructed as presently scheduled. This situation is discussed in the revised cumulative impacts section (Sect. 4.2.5).

8.108 Comment: How will the plant affect our community in ten to thirty years from now as regards roads to get coal to the plant and strip-mining with the destruction of land?

Response: As is discussed in Sects. 4.2.4.2 and 4.2.4.3 (railroad and barge docking facilities subsections), the two most probable alternatives for shipping coal to the commercial facility are rail or barge. Accordingly, it is considered unlikely that there will be long-term negative effects on area roads as a result of coal transport. As for the possibility of project-induced strip-mining, the likelihood of converting other land uses to mining is small because of the existence of numerous mines (both active and inactive) in the region.

9. FLOODPLAIN AND WETLANDS

9.1 Comment: While it is undoubtedly possible to engineer facilities so that they will withstand the design flood, encroachment into the floodplain is directly contrary to the intent of Executive Order 11988.

Endorsement of the proposed site by DOE does not reflect the leadership in avoiding floodplains to the maximum extent possible, as directed by the Executive Order. (Commenters: Speaker ?8; 44, p. 3; 21, p. 15; 6, p. 3; Speaker 19; 58, p. 1, 56, p. 1)

Response: To comply with Executive Order 11988, "Floodplain Management," Appendix D identifies, evaluates, and assesses alternatives to the floodplain and wetlands impacts associated with the proposed action. This Appendix follows the regulations established by the Department of Energy (DOE) published in *Federal Reserve Regulations* (Title 10, Chap. X, Part 1022, Subparts A and B, March 7, 1979). Pursuant to Executive Order 11988 a floodplain determination for the project is to be made by the Secretary of the DOE.

9.2 Comment: Although there is no discussion of whether there are practicable alternative sites where floodplain encroachment can be limited to barge access and water intake and discharge facilities, this in fact appears to be the case at the two alternative sites where plant layout is shown (Equality site, Fig. 3.20, p. 3-57, Fig. 3.21, p. 61; Ravenswood site, Fig. 3.25, p. 3-71, and Fig. 3.26, p. 3-74). We recommend further consideration of the possibility of reducing encroachment on a floodplain. (Commenter: 59, p. 2)

Response: In Appendix D of the EIS a tentative finding is made that there are no practical alternatives to the projected floodplain/wetlands impacts. No practicable sites were identified that had no floodplain/wetlands impacts. All reasonable measures for mitigating floodplain/wetlands impacts at the proposed site have been considered (see Appendix D, Sect. D.4.1). The measures adopted for the proposed design are discussed in Appendix D, Sects. D.3.1 and D.4.2.

9.3 Comment: The Ohio River is the controlling surface watercourse at the site, and it will cause the maximum flooding damage in the project area. While the DEIS reports that a hydraulic analysis was conducted for the Ohio River, the document does not indicate whether any site or project construction will occur in the Ohio River floodway. An additional map specifying the floodway limits and an explanation of whether the site will be inside or outside of the Ohio River floodway should, therefore, be included in the FEIS. (Commenter: 12, p. 3).

Response: The site is within the common floodplain of the Ohio and Green rivers. This is shown in Fig. F.1 (Appendix F) of the EIS. Floodway maps of Daviess County, (e.g., U.S. Department of Housing and Urban Development, 1980; Flood Boundary and Floodway Map, Daviess County, Kentucky, Community-Panel Number 210062, 001A and 002A; National Flood Insurance Program, Washington, D.C.) show that the Ohio River floodway extends only a short distance into the floodplain and not onto the Newman site. This boundary has been added to Fig. F.1, Appendix F, of the FEIS.

9.4 Comment: The impact statement cites data indicating that "as much as 90% of the nation's original floodplain forests may have already been lost, and [that] current losses approximate 6% of the remaining area per year." Although construction of the Newman plant will not result in loss of "significant" tracts of riparian habitat, it is not yet clear that activities of SRC-I will not be harmful to a habitat whose existence is, at best, precarious. (Commenters: 65, p. 55; 38, p. 66)

Response: Because of the importance of riparian or floodplain habitats to wildlife and because of the losses such areas have already experienced, as little forest as possible will be cleared at the site. Mitigation options for these areas are included in Appendix K of the FEIS.

The DEIS stated that clearing of riparian forest on the site will contribute slightly to the significant national problem of loss of floodplain forests and did not divorce the SRC-I impacts from the national trend as the comment implies. The assessment of the amount and significance of the direct loss of the riparian forest on the site is believed to be accurate.

9.5 Comment: Destruction of the riparian zone along the Green River will be necessitated for the construction of the barge slips (p. 4-24, paragraph 4; and p. 4-26, last paragraph) and water intake and discharge structures. To offset damages to the aquatic system and the associated terrestrial wildlife species, we recommend that the riparian zone be reestablished where feasible by revegetating with species indigenous to the area. Revegetation should be at a density (stems/acre) similar to that which exists in undisturbed sections of the Green River. Species composition should reflect the relative importance of values of species indigenous to the riparian zone. (Commenter: 9, p. 4)

Response: DOE has prepared a set of habitat mitigation options in accordance with the Fish and Wildlife Coordination Act. These options are included in Appendix K of this FEIS and includes consideration of the riparian zones.

9.6 Comment: The middle third of the site will require flood proofing and runoff water control for the liquid storage, ash ponds, SRC-product storage, coal storage, and the administration building, which will result in floodplain encroachment and impacts. The barge-docking facility for the demonstration phase of the project will necessitate the removal of 700 ft of riparian habitat, but the docking facility may be greatly increased with commercial expansion since "it is estimated that almost 100% of the commercial plant's feed coal will be supplied by barge." (p. D-5) (Commenter: 4, p. 3)

Response: The size and location of the barge-docking facility for commercial operation is shown in Fig. D.4 of the EIS. The impacts of this expanded barge facility are discussed in Sects. 4.2.1.3 and Y.3.3.1. The most significant impact on the riparian habitat will occur as a result of the construction of the docking facility for the demonstration phase; impacts of the expansion of the docking facility for the commercial phase are not expected to be as significant.

10. ECOLOGY

Aquatic

10.1 Comment: The Draft EIS points out that water consumption by the proposed SRC-I project would be minimal as compared to normal flow of the Green River and, therefore, impacts to the aquatic ecology would be minimal. This contention is not supported; the narrative description of the Newman site's aquatic ecology indicates that ichthyoplankton concentrations are highest in near-shore areas, indicating that the amount of ichthyoplankton that would be entrained could be, depending on local conditions, substantial. If the purpose of the discussion of a conventional intake is to present a worst-case analysis, the unequal distribution of ichthyoplankton should be addressed. (Commenter: 55, p. 2)

Response: Although there is a general trend of higher icthyoplankton densities in near-shore areas, this pattern doesn't appear at the site of the proposed intake. Data from the ichthyoplankton baseline survey have been added to the FEIS (Table J.5), indicating that ichthyoplankton densities at the intake site are similar to those in the midchannel. This may be due to the mixing by river currents and the lack of protective habitat along the scoured outer bank of the river. Consequently, the quantity of ichthyoplankton that will be entrained is believed unlikely to exceed 2% under worst-case conditions (low flow during periods of peak ichthyoplankton density). For the demonstration plant no significant impacts to fish populations are anticipated to result from raw water intake by either a conventional intake structure or a submerged intake structure.

10.2 Comment: No complete species list or collection method is presented for phytoplankton, zooplankton, or benthic macroinvertebrates sampled at either the primary site or the alternate sites. Collecting methods are not described. (Commenter: 65, p. 58)

Response: Inventories of phytoplankton, zooplankton, and benthic invertebrates collected and/or observed at the sites and a description of collection methods are detailed in the Environmental Report (ER) and summarized in Sect. 3 and Appendix J of the EIS.

10.3 Comment: At the Newman site, sampling of phytoplankton and zooplankton was apparently conducted only during Fall 1977 and Spring 1978. Benthic macroinvertebrates were apparently collected only during Fall 1977 and Winter and Spring 1978. No summer collecting seems to have been done. (Commenter: 65, p. 58)

Response: Further sampling, including collections during the summer months, will be conducted as part of the continuing baseline survey.

10.4 Comment: It is not clear from the data presented when sampling was done for any organism at the Equality and Ravenswood sites. (Commenter: 65, p. 58)

Response: The site reconnaissance surveys were conducted at the alternative sites from June 27 to July 9, 1977 (Equality) and September 28 and 29, 1980 (Ravenswood).

10.5 Comment: Page 3-26, Paragraph 4: Tissue residues were measured for organic and inorganic compounds, but mercury levels were excluded or not reported in the table on residue analysis. This information should be added in the FEIS. Recommendations for expanded baseline biological monitoring to be covered in FEIS include:

1. Zn, Hg, Cu levels should be determined in fish tissue (whole body),

2. mussel tissue should be analyzed for organic and inorganic residues due to the sessile nature and long-life history of these organisms. This should be done upstream as a baseline for determining the efficiency of the proposed treatment plant, and

3. macroinvertebrates should be measured for organic and inorganic residue due to their increased abilities to bioaccumulate many of the cpds in ranges up to 10,000 times. (Commenter: 12, p. 7)

Response: As noted in revisions to Sect. 4.5, an expanded baseline monitoring program will establish the levels of heavy metals (including mercury) and organic compounds in periphyton and mussel tissue. These will be sampled both at control (upstream) stations and at downstream stations.

10.6 Comment: The biological monitoring data referenced in the 1977 Environmental Report, Appendix H, is only referenced; it is not provided for review. This report should be made available for review and comment prior to finalizing the EIS. (Commenters: 9, p. 5; 12, p. 6)

Response: The Phase Zero deliverables, including the ER and its appendixes, are available in the public reading rooms (see Sect. 6 of the Summary of this FEIS).

10.7 Comment: Entrainment of phytoplankton, zooplankton, larval fish, and other aquatic organisms that are unable to escape intake velocities will result in their death. The percentage of water taken in tends to reflect the percentage of the basic food chain available to aquatic organisms that is lost. This has a potential devastating effect upon an area of the Green River that is, in our professional opinion, already severely degraded. Losses of this magnitude during the flow regimes described are unacceptable. Information regarding entrainment rates during normal flows should also be addressed. (Commenters: 9, p. 3; 39, pp. 1 and 2; 21, p. 10)

Response: Reference is made to the possible loss under worst-case conditions of 2% of the planktonic organisms with the demonstration plant, 9.3% with the commercial plant, and up to 30% due to combined withdrawal of electric generating stations, the SRC-I commercial facility, and the commercial W. R. Grace facility. In evaluating the severity of the loss of plankton, it should be recognized that the 30% withdrawal is distributed over 100 river miles between the Paradise Steam Plant and the Grace site at the Green River's mouth. In addition, the impacts of withdrawal at the Grace facility would be diminished because of proximity to the Ohio River. Further study would be needed to completely assess the cumulative impacts to plankton from water withdrawal. Information on biotic impacts of water withdrawal will be derived from further baseline and operational monitoring at the SRC-I site. Entrainment impacts during periods of normal flow would be far less severe than during low flows. Average discharge for Lock No. 2 (Calhoun) is 316 m^3/s, and the combined withdrawal of all energy facilities on the Green River is less than 30% of this average flow. (See response to comment 6.23 and Sect. 4.2.5.3).

10.8 Comment: On page 4-100, the section on water quality and aquatic ecology describes the possible impacts of water quality on aquatic ecology. The effects inflicted upon aquatic organisms through heavy metal uptake and accumulation are generally subtle and cryptic. Impacts may be beyond prevention by the time they are discovered. Accumulations in river sediment could become serious contaminants in downstream ecosystems. Attention to this problem is essential and should be addressed further. (Commenters: 18, p. 7; 21, p. 10; 9, p. 3; 65, p. 53)

Response: Concerns about bioaccumulation of heavy metals and trace organic compounds are partially responsible for the selection of the zero-discharge wastewater treatment system, which will produce a tenfold reduction in the total quantity of potential pollutants released. The best available technology for wastewater treatment will be used, and accumulation of potential pollutants in river sediments is not expected to cause significant contamination of downstream ecosystems. During operation, monitoring for heavy metal accumulation will be performed (see Sect. 4.5).

10.9 Comment: Effects of construction and periodic plant effluent release on aquatic productivity are not thoroughly discussed. (Commenters: 65, p. 58; 21, p. 10)

Response: Effects of construction and periodic plant effluent release are adequately addressed in Sect. 4.2.2.4 of the EIS. Construction activities are not expected to affect aquatic productivity significantly. Periodic wastewater discharges may cause chronic or sublethal impacts to sensitive species in the mixing zone, but the overall productivity should not be greatly affected.

10.10 Comment: The possible predisposition of fishes to infectious diseases due to the stresses of construction and periodic plant effluent release has not been mentioned. (Commenter: 65, p. 58)

Response: A statement concerning sublethal effects has been added to Sect. 4.2.2.4.

10.11 Comment: Another stress point that is physical in nature is the fact that discharge water temperature, especially in winter, will create a small area of warmer water, which would be very attractive to fish and other aquatic organisms. These fish could become adjusted to this artificially induced temperature increase, and any subsequent sudden stoppage of discharge water decreasing the temperature to ambient levels would cause adverse biological effects. (Commenter: 21, p. 9)

Response: The occasional wastewater discharge is expected to conform to the Kentucky water quality standard (Table H.1). The maximum temperature rise will be less than 2.8°C (5°F) over ambient. Because of the use of a diffuser structure to enhance mixing of the effluent, the temperature elevation in the mixing zone should be minor, and relatively slight thermal shock should result from stoppage of the discharge.

10.12 Comment: Waste disposal ponds have the potential of being colonized by various aquatic life forms including zooplankton, phytoplankton, mollusks, crustaceans, insects, fish, and amphibians. More than likely predatory forms of reptiles will migrate to these ponds as well. With such a repertoire of living organisms, these ponds could become popular watering and feeding habitats for various aquatic, terrestrial, and avian predators. Considering the possibility exists for environmental contamination besides outright lethal effects, various sublethal effects could become evident such as decreased reproduction and mutagenic and teratogenic actions on wildlife populations. (Commenters: 21, p. 10; 39, p. 3)

Response: Chemical composition of the ponds will be monitored, and a determination made based on the monitoring data as to whether or not some action should be taken to prevent wildlife use. The size and degree of contamination of various ponds are as follows:

Description	Size, ha (acre)	Level of concentration
Storm water and retention pond	1.0 (2.5)	Low
Slag ponds	3.5 (8.7)	Medium
Wastewater equalization and treatment ponds	0.8 (2.1)	Medium-high
Total	5.3 (13.3)	

These ponds will be colonized by pollution-tolerant aquatic species, which will bioaccumulate heavy metals and organic compounds that are present. However, the ponds are unlikely to be a source of significant environmental contamination. The overall area of ponds, especially the highly contaminated area, is rather small. Because the ponds are within or next to a large industrial facility, they will be relatively unattractive to wildlife. The adverse effects due to contaminants in waste ponds will be predominantly limited to the organisms inhabiting the ponds and peripheral habitat.

10.13 Comment: Due to the importance of Richland Slough to resident and migratory fish and wildlife resources, particular attention should be given to that portion of the site which drains into Richland Slough via Bryant Ditch. Further, all precautions should be taken to eliminate the entry of sediments into the Richland Slough area. (Commenter: 9, p. 4)

Response: During construction and operation, the design site drainage system will be designed to divert all site runoff to the wastewater handling system. To prevent entry of sediments into Bryant Ditch during construction, a soil erosion control plan will be implemented (see Appendix GG).

10.14 Comment: Since the barging of coal to the SRC-I facility will undoubtedly be a major coal transportation mode, the impacts of shearing action and the resuspension of sediments that results will continue and intensify an already identified problem. The recovery potential of aquatic resources will be eliminated as the problem is aggravated. (Commenter: 9, p. 4)

Response: For the demonstration facility, coal is intended to be transported by rail. There are no plans to ship feed coal or plant product by barge during the demonstration phase of the project. Barge shipment of coal will be considered only if coal suppliers do not have access to rail facilities. The impacts described by the commenter may accompany the commercial phase of development, and Sect. 4.2.2.3 has been revised to note this impact.

10.15 Comment: There was no mention in the DEIS of the impact of this project on the commercial and sport fishery in the Green River. This problem needs to be addressed. Certainly these activities will be impacted by the lowered water quality brought about by the destruction of aquatic organisms lost in the plant intake waters, by possible toxic materials discharged into the river in wastewater, and by the increased barge traffic caused by the large amount of coal used in the plant operation. (Commenters: 39, p. 3; 9, p. 4)

Response: Section 3.2.2.3 of the EIS states that "the reaches of the Green River adjacent to the proposed plant site are not fished commercially, nor is sport fishing extensive." During the demonstration phase, loss of aquatic organisms will be a minor impact (see response to comment 10.7) and should have minimal effect on sport fisheries. As noted in response to comment 10.9, discharge of toxic materials will be eliminated to the extent possible, and sport fishing will not be greatly affected. As now envisioned for the demonstration phase, feed coal and plant products will be transported by rail, not barge.

10.16 Comment: Potentially 9.3% of the susceptible organisms could be killed by the commercial plant's withdrawal. The possibility exists that water withdrawal for the SRC-I facility, especially when commercialized, might stress biological productivity within the river. (Commenter: 21, p. 9)

Response: While this possibility exists, its probability is low. Ichthyoplankton are the most susceptible to impact due to entrainment in raw water withdrawn. Other classes of organisms (e.g., planktonic algae and invertebrates) can regenerate rapidly, within hours to days. Ichthyoplankton losses of 9.3% would occur only during an extreme low-flow event. To significantly affect fish populations, large losses of ichthyoplankton would have to occur after fish spawning during late spring and early summer when fish eggs and larvae are present at high densities. Low flows do not typically occur at these times. (See response to comment 10.7)

10.17 Comment: How can a project of such immense proportions be given the go-ahead if in case of contamination of a riparian ecosystem it is not possible to estimate the severity of these impacts regarding spills of SRC-I produce? Oil-covered water and shoreline could cause limited mortality to birds and other riparian organisms. (What is considered to be "limited mortality?" That statement comes across as vague.) Substantial quantities of spilled product would be mixed with gravel, sediment, and other debris in the river. (Commenter: 21, p. 2)

Response: Appendix DD has been clarified to indicate that contamination could kill limited numbers of birds and riparian organisms. Although the impacts of spillage of SRC-I liquid product are potentially severe and not fully quantified, the probability of the worst-case spills described is very small. See Sect. DD.4.1.

Terrestrial

10.18 Comment: Before an accurate assessment of the effect of the proposed project on fish and wildlife resources can be attempted, the exact nature of those resources must be investigated. This entails a thorough survey of the proposed site. As yet, however, several important ecological studies have not been conducted:

- Field surveys of rare and uncommon birds that inhabit the site during breeding season should be made.
- Data is given for only 70% of the site.

(Commenter: 38, pp. 65 and 66)

Response: The present data base on vegetation and wildlife (Sect. 3.2.1.3) is considered to be adequate for indicating the ecological value of the site. Although the number of breeding pairs was not determined, rare or uncommon species such as the loggerhead shrike, redheaded woodpecker, and sparrow hawk are known to occur on the site during the breeding season (Sect. 3.2.1.3). Estimating the number of these birds on the site is not expected to provide significant new information. Rare or uncommon species other than those mentioned in Sect. 3.2.1.3 are not expected to occur regularly on the site. The 176-ha (434-acre) addition to the site noted in Table 4.3 is similar to the rest of the site in terms of cropland and wildlife habitat, except that there is no riparian and floodplain forest on the addition. Therefore, additional surveys are not necessary.

10.19 Comment: Volume II, Appendix K. While the documented occurrence of the federally endangered Indiana bat *Myotis sodialis* is important and warrants special consideration, we feel that the terrestrial ecology of the area should be addressed in sufficient detail to make the public aware of the overall value of the site to wildlife. (Commenter: 9, p. 5)

Response: The terrestrial ecology of the site is adequately described in Sect. 3.2.1.3 of the EIS.

10.20 Comment: Biological surveys completed to date are inadequate on two counts: (a) sufficient data regarding species identification (particularly of vertebrates other than *Myotis sodalis*) and regional abundance were not provided for the Newman site but were provided for the Equality site and (b) the length of term of the survey was inadequate to determine habitancy of *M. sodalis* in marginal onsite habitats during periods of stress in Martin forest and other optimum sites near the proposed plant. (Commenter: 65, p. 56)

Response: Important species other than the Indiana bat are identified in Sect. 3.2.1.3 of the EIS. As is noted in Appendix K of the EIS, additional surveys for the Indiana bat will be done during the summer of 1981.

10.21 Comment: No data were presented which specifically address the impact of pollutants (both air and water) on the biota of the plant site. Simple statement that there is no published information that adequately supports the hypothesis that *M. sodalis* and other species would be affected by pollutants does not allow the assumption of truth, because there is, also, no evidence that proves no harm. The structural ecology of the onsite ecosystem has not been reported; therefore, there can be no assurance that ecological accumulation of toxins will not occur. Elucidation of the food chain ecology of the Indiana *Myotis* would be prerequisite to statement of minimal harm. (Commenter: 65, p. 56)

Response: The effects of air emissions on biota at the site are addressed in Sect. 4.2.1.3 and Appendix K of the EIS. Quantitative data are included in these sections. The structural ecology of the ecosystems on the site are discussed in Sect. 3.2.1.3 of the EIS. Analysis of the food chain of the Indiana bat would not add significantly to the assessment of air pollutant effects presented in Appendix K, p. K-8, of the EIS. Extensive monitoring will be conducted to determine if any impacts occur because of plant operation as noted in Sect. 4.5 of the FEIS.

10.22 Comment: No baseline genetic data have been reported for any onsite species. These data would be necessary as a reference in assessing potential effects of mutagenic compounds released by operation of the plant. (Commenter: 65, p. 57)

Response: Mutagenic studies may be undertaken if other monitoring indicates that impacts on crop productivity or wildlife populations are significant. If mutagenic studies are undertaken during operation of the SRC-I facility to address the effects of mutagenic compounds, reference baseline genetic data could be obtained from areas relatively unaffected by SRC-I emissions.

10.23 Comment: No baseline data on the productivity of onsite habitats were reported in the DEIS. Collection of these data is necessary to assess long-range effects on productivity as mandated by the National Environmental Policy Act. (Commenter: 65, p. 56)

Response: Lands on the site are characterized in the EIS as prime farmlands (Sect. 4.2.1.1) and as highly productive land that, in the absence of agricultural and industrial use, could be high-quality wildlife habitat (Sect. 4.2.1.3). This is sufficient characterization of the productivity of onsite habitats for an adequate analysis. Formal productivity studies are planned for the site and vicinity prior to and during construction and operation. These studies will aid in determining effects of operation on productivity of crops (Sects. 4.6.8 and 4.5).

10.24 Comment: Data presented are insufficient to make any hypotheses regarding long-term effects of possible accumulations of trace metals on the productivity of Martin and Green River forests and of Richland Slough. (Commenter: 65, p. 57)

Response: Data on emissions of trace metals to the air are presented in Sect. 4.2.3 of the EIS. Based on these data, it can be hypothesized that the productivity of these habitats will not be affected by emissions to the air. Also, concentrations of trace metals in wastewater discharges will be very low (Sect. 4.2.2.3) and will likely not affect productivity in these habitats. The productivity of sensitive plants will be monitored at the plant site as discussed in Sect. 4.5 of this FEIS.

10.25 Comment: The DEIS treated the impact on the terrestrial ecology at somewhat greater length. However, most of the discussion centered around the Indiana bat - an endangered species found on the plant site. I have no problem at all with the treatment of this species. This was good. However, I have a real problem with the treatment of the many other wildlife species found at the plant site. They were briefly referred to in statements like - "Wildlife populations would be permanently reduced because of habitat loss." (Volume I - I-47). (Commenter: 39, p. 2)

Response: The treatment of the Indiana bat was lengthy to satisfy the requirements of NEPA and the Endangered Species Act and to provide the U.S. Fish and Wildlife Service sufficient information to prepare the Biological Opinion. Lengthy treatment of nonendangered species (Sects. 3.2.1.3 and 4.2.1.3) was not appropriate.

10.26 Comment: It's invalid to assume that the elimination or degrading of small segments of a declining habitat will have no effect on species inhabiting the area. Areas now considered to be marginal habitat for species may with time become critical. (Commenter: 65, p. 56)

Response: The EIS does not assume that losing small areas of habitat would have no effect on species populations. Section 4.2.1.3 of the EIS states that "the primary impact to terrestrial biota at the site will be the loss of habitat and consequent reduction in wildlife populations due to construction and long-term presence of the industrial facility." It is also stated that "populations of permanent and summer resident wildlife species will be reduced at least in proportion to the amount of their required habitat lost."

10.27 Comment: Stockpiling of wildlife as you describe does not occur as adjacent habitats are probably at or near carrying capacity and, therefore, incapable of incorporating the displaced individuals.

A more realistic statement would be that those individuals of species occupying the site would perish. Further, the area will be permanently lost to production of wildlife species for the life of the project. (Commenters: 9, p. 5; 39, p. 2; and 65, p. 56)

Response: The statement in Sect. 1.4.4.5 that wildlife will relocate to other areas has been deleted.

10.28 Comment: The general tone conveyed is that since the site is cropland and no significant habitat types exist little real impact will be had on wildlife. Wildlife habitat is relative to land fertility and about 90% of the site is considered to be prime farmland. The statements regarding the fact that since most of the site has been cleared of timber and is used for agricultural purposes it is of low-quality wildlife habitat are somewhat misleading. Agricultural practices are a vital ingredient in managing many public and private wildlife management areas. Farming practices can be used to benefit selected wildlife species. (Commenters: 21, p. 13; 9, p. 5; 39, p. 2)

Response: Both the expected decline of wildlife due to habitat loss and the relationship of land fertility to good potential wildlife habitat are considered in the EIS. Natural habitats for wildlife are in short supply. Even for those relatively few wildlife species that benefit from agricultural crops, there is an abundance of

cropland and a shortage of areas to fulfill other habitat requirements of these species. For example, deer populations are low in the area because of a lack of forested areas. The same is true of the swamp rabbit. Therefore, from an ecological viewpoint, loss of farmland would have much less impact on wildlife than loss of forest.

10.29 Comment: The Fish and Wildlife Coordination Act stresses that all activities of the Federal government be coordinated with State fish and wildlife agencies. This act seems to have been neglected as only token contact with the Kentucky Department of Fish and Wildlife Resources is recorded in the DEIS. Little attention is paid to the fact that the state agency owns and manages a wildlife area directly across the Green River from the Newman site. The Department of Fish and Wildlife should have been contacted and included during the early planning and design stages of the project. (Commenters: 21, p. 15; 9, p. 6)

Response: Subsequent to a meeting with personnel of the U.S. Fish and Wildlife Service and the Kentucky Department of Fish and Wildlife Resources, DOE prepared a set of habitat mitigation options in accordance with the Fish and Wildlife Coordination Act. These options are presented in Appendix K of the FEIS and includes consideration of establishing riverbank woodland.

10.30 Comment: The DEIS states that "the effects of potential vehicular traffic, noise, and human presence (on terrestrial ecology) would be relatively minor." (DEIS p. 4-24.) This seems inconsistent with the DEIS's own evaluation of the socioeconomic impact of the facility, which projects considerable commercial development in nearby communities and such massive increases in traffic that additional roads and rail commuter services are contemplated. (Commenters: 38, p. 68; 9, p. 2)

Response: Section 4.2.1.3 of this FEIS has been expanded to cover indirect impacts of the SRC-I facility on wildlife. Cumulative impacts are addressed in Sect. 4.2.5.

10.31 Comment: The DEIS does not fully discuss the indirect impacts that are expected to occur on the site. For instance, what effect will increased barge traffic on the Green River have on wildlife along its bank? How will the destruction of portions of the forest habitat disrupt normal wildlife use patterns? The treatment of floodplain encroachment in the DEIS is generally misleading. It not only underestimates the direct and indirect impact of the SRC-I plant on floodplain habitat, but also fails to address the very significant cumulative impacts that can be expected from related development. (Commenters: 38, pp. 67 and 68; 44, p. 2; 9, p. 2; 21, p. 13)

Response: Cumulative and indirect impacts are addressed in Sects. 1.4.3 and 4.2.5 of the FEIS. Increased barge traffic on the Green River would have little adverse effect on terrestrial wildlife occurring in the area. Destruction of portions of the floodplain forest habitat will eliminate wildlife from these areas, thus causing a reduction in wildlife populations (Sect. 4.2.1.3). The presence of the facilities will inhibit movement of terrestrial animals other than birds.

10.32 Comment: The DEIS states that dislocation of agricultural activities may result in added pressures on remaining farmland and on the clearing of more floodplain and riparian forests to compensate for farm losses (DEIS, p. 4-24). However, the impact of this anticipated development on wildlife habitat is never calculated, nor are mitigation strategies even discussed. (Commenter: 38, p. 69)

Response: It is not feasible to calculate or quantify accurately the impacts on wildlife from forest clearing resulting from any trend to create more farmland to make up for losses at the proposed site. Any such clearing of forest can be assumed to result in proportionate reductions of wildlife requiring forests. Mitigation is discussed in Sect. 4.6 of this FEIS and Appendix K.

10.33 Comment: There is incompleteness in the discussion of impacts on wildlife. To make only one point, the Environmental Report circulated with the Phase Zero Deliverables (Appendix D, p. D-78 to 79) noted that the SRC-I plant is located in a pathway of bird migration. The plant will have stacks and a cooling tower producing clouds of condensed steam. Migrating birds are attracted by the lights of buildings and towers during hazy and foggy periods. When they knock high towers, "resulting casualties and injuries may be in the thousands." The DEIS is strangely silent on bird migration (see p. 3-12, which mentions birds in other ways). (Commenters: 46, p. 5; 21, p. 11)

Response: Consideration of bird mortality from collision with plant structures has been added to Sect. 4.2.1.3 of this FEIS. Waterfowl are not expected to congregate in very large numbers at the site, and the potential for mortality by collision should not be great. However, waterfowl use of the solid-waste landfills and mortality at the power line will be checked periodically to determine whether any further preventative measures are advisable.

10.34 Comment: The DEIS indicated that a 16-ha (40-acre) waste pond would be necessary during the plant demonstration phase and an additional 73-ha (180-acre) waste pond during 14 years of operation of the commercial facility. Unsuspecting wildlife have a habit of getting into such ponds — waterfowl in particular. This problem was not addressed in the DEIS. It should be addressed and measures instigated to forestall the problem of wildlife coming into contact with toxic wastes. (Commenters: 39, p. 3; 21, p. 11)

Response: It is unlikely that waterfowl, raptors, and other terrestrial wildlife will use the waste ponds for either the demonstration facility or the commercial facility to the extent that their populations would be adversely affected through death of poisoned individuals. However, chemical composition of the ponds will be monitored, and a determination made based on the monitoring data as to whether or not some action should be taken to prevent wildlife use.

10.35 Comment: A proposed electric transmission line route intersects Martin Creek and Richland Slough. The DOE is strongly urged to negotiate an alternate route with Big Rivers Electric Corporation to avoid these habitats. (Commenters: 21, p. 11; 65, p. 57)

Response: The route for the power line has not yet been finalized. Alternate routes will be considered.

10.36 Comment: The swamp rabbit is not mentioned in the DEIS although it is considered to be a threatened species by Kentucky wildlife biologists. Floodplain encroachment of forested habitat is considered to have a damaging effect on swamp rabbit populations. (Commenters: 21, p. 15; 39, p. 2; 9, p. 6)

Response: Consideration of the swamp rabbit has been added to Sects. 3.2.1.3 and 4.2.1.3 of this FEIS.

10.37 Comment: The impact of an increased noise level is expected to eliminate many resident species from occupying the site. (Commenter: 21, p. 15)

Response: Noise may have some impacts on wildlife in the vicinity of the site. However, the major impacts will result from habitat loss. Many species become accustomed to noise and will inhabit the area if otherwise suitable habitat is available (see Sect. 4.2.1.3).

10.38 Comment: What effect will emissions from the plant have on surrounding crops? (Commenters: 5, p. 1; 49, p. 1; Speakers 93 and 100)

Response: Emissions from the plant (Sect. 4.2.3.1) should not affect crop value (Sect. 4.2.1.3). Emissions from the plant should not significantly reduce crop productivity (Sect. 4.2.1.3).

11. MONITORING AND MITIGATION

The monitoring and mitigation measures discussed in this section are pursuant to the proposed action.

General

11.1 Comment: The DEIS repeatedly indicates that one of the major purposes of the demonstration project is to "confirm the effectiveness of environmental control systems" (e.g. DEIS, p. 1-23). Unfortunately, the DEIS does not provide a detailed plan for assuring that this goal can be accomplished. If the SRC-I plant is to be an environmental demonstration plant, the following four steps must be taken:

- the DEIS must identify those substances that are of environmental concern and that, consequently, will be subject to monitoring. This list should include all potentially harmful substances whether regulated or not.
- the DEIS must set forth a plan and schedule for collecting environmental baseline data. Data must be collected for all substances of concern and all potential health effects.
- the DEIS must set forth a detailed environmental monitoring program. This program must, among other things, provide for the monitoring of fugitive and other emissions both within and outside the plant. A detailed explanation must be provided of the methodology to be employed in selecting monitor locations.
- the DEIS must provide a detailed plan for evaluating the monitoring data and translating that data into changes in plant design. (Commenters: 38, pp. 36-37; 17, p. 8)

Response: Section 4.5 has been expanded to identify additional substances of environmental concern that will be monitored for, including both regulated and nonregulated substances. The monitoring program in the FEIS has been expanded to include additional information on a preconstruction monitoring program.

Preconstruction monitoring will continue until the construction monitoring program is fully developed and implemented at the start of construction. The preconstruction program will serve as an outline for the development of the monitoring programs for the construction and operational phases.

The conceptual operational monitoring program is described in Sect. 4.5. The details of the program will be finalized as the detailed design nears completion, in coordination with EPA and KDNREP, as outlined in Appendix EE.

Results from all phases of the monitoring program will be reviewed by the project sponsor and regulatory agencies, relative to their associated impacts on the design for the demonstration plant.

Plant Monitoring and Maintenance

11.2 Comment: What exactly is a "directed maintenance and monitoring program" and what assurance does the public have that such a program, which should be detailed in the FEIS, will be carried out, especially several years into operation when valves, pumps, compressors and other fugitive emisson sources begin to leak? Will early enthusiastic work on maintenance give way to less rigid inspections after a few years? (Commenters: 64, p. 3; 18, p. 3)

Response: The concept of a directed maintenance and monitoring program is discussed in a Radian study published in EPA document EPA/600/2-80075c, "Assessment of Atmospheric Emissions from Petroleum Refineries." The concept is to monitor equipment susceptible to leaks periodically to determine when maintenance is needed to reduce fugitive emissions. Monitoring is also done during and after maintenance to determine when sufficient maintenance has been done. The project sponsors will be required to carry out this program by the PSD permit issued by EPA and KDNREP.

11.3 Comment: Page C-40, last paragraph. The DEIS outlines a directed maintenance protocol for the control of fugitive organics. The proposed protocol should be expanded during the first year or two of plant operation, being supplemented and guided by the fugitive organics monitoring program discussed above. The nature of the ultimate directed maintenance protocol for routine operation during subsequent years should be based upon the more complete monitoring accomplished during the first year or two. (In no case would the ultimate protocol be expected to be less stringent than EPA's conventional refinery VOC leak guidelines.) (Commenters: 56, p. 11; Speaker 28)

Response: The directed monitoring, maintenance, and repair plan exceeds the requirements outlined in the proposed NSPS for synthetic organic chemical manufacturing industries (SOCMI). The SOCMI monitoring requirements do not apply to flanges or to valves in heavy liquid service. Because many of the heavy liquid streams in the demonstration plant will contain significant amounts of materials having a boiling point greater than 260°C (500°F), it was decided to monitor heavy service valves on a regular basis to minimize health impacts.

Currently, no evidence exists to indicate that inspecting a fitting each month, as opposed to each quarter, will significantly reduce total mass emissions from a component. During the demonstration phase, the plan will accordingly be implemented as proposed. The results of the instrumental monitoring of fittings and monitoring plant impact to ambient air quality at large will enable plant professionals to determine if the program should be modified to ensure protection of the environment for employees and the community.

It should be noted that monitoring results from the Wilsonville pilot plant tend to verify the assumption that the heavier, carcinogenic components will not volatilize. Enviro Control, a subcontractor to NIOSH, conducted the program by attaching portable air samplers to operators as they went about their daily activities. The samples were then analyzed for polyaromatic hydrocarbons. Ninety percent of the samples consisted of the more volatile, noncarcinogenic, two-ring compounds. Only extremely small quantities of the heavier, nonvolatile four or more ring compounds were detected. Pyrene, which is noncarcinogenic, was the only compound detected in this group.

11.4 Comment: Page C-40, last paragraph. The DEIS indicates that various organic fugitive sources will be screened at a trigger concentration ranging from 1000 to 10,000 ppm. The sampling/analytical techniques which will be used for this screening are not given. This information, if available, or a schedule by which this information will be available, should be included in the FEIS. (Commenter: 56, p. 11)

Response: The requested information is contained in Sect. B.2, Appendix B, of the PSD permit application.

11.5 Comment: Page C-40, last paragraph. The DEIS describes some aspects of the proposed directed maintenance protocol in general terms: e.g., "valves... will be inspected regularly." More details should be provided — source type by source type — regarding the nature of the inspection and the actual frequency. It is recognized that details on the directed maintenance protocol will not be completed until after the FEIS is submitted. The FEIS should indicate the schedule by which the information, if not currently available, might be expected. (Commenter: 56, p. 12)

Response: The information requested by the commenter is provided in Appendix B of the PSD permit application, specifically in Table 1 of the section titled "Fugitive VOC Emissions."

11.6 Comment: To what degree will these harmful chemicals be contained? This question is not answered, or even adequately addressed in the DEIS. Vague references to a "directioned maintenance and monitoring program" are not reassuring, nor do they present a specific impact. (Commenter: 64, p. 2)

Response: The degree to which fugitive nonmethane hydrocarbons will be contained is discussed in the EIS, Appendix C, Sect. C.3.1.5, "Mitigation of Fugitive Emissions." Sections C.2.2 and C.4.1 of Appendix C in the DEIS discuss the extent to which other hazardous gaseous emissions (such as H_2S and CO) will be controlled. See also the responses to comments 11.2 and 11.3.

11.7 Comment: Leaks are supposed to be detected by monitoring equipment and visual inspection. What kind of equipment? How often? Is visual inspection of all the pertinent equipment, pipes, flanges, and aerial coolers sensitive enough, reliable enough to detect the leaks? Is it even possible? (Commenters: Speakers 38; 18, p. 6)

Response: See the response to Comment 11.5 for the type of equipment, frequency, and type of inspection. In general, visual inspections will be used only for detecting liquid leaks. A sensitive VOC (volatile organic carbon) analyzer will be used to detect gaseous and vapor leaks.

11.8 Comment: Appendix C, p. 41. "Leaking flanges will be repaired within 15 days when possible." This is inadequate where leakage of carcinogens is concerned. (Commenter: 18, p. 6)

Response: A major leak in a valve, pump, or flange would be maintained immediately, of necessity, so that process operations could continue. Smaller leaks detected instrumentally would be fixed within 15 d if feasible. Small leaks from flanges and valves handling heavy liquid distillates would not contribute levels of organics high enough to pose a worker or environmental threat. These distillates have very low volatility, and loss of 500+ boiling materials would not be significant before a repair could be made. In many cases, attempting to repair a component in service can result in an increase in emissions, and repairs should accordingly be delayed until a shutdown is planned. See also response to comment 11.3.

11.9 Comment: Page C-40, Sect. C.3.1.5. The FEIS should indicate the schedule by which the monitoring plans for the controlled combustor/flare and the wastewater treatment system will be prepared. (Commenter: 56, pp. 14 and 22)

Response: Detailed monitoring program development will be completed prior to operation and is currently scheduled to be completed by June 1982.

11.10 Comment: How efficient are "coal scrubbers" and electrostatic precipitators over time? Can the monitoring systems detect "unique emissions?" Will these systems be conscientiously operated and maintained over time? (Commenter: 44, p. 5)

Response: The age of the pollution control device is not a factor in determining whether the device must comply with the emission limitation specified in the PSD permit. The device must be monitored periodically to demonstrate compliance with the emission limitation and must be mechanically maintained to achieve the limitation. The monitoring systems for these devices will be designed to detect the substances they emit.

11.11 Comment: Prior to finalization of the EIS, the following should be made available for public review and comment.

- lists of substances to be monitored, including pollutants controlled by regulatory standards and toxics not yet controlled by standards but identified by previous research as substances that may be produced and hazardous;
- locations of monitoring instruments, and
- specific emergency response plans and procedures to be initiated in the case that toxics are released into the environment.

(Commenters: Speaker 21; 17, p. 6; 16, p. 20)

Response: The conceptual operational monitoring program, including the list of substances to be monitored and the locations of monitoring instruments, has been expanded in Sect. 4.5 of the FEIS.

The monitoring program for construction and operation cannot be finalized in a detailed manner until the detailed plant design is more complete; thus, it cannot be presented in the EIS. Many agencies have been asked to review these plans as they are developed.

For specific emergency response plans, see the response to comment 4.1 and Appendix DD.

11.12 Comment: There is no mention of what specific parameters of human health will be measured either in the workers or the surrounding general population. There is no mention of measuring human levels of toxins emitted by the plant — serum, hair, urine or fat samples to indicate human body burdens of organic and trace metal constituents before and after plant operation. There is no mention of periodic pulmonary function tests. (Commenters: 18, p. 5; Speaker 38)

Response: Workers will receive a periodic screening examination, which will include a detailed medical history; physical examination; vital signs; blood chemistries, hematology, and urinalysis; spirometry; and electrocardiograms. Chest x-rays are ordered as indicated clinically. Special provision is made for skin examinations. Bioassay is used when materials at the work place (e.g., benzene and lead) suggest that this approach would have utility in a medical surveillance program. In view of the active onsite surveillance program and accumulated experience in the chemical industry, screening of offsite populations would serve no purpose relative to the project and is not contemplated. See also the response to comment 5.12.

11.13 Comment: We wish to request that a system be developed to collect and store human tissues and materials from the food chain in the area for future analysis and comparison purposes when more knowledge is gathered on the metabolites of process-related chemicals and their biologic effects. (Commenter: 11, p. 2).

Response: Representative species collected in the aquatic surveys will be placed in the permanent collections of the Academy of Natural Sciences of Philadelphia. In addition, a herbarium is being considered. See also the response to comment 11.12 regarding bioassays.

Water

11.14 Comment: Mention is made in the DEIS that chemical effluent entering the Green River will be monitored for:

"bioaccumulation of process specific chemical entities with potential for adverse health effects as determined through ongoing research and established criteria."

What about non-process specific chemical combinations that could potentially be quite hazardous? Again, the exact chemical constituent makeup of effluent streams is not known at this time. (Commenter: 21, p. 7)

Response: The general composition of effluent streams is known from pilot plant studies, and the estimated effluent composition (Tables C-16 and C-17) reflects the data currently available. Synergistic effects of two or more wastewater constituents must be determined by bioassay studies, included in revised Sect. 4.5 of the FEIS.

11.15 Comment: In addition to the water quality constituents considered, wastewater from the SRC-I facility will contain many organic compounds for which no criteria or standards have been established. With the preceding statements is not one led to believe that since specific chemical constituents are not known, monitoring plans have not yet been established? (Commenter: 21, p. 7)

Response: Although no standards or criteria have been established for the polynuclear aromatic compounds (PNAs) these compounds are well characterized and can be monitored for in the raw wastewater and in the receiving environment. Current plans for monitoring are summarized in revised Sect. 4.5 of the FEIS.

11.16 Comment: The following additions to the proposed monitoring program are believed to be necessary to provide enough essential information for sound water quality decisions to be made: (1) In-plant biomonitoring for use during discharge should be incorporated into the treatment system proposal, and (2) biomonitoring should be incorporated into the long-term monitoring strategy for the facility so that sediment and tissue residue can be checked on a periodic basis. The FEIS should be revised to incorporate these proposals. KDNREP should be provided with all reports from ongoing and upcoming monitoring activities. (Commenter: 12, p. 3)

Response: Section 4.5 of the FEIS has been revised to reflect this comment.

11.17 Comment: Section 4.2.2.4: Site plans that incorporate during the construction phase BMP's to reduce the impact of suspended materials on the aquatic system should be prepared, and the BMP designs should be implemented. (Commenter: 12, p. 7)

Response: An erosion control plan will be used to minimize the impact of suspended materials on the aquatic system during construction. The erosion control plan has been added to the FEIS as Appendix GG.

11.18 Comment: Wastewater released into the Green River will contain organic and trace metal toxic substances that may eventually make their way into the Ohio River. What plans are made to purchase and run the special equipment necessary for monitoring these substances in the Evansville water supply? (Commenter: Speaker 38)

Response: The facility will use the best available technology and expects to function primarily in the zero-discharge mode. Any wastewater purposely released into the Green River will meet Kentucky water quality standards. The flow of the Green River is diluted approximately 13-fold when it enters the Ohio River. It is doubtful that any effects of SRC-I wastewater discharge would be measurable at the Evansville raw water intake.

Air

11.19 Comment: Page 4-133, first paragraph: The DEIS indicates that DOE will develop a monitoring program for fugitive emissions (including, presumably, fugitive organic air emissions). The FEIS should indicate (in Sect. 4.5, and in Sect. C.3.1.5): (1) the schedule by which this monitoring plan will be developed; and (2) the general manner in which the results of this monitoring program will be used in order to help define the trigger concentrations, the procedures, and monitoring frequency for the fugitive organics directed maintenance protocol. To the extent that the following information is available prior to the FEIS, the nature of the fugitive organics monitoring effort should be defined, including: monitoring techniques; monitoring frequency; species to be determined; monitoring location; duration of monitoring program after plant operation begins; and how information might be used in defining the directed detailed monitoring plan itself, which will present the above information and will not be completed until after the FEIS. (Commenter: 56, p. 11)

Response: Fugitive emissions will be monitored as part of the in-plant monitoring program described in revised Sect. 4.5 of the FEIS. The detailed program is scheduled for completion in June 1982. In this and all monitoring programs, feedback of results will enable the program manager to modify projects to focus on significant issues and, in general, be more effective.

As indicated in revised Sect. 4.5 of this FEIS, specific monitoring plans for the operational phase will be available in June 1982. General sampling and analytical techniques to be used for this screening are outlined in Appendix B of the PSD application.

11.20 Comment: Page 4-8: "Exposure to fugitive hydrocarbons transported away from the plant site will not have a significant health impact because concentrations in the immediate plant area will be held to a low level." Site and frequency of ambient monitoring are not specified except to say that complex hydrocarbons "will be monitored at points where air dispersion modeling predicts greatest exposure for the surrounding public;" I would like some monitoring in Evansville/Vanderburgh County even if the models don't predict "greatest exposure." (Commenters: 18, p. 7; Speaker 38)

Response: Concentrations of coal tar pitch volatiles will be below OSHA standards within the plant. Dispersion modeling of volatile organic hydrocarbons indicates that concentrations fall off rapidly with distance. Therefore, the resultant concentrations in Evansville would be insignificant. No such monitoring is planned by the plant operators for the Evansville area. In-plant health effects monitoring is described in revised Sect. 4.5 of this FEIS. See also the response to comment 5.12.

11.21 Comment: What procedures will be done to monitor the concentration of fugitive emissions that contain hazardous compounds? Perhaps modelling suggests no impact should be expected in Indiana, but the highly toxic nature of the chemicals involved suggests the prudence of ongoing experimental measurements to check calculations. Monitoring for these compounds is not generally performed and requires a significant commitment of time and money. (Commenter: 18, p. 3)

Response: Measure and control of fugitive emissions at the source of release is considered to be the most effective means of reducing public exposure. See also the response to comment 11.1.

11.22 Comment: How will volatilization and aerosolization of hydrocarbons and trace minerals from the cooling towers be monitored? (Commenter: 18, p. 6)

Response: The monitoring program outlined in revised Sect. 4.5 specifies monthly and event monitoring of the cooling tower water for volatile organics. No specific monitoring of the cooling tower exhaust is planned. The makeup water to the cooling tower will also be monitored.

Fish and Wildlife

11.23 Comment: Coordination between the U.S. Fish and Wildlife Service (USFWS), the Kentucky Department of Fish and Wildlife Resources (KDFWR), and the Department of Energy (DOE) should be implemented as soon as possible and that any mitigatory plans be implemented concurrent with project development. (Commenter: 9, p. 1)

Response: DOE met with personnel of the U.S. Fish and Wildlife Service and the Kentucky Department of Fish and Wildlife Resources and DOE will prepare a habitat mitigation plan in accordance with the Fish and Wildlife Coordination Act. A number of options being evaluated are presented in revised Appendix K of this FEIS.

11.24 Comment: The loss of wildlife habitat at the site (especially floodplain forests) will likely increase the demand for additional cropland and more clearing of timber for agricultural use in other areas. Impacts at the site could be lessened by wildlife plantings and fallowing selected areas. Trees and shrubs could be planted on the exterior of the facilities to serve as a buffer zone. Vegetation could help serve as a natural monitor of environmental conditions at the site. The Kentucky Department of Fish and Wildlife Resources should be contacted to provide technical assistance in lessening habitat destruction. (Commenters: 21, p. 14; 39, p. 3)

Response: Improvement of wildlife habitat through plantings is included in revised Appendix K of the FEIS. The use of vegetation for monitoring environmental conditions is discussed in revised Sect. 4.5.3 of the FEIS. The Kentucky Department of Fish and Wildlife Resources has been contacted as noted in the response to comment 11.23.

11.25 Comment: Section 4.6.8 addresses the mitigation of these terrestrial impacts. Unfortunately, this discussion is directed primarily towards avoiding adverse impacts where possible and does not address the mitigation of the unavoidable conversion of 550 acres of terrestrial habitat. Therefore, the final statement should address the available opportunities for offsetting the adverse impacts expected from unavoidable habitat conversion. We recommend that the DOE address the possibilities of utilizing all or part of the remaining acquisition area (approximately 934 acres) as temporary or permanent mitigation lands. Opportunities for mitigation are also available at the nearby state-managed Henderson Slough Wildlife Management Area. The FWS would be available to assist DOE in developing a mitigation plan that is harmonious to both the demonstration facility and future commercial expansion plans. (Commenter: 58, p. 2)

Response: A number of options under consideration for offsetting the impacts of habitat conversion are included in revised Appendix K of this FEIS.

11.26 Comment: Sedimentation basins should be used to contain construction runoff. Erosion control facilities such as dams, seeding, and mulching should be employed to reduce erosion. (Commenter: 21, p. 4)

Response: Sedimentation basins will be used as indicated in the Erosion Control Plan provided as Appendix GG of this FEIS.

11.27 Comment: According to the DEIS, a portion of the riparian habitat will be destroyed and altered for the construction of barge unloading facilities. A suggested mitigation measure is to establish a wide strip of streambank woodland along the company property bordering Green River. This would do three things: (1) control streambank erosion, (2) mitigate some of the wildlife habitat losses, and (3) serve as a model of streambank management for all landowners up and down the river where good streambank management has been sadly lacking for many years. (Commenter: 39, p. 2)

Response: Natural vegetation will be allowed to develop on riverbank areas not occupied by project facilities.

11.28 Comment: The DEIS states that 526 acres of land will be affected by power transmission lines serving the SRC-I facility. Where it is possible to do so, I would recommend that wildlife benefitting plants be established on this corridor. This would be one mitigation measure to compensate for wildlife habitat destroyed or altered. (Commenter: 39, p. 4)

Response: DOE has no direct control over the power-line corridor. Maintenance and control of the power-line corridor will be conducted by the Big Rivers Electric Corporation (BREC). See also the responses to comment 11.24.

11.29 Comment: Much research has been conducted on the design of intake structures to lessen impingement of fishes. Plans for mitigating impingement should also be addressed. (Commenter: 9, p. 3)

Response: Fish impingement will be considered in the final choice of intake structure design.

Agriculture

11.30 Comment: The list of current and proposed monitoring studies contains no mention of agricultural studies. Since the vigor of the productivity and economy of the surrounding agricultural community is at stake, the final EIS should contain a commitment to conduct studies to assess crop productivity, chemical uptake in crops, vegetation damage and the like, both pre-project and through the demonstration phase. (Commenters: Speakers 21, 16, p. 1)

Response: Effects on agricultural crops will be studied as part of the program discussed in Sect. 4.5 of the FEIS.

Groundwater

11.31 Comment: Specific groundwater monitoring plans should be provided in the FEIS. How many monitoring wells will be used, what will their locations be, and at what depths will they sample? The cross-section on page 3-9 is too generalized for a realistic appraisal of alluvial deposits and their influence on groundwater flow and degree of complexity of the subsurface regime. Logs of the drill borings should be included in the FEIS. A detailed examination of this information may reveal the need for monitoring at several vertical layers in order to have adequate information pertaining to leachate movement. (Commenter: 64, p. 5)

Response: The cross sections referred to present general site conditions and are not intended to show complex details. Inclusion of all drilling logs in the FEIS is deemed unnecessary for the purposes of the document. Detailed groundwater monitoring plans for operational monitoring are not yet available. These plans will be included in the landfill operation permit application. Plans for additional preconstruction groundwater monitoring are included in revised Sect. 4.5 and Appendix M of the FEIS.

The EPA will receive copies of all necessary subsurface information along with the required permit applications for the landfills. See also the response to comment 11.1.

11.32 Comment: Page 4-133, Sect. 4.5.3.1, and Page C-34, top paragraph. The FEIS should indicate the schedule by which the leachate/groundwater monitoring plan will be prepared. (Commenter: 56, p. 27)

Response: The Preconstruction Environmental Monitoring Program is discussed in Sect. 4.5 of the FEIS. The environmental monitoring programs for the construction and operational phases will be available in June 1982.

11.33 Comment: Page 4-28, fourth paragraph: In the event groundwater contamination from leachate is detected, what measures could be taken to eliminate the source of contamination and mitigate potential impacts to nearby water supply wells? (Commenter: 56, pp. 4 and 27)

Response: A contingency plan to be used should groundwater contamination occur is included in Appendix HH of the FEIS.

11.34 Comment: The FEIS should confirm any plans for groundwater modeling and the schedule for conducting such modeling. (Commenter: 56, p. 27)

Response: Some preliminary groundwater modeling has been performed and is discussed in Sect. 4.2.2.2. As is discussed in revised Sect. 4.5, additional data will be obtained during the preconstruction monitoring program to provide a more complete understanding of the groundwater hydrology system at the site. Additional modeling will also be performed during this phase of the project.

12. SITE SELECTION

12.1 Comment: Why was the Newman site chosen? Surely there is a more suitable location for this "demonstration project" than on the fringe of a metropolitan area of 300,000 people. (Commenters: 61, p. 2; 5, p. 1; Speaker 102)

Response: Appendix B of the EIS identifies the candidate sites and the criteria used for evaluation. The Newman site was chosen as the preferred site through the process of a site selection study conducted by Rust Engineering. An independent alternate site comparison conducted by ORNL reviewed these original candidate sites as well as other potential alternate sites. The conclusion reached by the ORNL study (also described in Appendix B of the EIS) is that although the proposed site would experience adverse environmental impacts, so would the alternative sites. It is believed that these impacts at the proposed site can be mitigated to an acceptable level. The fact that the population in the vicinity is 300,000 has advantages in terms of providing labor and an infrastructure that can accommodate the demands for human services required for employees involved in construction and operations of the facility.

12.2 Comment: The siting of this plant and others planned for this area was given inadequate attention. The health effects of SRC-I is one factor of the cumulative effects, not only of 4 or 5 synfuel plants but the 4-5 coal powered generating plants planned within a small radius. (Commenters: 18, p. 2; 39, p. 1)

Response: The choice of Newman as the proposed site for the SRC-I project is described in Appendix B of the EIS. The site selection process for the other synfuel and power plants is not within the scope of this EIS. A discussion of cumulative effects of the proposed SRC-I project in conjunction with other planned or existing projects is included in the EIS as Appendix CC and Sects. 4.2.5, 4.3.5, 4.4.5, and 2.3.1.3.

12.3 Comment: Nowhere in the EIS or apparently elsewhere, is there an environmental analysis comparing the Newman, Kentucky site for the plant with other potential alternative sites. The Appendix B analysis compares alternative sites with each other, but not with the Newman site.

The National Environmental Policy Act requires that the DEIS do more than justify a contractor's inadequate analysis. (Commenters: 38, p. 31, 35; 17, p. 5; Speaker 29)

Response: The method used by Rust Engineering for selection is described in Appendix B of the EIS. DOE performed an independent analysis to select two sites that could be alternatives to the proposed Newman site. The analysis included all sites used in the original Rust site selection study as well as other sites that are currently viewed as potential alternatives using the ORNL process based on environmental criteria (described in Appendix B of the EIS). The ORNL process was intended to identify the most environmentally competitive alternatives for comparison with the proposed site. Ravenswood and Equality were identified as the least environmentally sensitive alternative sites, or in other words, the alternative sites where the proposed plant would be expected to have the least environmental impact. These prime alternative sites are compared with the proposed site in Sects. 4.3 and 4.4 and 2.3.2.1 of the EIS.

12.4 Comment: The sites selected for comparison are the same locations considered in the SRC-II environmental impact statement. (Commenter: 38, p. 35)

Response: The commenter is correct. The universe of candidate alternative sites for ORNL's independent analysis was the same for both SRC projects and the resource needs of the two projects are similar. Thus, Ravenswood and Equality, again, emerged as the environmentally least sensitive alternative sites. These sites are compared to the proposed Ft. Martin site in the SRC-II FEIS.

12.5 Comment: If the environmental criteria used to eliminate alternative sites in the Oak Ridge study were applied to the Newman site, it would be unacceptable according to all seven criteria. One wonders, then, what standards have been used to justify the environmental acceptability of the Newman site?

The DEIS amply points out that the Newman site is obviously not the correct site to locate the facility and that the entire siting process as presented is an inadequate, incomplete and confusing attempt to select a site not environmentally or economically acceptable for a plant of this size and scope. (Commenters: 45, p. 1; 6, p. 3, 5; 17, p. 5; 38, p. 32)

Response: It should be noted that the ORNL study is based on environmental criteria and does not give credit to any of the sites for favorable engineering or economic characteristics. The Rust Engineering study did include these other important criteria and selected Newman as the preferred site. The EIS adequately identifies the adverse environmental impacts that would be experienced at the proposed site, and in conjunction with the comparison of impacts between Newman and the alternative sites, provides the decision-maker with sufficient information to make an environmentally informed decision about the proposed project (see Sects. 2.3.2.1, 4.3, and 4.4).

12.6 Comment: In June, 1980, DOE published a document called *Synthetic Fuels and the Environment: An Environmental and Regulatory Impacts Analysis*. In this document the DOE determined what locations would be best and worst for locating a coal conversion plant. Several categories were considered. Four classes were determined in each category. In the Environmental Health category – which is based on population density and existing cancer rates – Daviess County – the Newman site is in the worst class, and Henderson County is in the next-to-worst class. In the category of Ecological Sensitivity – which is based on prime farmland – the Newman site is in the next-to-worst class. In regards to existing air quality – the cities of Owensboro and Henderson and Vanderburgh County in Indiana are shown to be in the next-to-worst class. All of these factors would indicate that Newman is not a likely site.

This information was available to the proposers of this project, but nowhere in the DEIS is this information described. This type of information certainly indicates that the site selection process is open to question. Why did the DOE not use this information? (Commenters: 6, p. 4; 60, p. 13)

Response: The cited document was a generic study and is not intended to substitute for a project-specific selection process (Appendix B, EIS) which would consider a great many factors in addition to those cited. The EIS evaluated Newman relative to alternative sites (Sect. 2.3.2.1).

12.7 Comment: The use of railroads to deliver coal to the project significantly reduces the importance of water transportation as a site selection criterion. Therefore, a reevaluation of the alternative sites with reduced emphasis on water transportation would seem to be appropriate in the final EIS. (Commenter: Speaker 28)

Response: As discussed in Appendix D of the EIS (Floodplain/Wetlands Review) barge access is essential for the delivery of large pieces of construction machinery and process equipment, regardless of coal delivery. In addition, the site selection process factored in the needs of the expanded commercial plant, which would likely require coal delivery by barge. Therefore, water transportation is a necessary and important site selection criterion.

12.8 Comment: The validity of the initial Rust study is itself questionable, not only for its total disregard of environmental factors, but also in light of later design changes in the plant and because of inconsistencies in the original selection process. The Rust study was premised on a 2,000 tpd facility; however, the current plan is for a 6,000 tpd plant with capacity for expansion to a 30,000 tpd commercial facility. (Commenters: 38, p. 34; 6, p. 2)

Response: As discussed in Appendix B of the EIS, when DOE became the sponsor of the project, an independent alternative site analysis was deemed necessary and was initiated. The characteristics of the proposed site lend themselves not only to the construction and operation of a 2000 tpsd facility but also to a 6000 or 30,000 tpsd plant (with the exception of ash disposal for the commercial facility). The expansion in plant capacity does not introduce any unmitigatable adverse environmental impacts that would disqualify the proposed site or render the alternative site evaluation obsolete.

12.9 Comment: If there is a significant change in the scale of the plant (down-sizing the plant to 3000 tpsd) compliance with NEPA and Executive Order 11988 requires a new and comprehensive site selection study. (Commenter: 17, p. 9)

Response: Down-sizing the plant would not require a new site selection study. See response to Comment 12.8.

12.10 Comment: It is necessary under Executive Orders 11988 and 11990 to determine if other sites would offer a practical alternative to reducing the floodplain/wetlands effects caused by development of the Newman site. (Commenter: 17, p. 5)

Response: See response to comment 9.2.

13. SOLID WASTE

13.1 Comment: Since the DEIS was published, regulations have been published in the *Federal Register* (January 12 and February 5, 1981) formalizing EPA's groundwater protection strategy in respect to location and performance standards for hazardous waste disposal facilities. In this regard, the FEIS should discuss the potential for leachate and other subsurface discharges from the residual disposal area and their potential impact on future domestic agricultural, industrial, and commercial groundwater uses in the area. (Commenter: 56, p. 3)

Response: Additional groundwater modeling information supplied by ICRC has been added in Appendix R of the FEIS. Groundwater hydrologic conditions at the site are discussed in revised Sect. 3.2.2.2 of the FEIS. A groundwater contamination contingency plan has also been added in Appendix HH.

13.2 Comment: The site is located in a moderately seismic-active area, as the DEIS points out. But the DEIS fails to say what the design criteria for acceleration will be for the hazardous waste landfill. Will the landfill be able to withstand an earthquake that results in an acceleration of 0.1 *g*? Will it be able to withstand a 0.25 g acceleration? (Commenters: 64, p. 5; Speakers 38; 22; 21, p. 12; 18, p. 9; 12, p. 12)

Response: The ability of the landfill liner system to withstand earthquake-induced acceleration is not an applicable design criterion. The appropriate criteria to protect against minor differential settlement (which might result from earthquake-induced soil liquefaction) have been included in the liner design. Major settlement that results in a breach will be detected and repaired before groundwater contamination occurs (see response to comment 13.3).

13.3 Comment: The geologic report in the appendixes of the DEIS points out that the loose river sand deposits that the solid waste material will be placed on are definitely susceptible to the liquefaction phenomenon. This occurs when an earthquake happens and the groundwater levels are high. The material literally liquefies, much in the sense of quicksand. This would certainly jeopardize the containment efforts for this landfill. (Commenters: Speakers 22; 64, p. 5; 21, p. 12)

Response: Appendix L mentions that the probability of soil liquefaction is remote. A joint occurrence of the 100-year flood and an earthquake would be required. If liquefaction occurred, the most severe result would be several inches of ground settlement. The ash ponds, with their flexible linings and leachate detection systems founded on several feet of clay are not settlement-sensitive structures. They should be able to conform with little or no distress.

Additional soil testing by geotechnical subcontracting firms is planned for the site. Liquefaction potential will be further assessed at that time. If it is determined that the liners have some remote possibility of failing (if liquefaction potential is present), subgrade improvements will be made on the near-surface, loose, granular soils. Improvements are made by compacting the soils, through various standard measures, to withstand earthquake-induced accelerations of 15% of gravity.

Preliminary groundwater modeling was conducted assuming a worst-case situation (i.e., a breach or total failure of the lining system). Results indicate that it would take several years for toxic materials to reach the groundwater table and concentrate to harmful levels. A liner failure would be quickly detected by the leachate detection system, and excavation and liner repair measures could be taken well before groundwater contamination could occur.

13.4 Comment: Problems with the water table rise associated with flooding are likely. Alternate floating and settling of this ashpond could cause breaching in the liner at several points, and as yet, nothing has been written about how this problem could be alleviated. (Commenters: 21, p. 12; 64, p. 5; Speakers 38; 18, p. 1; 56, p. 26)

Response: Liner flotation control and mitigation of liner failures are discussed in revised Sect. 4.2.2.2 and Appendix C of the FEIS.

13.5 Comment: "It is believed that public health impacts resulting from leaching of biologically active organic compounds will be minimal (Appendixes C and P)." There is no information about the organic constituents of leachates from coal, slag, fly dust, or SRC product in the appendixes; therefore, no data supports that "belief." On the other hand DOE/HHS/EPA publication 0-5 MTR-79W 15902, "Health Effects of Coal Technologies," p. 84, states, "There is considerable evidence that coal refuse dumps will continue to produce significant quantities of water-borne contaminants for many years after their disposal." (Commenter: 18, p. 6)

Response: Organic carbon content of leachate from the SRC product is reported in Appendix P of the EIS. Data are not available to identify organic compounds in the leachate from the SRC product. Recent testing of SRC-I gasifier slag by ORNL indicated that essentially no water-soluble organic compounds exist in the slag. Total organic carbon content of coal pile leachate is also very low. Wastes with the potential to leach significant quantities of organic compounds will be stored in the hazardous waste landfill.

13.6 Comment: Tests to determine the classification of the gasifier waste under RCRA have not been completed. If these tests show the waste to be hazardous, will the landfill be raised above the 100-year flood level? This determination, as well as the leaching tests for the metal-bearing sludge from the water treatment system, should be included in the FEIS. (Commenter: 64, p. 4)

Response: Tests from the wastes generated in a pilot-scale gasifier are completed and indicate that the gasifier by-products will be nonhazardous. Testing of the wastes from a commercial-size gasifier will be conducted when the demonstration facility is built to verify this classification. Although the bases of the ash ponds are below the 100-year flood, they will be diked above the 500-year flood to prevent direct flood water inundation. The ponds will be designed against the unlikely event of soil liquefaction, which could potentially result only from a combined occurrence of the 100-year flood and an earthquake. One mitigation measure is to weight the ponds against upward pressures from high groundwater levels (which would also result from the 100-year flood saturation of the site) (see Sect. 4.2.2.2).

Although leaching tests have not been performed on the metal-bearing sludges, these wastes are expected to be hazardous. They will be disposed of in an approved hazardous classified landfill. The sludge will consist mainly of the chemicals used for precipitation, such as lime, alum, and ferric chloride. Only a small fraction of the dry sludge weight will consist of toxic metals. Leachate tests for the metal sludge will be performed when the laboratory study for wastewater treatment generates a sufficient quantity of the sludge sample.

13.7 Comment: Rather than going ahead and producing quantities of these wastes without proper disposal technology — which is the cart before the horse philosophy — we should instead solve the problem now and then proceed. I urge the ICRC and DOE to assume this approach to the problem. With the current plan, who is to assume the responsibility and liability for these wastes if the plant were ever to be closed? (Commenter: 39, p. 3)

Response: The hazardous landfill will be designed to meet the RCRA requirements for hazardous waste disposal facilities. Though not expected to require a hazardous landfill, the first gasifier slag and ash pond will be designed with the same key features as those used for the hazardous landfill, that is, double liners and provisions for monitoring water within the pond and leachate between liners and groundwater. See also response to comments 13.8 and 13.16. A discussion of closure requirements, as required by RCRA, has been added as Sect. C.2.2.3 in Appendix C of this FEIS.

13.8 Comment: Have tests been performed on the proposed synthetic liner for the landfill, and what will that liner be made of? Will it provide 100% impermeability to leachate? If not, how impermeable is it? Will it be susceptible to attack by the organic chemical fraction of the waste? (Commenters: 64, p. 4; 21, p. 13; 56, p. 26)

Response: Synthetic liner testing will be conducted as part of the selection process. Preliminary selection of liner materials will be based on knowledge of the expected compatibility of the material with the leachate, which will be generated by the wastes. Testing on the preliminary liner materials will be conducted by exposing the liner to leachate generated by the wastes for a finite time. The specimens are subjected to a variety of tests before and after exposure to the wastes to determine the adequacy of the materials. The types of tests included are thickness (swell), tensile strength, elongation at break, hardness, and tear strength measurements; water absorption and extraction tests; seam strength, puncture resistance, water vapor transmission, and density measurements; and leachate absorption tests. Liner testing is an integral part of the detailed landfill and ash pond design. Liner material is discussed in response to comment 3.57.

13.9 Comment: Page 4-2, second complete paragraph. In this section and throughout the DEIS, the ash ponds and the residual disposal areas were described as having a clay liner with a depth of 3 ft. However, in Appendix R the design parameters for the clay liner on the ash and waste disposal area were given as 6 in. The FEIS should eliminate this apparent inconsistency in design of the ash ponds and residuals disposal area. (Commenter: 56, p. 3)

Response: Appendix R has been revised so that it is consistent at 3 ft.

13.10 Comment: Toxic solid wastes will be put into a landfill with a clay liner and a leachate collection system. What potential effects may occur with this process? (Commenters: 18, p. 8; Speakers 38; 47, p. 3)

Response: Solid waste disposal landfills are being designed to provide total containment of the wastes and leachates derived from the wastes. An array of groundwater monitoring equipment will be installed under and around the landfills to detect infiltration of leachates, and remedial measures are being developed to correct any problems that arise (see Sect. 4.2.2.2 and Appendix C).

13.11 Comment: Designs for solid waste disposal are described as having "small" potential public health impacts, but the statement does not specify what "small" is. (Commenter: Speaker 19)

Response: Impacts from solid waste disposal are discussed in Sect. 4.2.2.2 of the EIS. Solid waste disposal facilities are being designed to prevent human exposure to any potentially toxic substances. Operational monitoring in and around the disposal areas is planned to detect escape of leachates from the secure landfill; remedial treatment will be undertaken to recover infiltrating contaminants. The qualitative term "small" has been deleted from the text. Worst-case quantitative impacts on groundwater have been evaluated and added to Appendix R.

13.12 Comment: In the event that siting of hazardous waste disposal areas cannot be completed before the plant begins operation, the FEIS should specify viable alternatives for the permanent disposal of these wastes and identify a monitoring plan to ensure that these hazardous substances would not be released into the environment. (Commenter: Speaker 21)

Response: Operation of the plant would not begin until the RCRA permit has been obtained for the hazardous waste landfill.

13.13 Comment: Page C-32, Sect. C.2.3.2. The FEIS should indicate the schedule by which more detailed design information concerning the secure landfills will become available. (Commenter: 56, p. 26)

Response: These activities will be conducted in accordance with permit applications shown in Appendix W. Appendix EE contains the work plan between DOE, EPA, and KDNREP.

13.14 Comment: No mention is made here of the site having recently been enlarged by more than 9.9 ha (400 acres), apparently to store slag, and it is not stated that, according to the Phase Zero Deliverables, a 587-ha (1450-acre) site would not be adequate to hold the slag for more than 14 years of commercial operation. The FEIS should be more explicit about the waste problem. Can 601 ha (1485 acres) contain the slag from the entire period expected for commercial operation? If so, how? If not, where will it be put? (Commenters: 46, p. 3; 51, p. 2)

Response: Onsite disposal areas will be designed to contain five years of wastes — the duration of the demonstration phase. Continued operation at the demonstration scale for an additional 15 years would require an additional approximately 48.6 ha (120 acres) of ash ponds. Therefore, if the facility is not expanded, sufficient land would be available at the site for these ash ponds. With expansion to a commercial facility and operation for 14 years, an additional 224 ha (560 acres) would be required for ash storage, only 72 ha (180 acres) of which would be on site. Before expansion, disposal alternatives for ash that cannot be stored on site will be evaluated. These alternatives include: fixation as a solid and sale as a commercial commodity, fixation and use for land reclamation, and acquisition of additional offsite land for disposal.

13.15 Comment: If no procedure for decommissioning these landfills exists, why is it necessary to store gasifier wastes in liquid form? (Commenter: 51, p. 2)

Response: Gasifier wastes will be slurried to the ash disposal pond, and the solid will settle to the bottom of the pond. Experience with other gasifier ashes (SASOL) indicates that the ash solidifies when dewatered. Solidification is partially caused by formation of a cement-like material. In the case of the ash ponds, the ash can be dewatered by underdrains and a decant system, and the ponds can be closed by covering the ash with a clay cap. Additional studies are being performed to ensure that the ash settles and dewaters as expected, and comparisons of wet and dry ash conveying are being made. See also Sect. C.2.3 of this FEIS.

13.16 Comment: The DEIS does not address the long-term effects of the waste landfills. Once the areas have been covered, will use of the land be restricted any? If not, what is the potential for eventual seepage from the pits and contamination of soil, plants, and grazing animals? (Commenter: 64, p. 4)

Response: The current final regulations under 40 CFR Part 267 of RCRA regulations dealing with new hazardous waste treatment storage and disposal facilities are performance-based standards. Previously, EPA had proposed standards that applied generic design criteria. However, because of the great diversity in site characteristics, EPA now believes a case-by-case review of each facility design and its respective site will provide greater assurance that the groundwater and surface water

are protected from potential long-term adverse environmental impacts. To this end, the closure plan for the SRC-I facility will be developed in conjunction with both the EPA and Kentucky Department of Natural Resources and Environmental Protection (KDNREP) and will be submitted for review and approval to these agencies before construction of the hazardous waste facilities. The scope of the closure plan has been included as Sect. C.2.2.3 in Appendix C of the FEIS. Appendix R of the FEIS presents preliminary modeling of long-term impacts of solid-waste disposal.

13.17 Comment: Page C-42, Sect. C.3.2.1. The FEIS should indicate the schedule by which a decision is expected regarding the possible stabilization of waste brines. (Commenter: 56, p. 27)

Response: The specific schedule is not currently available. This issue will be resolved in accordance with the DOE/EPA/KDNREP Work Plan presented in Appendix EE.

13.18 Comment: Disposal sites should be lined with an impervious material after the topsoil has been removed and stockpiled. As the disposal area is filled, the topsoil should be redeposited on the ash, and the area should be revegetated. Revegetation should consist of planting a grass/legume community of orchard grass and clover which should then be allowed to proceed through natural succession. (Commenters: 9, p. 4; 21, p. 13)

Response: Current plans for the ash pond and hazardous landfill disposal areas include removal and stockpiling of topsoil before excavation of the sites. The topsoil will be stored for later redisposition on filled disposal sites. The sites will be covered according to EPA and KDNREP requirements, topped with the topsoil, and revegetated.

14. LAND USE

14.1 Comment: The problem of the loss of prime farmland is not adequately discussed in the DEIS.

Of the nearly 607 ha (1500 acres) of the SRC-I site area, 91%, or about 547 ha (1350 acres), is prime farmland, with soybeans the principal crop. This land is likely to be removed "permanently" from agricultural production through severe alteration and contamination of the site from wastes associated with synfuel production. Can Kentucky afford this loss of prime farmland?

DOE's proposal to purchase farmland in the vicinity of the SRC-I plant and cease agricultural activity on that land to offset particulate emissions so that the plant can qualify for an air quality permit exposes DOE's apparent indifference to the nationally recognized problem of the loss of agricultural lands. (Commenters: 44, p. 2; 45, p. 1; 5, p. 1; 38, p. 64; Speaker 73)

Response: Impacts relating to the loss of prime farmlands resulting from the SRC-I project were discussed in Sects. 4.2.1.1, 4.2.1.2, and 4.2.5 and in the alternative site analysis presented in Sects. 4.3, 4.4, and Appendix B of the DEIS. The percentage of prime farmland removed by the SRC-I facility amounts to about 0.65% of Daviess County's prime farmland. The potential mitigating measures involving offsets were mentioned solely to indicate that the major source of particulate emissions in the vicinity of the site is agricultural activity. (See response to comment 7.31.)

14.2 Comment: The site area to be removed by the SRC-I facility is correct as shown in this table; however, the total site area has been increased to 600 ha (1484 acres). The land use classification of the additional 176 ha (434 acres) has not been determined. The FEIS should not ignore this matter. (Commenter: 46, p. 3)

Response: The 176-ha (434-acre) addition to the site noted in Table 4.3 is similar to the rest of the site in terms of cropland and wildlife habitat. However, the addition contains no riparian and floodplain forest. This has been noted in Sect. 4.2.1.3 of the FEIS.

14.3 Comment: Annual value of the loss of agricultural production given in the DEIS was calculated on the basis of an earlier, 425-ha (1050-acre) site. Data on the agricultural production for the currently proposed site is not given. (Commenter: 38, p. 63)

Response: Tables 4.3 and 4.4 have been revised to reflect the annual value of the loss of agricultural production based on the new 600-ha (1484-acre) site.

14.4 Comment: The FEIS should more definitively address agricultural land impacts associated with the power-line right-of-way to the project, possible widening or improvement of transportation corridors such as U.S. 60, housing, commercial development, and ancillary industries associated with the project; these costs should be added to the total annual value of agricultural production that would be forfeited. (Commenters: 12, p. 13; 38, pp. 62-63; Speaker 19)

Response: Section 4.2.1.1 has been expanded to address this comment.

14.5 Comment: Although specific mines to feed the plant have not been identified, it is estimated that about 660 ha (1630 acres) per year will be disturbed. Given a life expectancy of 20 to 30 years for the commercial plant, that would amount to the "disturbance" of 13,200 to 19,800 ha (32,600 to 48,900 acres). How much of this will be forest, pasture, and cropland? (Commenters: 44, p. 2; 38, pp. 62-63)

Response: Coal requirements for the demonstration phase will come from existing mines. Table 1.13 lists the acreage required per year for the mining requirements to support a 30,000 tpsd commercial plant. It is not possible at this time to state with certainty what percentage of that mining acreage would be forest, pasture, or cropland.

14.6 Comment: The loss of prime agricultural lands needs more study in the cumulative impact area. The full impact of SRC-I, allied growth, and other facilities on the agricultural lands and production in western Kentucky and in the 21-county impact region, must be evaluated and quantified in the final EIS.

Response: Section 4.2.5 has been revised to address most of this comment, particularly with regard to the four proposed synfuel plants in the region. Impacts of the five electrical generating facilities have not been covered in as much detail. It is not possible to adequately estimate the quantity of land that will be affected by the "impermanence syndrome" or by petrochemical plants that might locate near the synfuel plants or to estimate the total economic losses from all direct and indirect cumulative impacts. Mitigation for the SRC-I project is considered in Sect. 4.6. Developing mitigation plans for the other potential facilities is not currently feasible.

14.7 Comment: The FEIS should specify that the clearing, construction, reclamation, and maintenance of the transmission line right-of-way will follow the suggested guidelines of the U.S. Department of Agriculture and the U.S. Department of the Interior contained in the publication *Environmental Criteria for Electric Transmission Systems.* (Commenter: 9, p. 5)

Response: DOE has no authority over management of the power-line corridor; it will be under the control of the Big Rivers Electric Corporation. Discussion of transmission line rights-of-way is included in Department of Agriculture, Rural Electrification Administration, *Final Environmental Statement, D. B. Wilson Station Units 1 and 2 and Associated Transmission Facilities,* May 1980.

14.8 Comment: We recommend that the following practices be implemented along transmission line rights-of-way (ROW). ROWs through areas that must be cleared of existing vegetation should be disked, fertilized, and planted in a manner to establish a community consisting of two-thirds grasses and legumes (orchard grass and clover) and one-third mixed shrubs. Maintenance of the corridor in this community structure should be accomplished by mechanical means. (Commenter: 12, p. 13)

Response: Maintenance and control of the power-line corridor will be by the Big Rivers Electric Corporation (BREC). DOE has no authority in this regard. See also response to comment 14.7.

15. GEOLOGY AND SOILS

15.1 Comment: Soil erosion control measures should be further identified in the FEIS. In addition, the KDNREP's Division of Conservation should be provided the opportunity to comment on the Construction Environmental Management Plan, which should describe in detail the potential for erosion and sedimentation problems associated with the project and control measures. (Commenter: 12, p. 13)

Response: Erosion control measures have been further identified in a soil erosion control plan developed by ICRC, which is included as Appendix GG in the FEIS. The Division of Conservation will be provided the opportunity to comment on the plan.

15.2 Comment: What is the geology and specific natural groundwater movement beneath the Newman site? (Commenter: Speaker 76)

Response: The FEIS contains additional data, collected after issuance of the DEIS, on the groundwater hydrologic system beneath the site (Sect. 3.2.2.2).

15.3 Comment: Breaching of the "clay unit" during construction of the Barge Slip would drastically change the groundwater flow regime – increased hydraulic gradient, more contaminants entering groundwater reservoirs from leachates because of increased groundwater velocity in the area, and subsequent pollution of drinking water wells. This problem is a great threat to the nearby communities that depend on wells as sources for drinking water. (Commenter: 65, p. 54)

Response: Additional groundwater monitoring data obtained since issuance of the DEIS indicates that the alluvial aquifer is already interconnected with the Green River along the southeast corner of the site (see Sect. 3.2.2.2). Therefore, concerns that excavation of the barge facility may adversely affect the groundwater hydrologic system are unfounded. At the time the DEIS was written, information was not sufficient to identify this hydraulic connection between the river and the aquifer.