DOE/EIS-0098

Final Environmental Impact Statement

Pantex Plant Site

Amarillo, Texas

U.S. Department of Energy

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COVER SHEET

FINAL ENVIRONMENTAL IMPACT STATEMENT
DOE/EIS-0098

(a) Lead Agency: The Department of Energy

(b) Proposed Action: Pantex Plant Site, Carson County, Texas

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(d) Designation: Final Environmental Impact Statement

(e) Abstract: This Environmental Impact Statement evaluates the impact of continuing operations and constructing additional facilities at the Pantex Plant near Amarillo, Texas, in order to meet the Department of Energy's continuing responsibilities for nuclear weapons assembly; stockpile monitoring, maintenance, and modifications; and retirements (disassembly) as mandated by Presidential direction and Congressional authorization and appropriation. The Environmental Impact Statement analyzes a range of alternatives to the proposed action. Alternatives identified include continued operations and construction of new facilities at the Pantex Plant; relocation of some or all of the Pantex Plant operations to existing facilities (which would require refurbishing) or new facilities at a formerly utilized nuclear weapons assembly plant site near Burlington, Iowa; relocation of all operations to new facilities at the Hanford Site near Richland, Washington; and impact mitigation alternatives.

FOREWORD

This environmental impact statement (EIS) analyzes the environmental effects of the Department of Energy's proposal to continue operations and to construct additional facilities at the Pantex Plant near Amarillo, Texas, to meet the Department of Energy's continuing responsibilities for nuclear weapons assembly, stockpile monitoring, maintenance, modifications, and retirements (disassembly) as mandated by Presidential direction and Congressional authorization and appropriation. The EIS analyzes a range of alternatives to the proposed action. The alternatives identified include moving some or all of the Pantex Plant operations to existing facilities (which would require refurbishing) or to new facilities at a formerly used nuclear weapons assembly plant site near Burlington, Iowa; relocation of all operations to new facilities at the Hanford Site near Richland, Washington. Several specific impact mitigation measures are also discussed. This EIS addresses those environmental impacts associated with Pantex Plant operations, proposed construction projects, and alternatives identified to those operations and projects, and related transportation operations. Both normal operations and potential credible accidents are evaluated for significant environmental consequences. The EIS addresses neither the United States nuclear weapon complex as a whole nor national policies regarding nuclear weapons.

This EIS was prepared in accordance with the regulations of the Council on Environmental Quality (40 CFR Parts 1500-1508) and the Department of Energy Guidelines for Implementation of those regulations (45 FR 20694). A Notice of Intent to prepare a draft EIS and conduct public scoping meetings regarding continuing operations and constructing additional facilities at the Pantex Plant was published in the Federal Register on April 24, 1981 (46 FR 23285-23286), and was provided directly to a number of Texas State agencies, other organizations, and local news media. A total of 18 communications were received prior to the scoping meetings in response to the Notice of Intent. Two scoping meetings were held in Amarillo, Texas, on May 28, 1981. Two persons made formal oral statements at the scoping meetings. The draft EIS was issued in December 1982 and made available to appropriate Federal, State, and local entities and members of the general public in order to provide those parties with an opportunity to review and comment on the document. Forty-five written comments were received during the public comment period, which closed on March 15, 1983. The comments received on the draft EIS were assessed and considered by the Department of Energy in its preparation of this final EIS. All of the comments received together with the Department of Energy responses are included as a new chapter in this final EIS. The EIS is being transmitted to commenters, made available to members of the public, and filed with the Environmental Protection Agency. The Environmental Protection Agency will publish a notice in the Federal Register acknowledging that the Department of Energy has filed the final EIS. The Department of Energy will make a decision on the proposed action not earlier than 30 days after the Environmental Protection Agency has published the Federal Register notice. The Department of Energy will record its decision in a Record of Decision, published in the Federal Register and made available to the public.

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CHAPTER 4. ENVIRONMENTAL IMPACTS (cont)

SUMMARY

This document evaluates the environmental impacts of actions being considered by the Department of Energy in conjunction with its nuclear weapons operations at the Pantex Plant near Amarillo, Texas. The proposed action is to continue operations and to construct additional facilities at the Pantex Plant to meet the Department of Energy's continuing responsibilities for nuclear weapons assembly, stockpile monitoring, maintenance, modifications, and retirements (disassembly), as mandated by Presidential direction and Congressional authorization and appropriation. The Environmental Impact Statement analyzes a range of alternatives to the proposed action. The alternatives identified include continued operations and construction of new facilities at the Pantex Plant; relocation of some or all of Pantex Plant operations to existing facilities (which would require refurbishing) or to new facilities at a formerly used nuclear weapons assembly plant site near Burlington, Iowa; relocation of all operations to new facilities at the Hanford Site near Richland, Washington. Several specific impact mitigation measures are also discussed.

I. PURPOSE AND NEED FOR THE PROPOSED ACTION

The purpose of the Department of Energy's proposed actions is to meet its continuing responsibilities for nuclear weapons operations under the Atomic Energy Act of 1954. Part of this responsibility is to provide new facilities to meet future military stockpile requirements established by Presidential directive. In the process of evaluating various means of carrying out its obligation, the Department is considering new or modified facilities that would provide improved operational reliability and additional mitigation of potential accidents for protecting workers, the general public, and the environment.

In 1978 the Department of Energy started to plan for construction of new facilities at the Pantex Plant similar to existing ones for handling increased workload schedules. Construction of some of these planned facilities was started in 1982. In addition to providing for increased workloads, the Department of Energy initiated a comprehensive planning and analysis effort in 1980 for the entire plant with goals for improving operational reliability and mitigation of potential accidents. These continuing studies include evaluating master plans to upgrade or replace many of the existing facilities.

II. BACKGROUND ON THE PANTEX PLANT

The Pantex Plant, located in the Panhandle of Texas in Carson County near Amarillo, was first used in 1942 by the Army Ordnance Corps for loading conventional ammunition shells and bombs. In 1950 the Atomic Energy Commission started rehabilitating portions of the original plant and building new facilities for nuclear weapons operations.

The Pantex Plant is primarily an assembly facility that receives conventional high-explosive materials (conventional means nonnuclear) and prefabricated weapons components from external suppliers. There are three major operations: (1) production of new nuclear weapons; (2) maintenance, modification, and quality assurance testing of nuclear weapons already in the military stockpile; and (3) retirement by disassembly of nuclear weapons no longer required in the military stockpile. The terms "nuclear weapons operations" and "workload" are used to refer collectively to all three types of operations throughout this document.

The high explosives are shipped to the Pantex Plant and fabricated into the required shapes for use in nuclear weapons. All other nuclear weapon components are supplied by other manufacturers. At the Pantex Plant these components are assembled to produce nuclear weapons for delivery to the Department of Defense.

Maintenance and modification of weapons in the military stockpile involve partial disassembly to permit replacement, modification, or inspection of components. A statistically selected number of nuclear weapons from the military stockpile or from initial production of a new weapons system receives a series of inspections and component evaluations.

When a weapon is completely disassembled for retirement, the conventional high-explosive components are separated from the nuclear components and disposed of at the Pantex Plant by burning. The nuclear materials components are returned to the original manufacturer. All other components are returned to the manufacturers or sent elsewhere for reuse, salvage, or ultimate disposal.

The Pantex Plant also conducts research and development work on conventional high explosives to support weapons design and development programs for the Department of Energy.

III. ALTERNATIVES

This Environmental Impact Statement includes analyses of either upgrading the Pantex Plant or replacing it at its current site or at another location. Two alternative sites were considered and options including either total or partial relocation of the nuclear weapons operations at each site were analyzed. These sites were selected on the basis of their suitability with respect to such features as (1) existing facilities and structures, (2) low population density, and (3) availability of land for major construction efforts.

The local environs differ greatly among the three sites. However, each is located within relatively flat, open country away from major mountain ranges. All three locations have agricultural areas onsite under cultivation. Each site is located relatively close to urban areas.

The three basic alternatives are identified according to sites. These alternatives and their options are identified below and summarized in Table I.

A. The Pantex Plant Alternative

The Pantex Plant Alternative includes four options, the first three of which consider different combinations of new facilities that could provide three levels of improved operational reliability and also would reduce the likelihood of occurrence or mitigate the consequences of potential accidents. The fourth option considers continuing operations in existing facilities and constitutes the "No Action Alternative" for the purpose of comparison in this Environmental Impact Statement.

- Pantex Plant Alternative Option 1 - New Construction to Meet Future Workload. This option assumes continuing operations in existing facilities and includes construction of 11 new facility projects. The new projects will be designed to currently applicable criteria for new construction. Five of the projects were under construction by the end of 1982, four more are expected to start

TABLE I

SUMMARY OF ALTERNATIVES

Action	Estimated Dates for Completion of Construction	Estimated Cost ($ Millions) (1981 values)	Operational Reliability Design Level
PANTEX PLANT ALTERNATIVE			
Option 1: New construction of specifically identified facilities	1982-1987	198	Existing facilities and Current Criteria applied to new construction only
Option 2: Major upgrade of existing facilities including significant new construction	1991-1993	664	Current Criteria applied to upgrading and new construction
Option 3: Complete replacement of certain major plant facilities with new construction	1993-1996	1239	Enhanced Goals for new construction
Option 4: Existing facilities and facilities currently under construction ("No Action")	--	53	Existing facilities, Current Criteria applied only to facilities currently under construction
IOWA ARMY AMMUNITION PLANT ALTERNATIVE			
Option 1: Partial relocation of workload (includes portion of Pantex Plant Option 1)	1985	216	Existing facilities, Current Criteria applied only to new construction
Option 2: All-new Plant (complete relocation of workload)	1993-1996	1488	Enhanced Goals for new construction
HANFORD SITE ALTERNATIVE			
All-new Plant (complete relocation of workload)	1993-1996	1552	Enhanced Goals for new construction

construction in 1983, and a new central power plant for heating and cooling is proposed to start construction in 1985 to replace the current gas-fired facility. One replacement facility has an indefinite start date.

- Pantex Plant Alternative Option 2 - Major Upgrade. This option would upgrade the entire plant to meet Current Criteria applicable to design of new construction. This option assumes the prior completion of Option 1 described above. It proposes additional new construction and refurbishment of existing facilities. Many existing facilities would be replaced by new construction or modified to accommodate less hazardous operations. Upon completion, the entire plant would have improved operational reliability and efficiency compared with Option 1.

- Pantex Plant Alternative Option 3 - Major Replacement. This option would replace essentially all facilities housing high-explosive fabrication and nuclear weapon operations with new structures designed to meet more stringent or Enhanced Goals for operational reliability and mitigation of accidents. This option first assumes the completion of substantial portions of Option 1 described above. Additional new construction would completely replace the facilities in the nuclear weapons operations area and the high-explosives research and development area. Upon completion, the all-new facility would have the highest reliability and operational efficiency as well as the greatest accident mitigation features of the first three Pantex Plant options.

- Pantex Plant Alternative Option 4 - Continue Operations in Existing Facilities. This option assumes continuation of current operations in only the existing facilities and those new facilities already under construction by the end of 1982.

B. The Iowa Army Ammunition Plant Alternative

The Iowa Army Ammunition Plant near Burlington, Iowa, is now operated for the U.S. Army to produce conventional munitions for the military. Because a portion of this plant was used from 1947 through 1975 by predecessors of the Department of Energy for nuclear weapons operations, existing special function facilities, similar to those at the Pantex Plant, are being considered for reuse.

This Alternative includes two options described below that represent either partial relocation or total relocation of the Pantex Plant operations. Both options assume common use of as many support facilities as would be practicable under a joint management agreement between the U.S. Army and the Department of Energy.

- Iowa Army Ammunition Plant Alternative Option 1 - Partial Relocation to Formerly Used Plant Facilities. This option assumes the reuse of facilities at the Iowa Army Ammunition Plant to accommodate about 25 percent of future workloads. Replacement facilities would be required for the Army if the Department of Energy reacquired the nuclear weapons operations facilities. About 75 percent of the workload would be accommodated at the Pantex Plant in existing facilities and the new facilities already under construction in 1982.

- Iowa Army Ammunition Plant Alternative Option 2 - Complete Relocation to New Plant. The all-new plant is assumed to be of the same conceptual design as proposed for the all-new plant option at the Pantex Plant (Pantex Plant Alternative, Option 3). Construction would be in a currently undeveloped portion of the Iowa Army Ammunition Plant site. The Pantex Plant, including the new facilities already under construction, would continue to be used until the new plant could be built; then the Pantex Plant would be closed.

C. The Hanford Site Alternative

The Hanford Site Alternative assumes building an entirely new plant on the Department of Energy's Hanford Site near Richland, Washington, with relocation of all nuclear weapons operations from the Pantex Plant. The new construction is assumed to be of the same conceptual design as proposed in the Pantex Plant Alternative, Option 3. Related support facilities also would have to be constructed at the Hanford Site, as no such facilities currently exist there. The Pantex Plant, including the facilities already under construction, would continue to be used until the new plant could be built, after which the Pantex Plant would be closed.

D. Termination of Operations at the Pantex Plant

Termination of operations at the Pantex Plant by the Department of Energy is defined to provide a basis for evaluating the impacts in the Amarillo area that would result from implementing the Iowa Army Ammunition Plant Option 2 or the Hanford Site Alternative that include closing the Pantex Plant.

IV. ENVIRONMENTAL IMPACTS

The major findings presented in the Environmental Impact Statement are summarized here for the alternatives and their options. The environmental impacts of the alternatives are categorized into four major areas: impacts from normal plant operation, risk to the public from potential plant accidents, impacts from directly related transportation operations, and impacts from construction.

A. Environmental Effects from Normal Operation

1. Pantex Plant Alternative, All Options

Studies of the environment in and around the Pantex Plant, which has operated for more than 30 years, found no significant accumulations of pollutants (including radioactive materials), no significant adverse effects on air or water, and no significant adverse impacts on the use of surrounding lands. None would be expected from normal operations under any option.

Current and future operations at the Pantex Plant under Options 1, 2, or 3 have low potential for adverse impacts because of improved waste management procedures and other routine operations that generate pollutants.

No radioactive wastes are now disposed of at the Pantex Plant site and none would be under any option. Radioactively contaminated materials and soil are compacted in metal drums and are sent offsite for disposal or storage. A few containers of radioactive residue from cleanup of military accidents with nuclear weapons at other locations are still being held at the Pantex Plant pending decisions on their offsite destination. Soil with low levels of contamination or suspected of having contamination associated with retrieval of the stored nuclear weapons accident residue is being packaged for shipment to an offsite radioactive waste disposal site.

An epidemiology study revealed no indication of unusual cancer mortality patterns in counties near the Pantex Plant or any effect attributable to the Plant.

Special sampling studies of surface water and sediments found no significant accumulation of high explosives or other pollutants. Subsurface soil samples did not contain any significant contaminants. No important changes in quality of ground water and no indications of contamination were found by studying analyses dating back to 1942. All current and future discharges of liquid wastes are onsite and conform to State of Texas permit requirements. If significant contaminants were present, geohydrologic conditions in the area preclude any movement of the contaminants from the land surface to ground water.

Projected water needs for future operation of the Pantex Plant are less than 1 percent of the total expected for Carson County. No significant impact on water availability has occurred from past use and none would be expected.

Nonradioactive air emissions associated with routine operations are not considered significant for any option. All emissions are well within limits of Federal and State air quality standards and would continue to be so under any option. Radioactive emissions from routine operations include depleted uranium and tritium. These emissions do not result in any detectable increment of airborne concentrations or measurable doses above natural background beyond the Plant boundary. Theoretical calculations of potential maximum doses from expected future emissions show they are negligibly small fractions of those from natural background.

Agricultural land use in the surrounding areas has not been and is not expected to be impacted by normal operations at the Pantex Plant. More than 80% of the plant site is leased for agricultural use.

The availability of energy resources is considered adequate for current and projected needs at the Pantex Plant.

The Pantex Plant has no known endangered or threatened species as listed by the U.S. Fish and Wildlife Service. There are no pollutants that would pose any significant concern for wildlife. There are no archeological or historic sites listed on the National Register of Historic Places at the Pantex Plant. An archeological survey of the site identified 42 prehistoric Indian Camps and 3 farmstead sites, but none would be impacted by proposed construction.

The permanent work force increases associated with any option are no more than 200 for the Amarillo area and would pose no adverse impacts. The combined payroll (basic and nonbasic) and purchases associated with the current Pantex Plant operations are about $106 million a year; the expansion would increase area retail sales by 0.3 percent.

2. Iowa Army Ammunition Plant Alternative, Both Options

If a partial or total relocation of the workload from the Pantex Plant to the Iowa Army Ammunition Plant were to occur, the environmental impacts of normal operation at the new site would be similar to the impacts of normal operation at the Pantex Plant under Pantex Plant Options 1, 2, or 3. Therefore, it is expected that the increase in total routine emissions from the Iowa Army Ammunition Plant resulting from either option will be small.

The largest impacts of either partial or total relocation of the workload to the Iowa Army Ammunition Plant would be socioeconomic in nature. The permanent work force would increase by about 1000 and 2600 workers with annual payrolls (basic and nonbasic) of $37 to $96 million, with partial or total relocation, respectively. Complete relocation would result in the loss of a comparable number of jobs and economic input in the Amarillo area.

3. Hanford Site Alternative

If the total relocation of the workload from the Pantex Plant to the Hanford Site were to occur, the environmental impacts of routine operations at the Hanford facility would be no greater than those projected under the Pantex Option 3. The Hanford Site proposed construction area is considerably more remote than either the Pantex Plant or Iowa Army Ammunition Plant proposed construction area and allows more atmospheric mixing and dispersion to occur before the small quantities of pollutants reach the site boundary. The impacts of routine air emissions are not considered significant. Adequate water is available from the Columbia River and no significant changes in surface or ground water will occur if relocation to the Hanford Site occurs. Any solid radioactive wastes produced would be disposed of at current waste disposal facilities at the Hanford Site.

The largest impact of complete relocation to an all-new plant at the Hanford Site would be socioeconomic in nature because the permanent (basic) work force would decrease by about 2,400 workers at the Pantex Plant and increase comparably at the Hanford Site.

B. Risks from Potential Plant Accidents

The only accidents that were found to be credible and that could have a significant impact on the environment were those that could release radioactive materials beyond the plant site and result in radiation exposure to the general public. Accidental detonation of conventional high explosives was found to be the only significant mechanism for dispersing substantial quantities of radioactive material beyond the Plant boundaries. The evaluation of the likelihood of such potential accidents focused on credible events that could initiate accidental detonations.

Nuclear detonation is not a credible accident at any Alternative site or during Department of Energy transportation operations because of fail-safe and redundant protective systems.

Many other types of accidents were evaluated that were found not to be credible or found not to have the potential for significant environmental impact. For example, spills of process chemicals or fuel would be relatively small, would be contained within the plant site, and could be cleaned up with no long-term effects. Potential accidents involving only conventional high explosives with no radioactive materials are not significant in terms of risk to the environment or the general public. The airborne releases from such accidents would be no different than those from the routinely conducted test detonations.

A summary of maximum risks from environmentally significant potential accidents is presented in Table II. Indicators of both the maximum likelihood of such accidents occurring and the maximum consequences that would result are given for each of the Alternatives and Options. The first two columns include probabilities, or chance of occurrence, for (1) any radioactivity-releasing accident and (2) the chance that the maximum release accident would occur in conjunction with the worst-case wind direction. The last two columns give indications of the maximum consequences that would be associated with the maximum release

TABLE II

SUMMARY OF RISKS OF MAXIMUM CONSEQUENCES

Alternative/Option	1. Overall Chance of Occurrence of any Plutonium-Releasing Accident (chance per year)*	2. Combined Chance of the Maximum Release Accident Occurring and Wind Being Toward Largest City (chance per year)**	3. Maximum Number of Possible Eventual Cancer Deaths Attributable to Maximum Release Accident with Likelihood Given in Column 2 (number)***	4. Upper Limit on Costs to Clean Up Contamination from Maximum Release Accident (millions of 1981 dollars)+
Pantex Plant Alternative				
Option 1 - New construction	1 in 7,900	1 in 2,600,000	68	890
Option 2 - Major upgrade	1 in 7,300	1 in 2,600,000	68	890
Option 3 - Major replacement	1 in 22,000	1 in 2,600,000	68	890
Option 4 - Existing facilities only	1 in 9,700	1 in 2,600,000	68	890
Iowa Army Ammunition Plant Alternative				
Option 1 -Partial relocation (risk in Iowa only, Pantex Plant Option 4 gives risk in Texas)	1 in 59,000	1 in 20,000,000	69	740
Option 2 - All new Plant	1 in 53,000	1 in 4,200,000	69	740
Hanford Site Alternative				
All new Plant	1 in 1,000,000	1 in 16,000,000	1	21

*This is the combined overall chance of any one of the three types of credible initiating events (aircraft crash, tornado, or operational) resulting in the dispersal of plutonium by an accidental detonation of conventional high explosives.

**This is the chance per year of plant operation that the accident releasing the largest amount of plutonium would occur and that the wind would be blowing in the direction of the largest metropolitan area. This would result in the largest number of people being exposed and would result in the largest number of eventual cancer cases. It is the probability of occurrence of the maximum release accident multiplied by the fraction of the time the wind blows in the direction of Amarillo for the Pantex Plant Alternatives, Burlington for the Iowa Army Ammunition Plant Alternatives, and Richland for the Hanford Site Alternative.

***This is the total number of cases of lung, liver, and bone cancer that might occur after latency periods of 5 to 20 years in the potentially exposed populations as a result of inhaling plutonium dispersed by the maximum release accident and assuming the wind direction toward the largest metropolitan area as indicated for Column 2. All cases of these types of cancer are assumed to result in death because cure rates are low. These numbers may be compared to the normally expected number of deaths from the same three types of cancer from all other causes. In the Amarillo, Texas, area, 4,900 such cancer deaths would be normally expected from all other causes in the 142,000 population potentially affected by the maximum release accident; in the Burlington, Iowa, area, 1,180 such cancer deaths would be normally expected in a population of 34,400, and in the Richland, Washington, area, 4,100 such cancer deaths would be normally expected in a population of 119,000.

+These are the highest estimated costs for removal of contamination from structures, vegetation, and soil, and other measures necessary to assure that the dose guidelines for transuranium contamination in the environment proposed by the Environmental Protection Agency would be met.

accident for which the probability was given in column 2. The maximum consequence indicators are (column 3) the maximum number of fatal cancer cases that might be expected and (column 4) the maximum costs of cleaning up the land areas that could be contaminated.

The maximum number of eventual fatal cancer cases that might occur after latency periods of 5 to 20 years are given as an upper limit on the risk of maximum consequences to society. It can be compared with the number of cancer deaths expected from all other causes as given in the notes in the table for each location. No member of the public would receive sufficient exposure to result in any short-term effects. The maximum exposed individual that might be near a plant boundary where the exposures were calculated to be the highest would have an annual chance of about 1 in 17 million of eventually dying of cancer from any potential accident associated with any of the alternatives. This upper limit individual risk may be compared with the overall United States average chance of death from all other types of accidents, which is 1 chance in 2000 per year.

Specific aspects of accident risks are discussed below.

1. Pantex Plant Alternative

Credible events that could lead to an accidental detonation of high explosives resulting in dispersal of radioactive materials include an aircraft crash, a tornado, and an operational accident in the cases of Options 1 and 4. The strength of new structures proposed under Options 2 and 3 would make it impossible for a tornado to lead to such an accident. Aircraft crashes are an important component of the overall likelihood of such an accident for any of the options. Operational accidents have the smallest chance of occurring, about one chance in a million per year of plant operation.

A significant effort to identify additional mitigating measures that would further reduce the overall risk from accidents that could release radioactivity to the environment is focused on reducing the likelihood of aircraft crash. This is because the analysis showed that, while overall risks are low, potential aircraft crashes are the largest portion of the overall likelihod and they have the potential for the largest consequences. The Department of Energy has started and will continue to work with the Federal Aviation Administration to identify and implement measures that would reduce the likelihood of an aircraft crash into the plant without adversely affecting normal air traffic. Other measures being considered by the Department of Energy include the modification or rebuilding of structures to reduce or eliminate off-site consequences should an aircraft crash occur; however, this approach appears to be much less cost-effective.

2. Iowa Army Ammunition Plant Alternative

Credible events that could lead to a release of radioactive materials by an accidental detonation of conventional high explosives include only aircraft crashes or an operational accident for either of the Options. Under Option 1, Partial Relocation, the risks listed in the table are only those that would be added in Iowa. The potential risks from accidents associated with the continuing operations at the Pantex Plant would be those given for the Pantex Plant Alternative Option 4. Aircraft crash risk is the largest part of the overall chance of any plutonium-dispersing accident for both options. Operational accidents have the smallest chance of occurring.

3. Hanford Site Alternative

The only credible event that could lead to a plutonium-dispersing accident would be an operational accident. Aircraft crashes were found not to be credible events that could lead to an accidental detonation because the flight frequency over the area is lower than either of the other sites and all facilities are assumed to be constructed so as to limit the consequences should an aircraft crash occur.

C. Impacts from Directly Related Transportation Operations

Evaluation of transportation operations directly related to nuclear weapons operations included (1) transportation of nuclear weapons or their components in special Safe-Secure Trailers and Safe-Secure Railcars, (2) transportation of certain components not containing plutonium in exclusive-use aircraft, and (3) shipment of conventional high explosives and hazardous chemicals by commercial carriers.

These modes were examined for impacts resulting from normal operations that include vehicular emissions and possible radiation doses to the public. The potential risk to the public from transportation accidents also was evaluated.

1. Pantex Plant Alternative

The environmental impacts of normal transportation, including normal exhaust emissions, represent less than 1 percent of the impacts from comparable vehicular traffic in the Amarillo area. Radiological impacts of Pantex Plant-related normal transportation are limited to radiation doses received by individuals in the vicinity of the shipments. The maximum possible annual radiation dose is less than one-half of 1 percent of typical annual background.

Two types of transportation accidents that could release radioactive material and result in radiation exposure to the public were found to be credible. The crash of an aircraft carrying tritium-containing components was estimated to have a likelihood of 1 chance in 25,000 per year. The likelihood of a plutonium release from an accident involving the crash of a Safe-Secure Trailer with a loaded fuel tanker truck leading to a long-burning fire was found to be about 1 chance in a million per year on the basis of total distance traveled nationwide. About 5 percent of the travel takes place within 80 kilometers (50 miles) of the Pantex Plant, and the chance of such an accident within that area is about 1 chance in 20 million a year. Mitigating measures are now being investigated to reduce this likelihood still further.

Assuming that the most serious of these low-likelihood accidents occurred and plutonium was released, the consequences to the public would be the potential for up to 38 eventual deaths from lung, liver, and/or bone cancer occurring over the lifetimes of the exposed population of persons. The cost to clean up the contaminated area would range up to $500 million.

Potential transportation accidents involving shipments of conventional high explosives or fuel were found to have possibilities of occurrence ranging from 1 chance in 300 per year (aircraft carrying high explosive), down to 1 chance in 20,000 per year (truck carrying gasoline or diesel fuel). The Pantex Plant-related contribution to overall risks of truck explosives shipments in the United States is no more than 0.01 percent.

2. Iowa Army Ammunition Plant Alternatives

Under Iowa Options 1 and 2, the environmental impacts resulting from normal transportation operations would not be expected to exceed those associated with the Pantex Plant alternative; radiation dose is a function of shipments rather than distance traveled. The risk of transportation accidents would not increase because the distance traveled would approximate that to and from the Pantex Plant assuming all other destinations remained the same.

3. Hanford Site Alternative

Total relocation to the Hanford Site would not increase impacts of normal transportation operations. However, the risk to the general public from transportation-related accidents would be approximately doubled because of the greater distance to be traveled assuming all other destinations remained the same.

D. Impacts from Construction

Any impacts from the proposed construction associated with the various alternatives and their options will be largely socioeconomic. Effects on the environment itself at any of the three locations would be minimal.

1. The Pantex Plant Alternative

Construction work force requirements for the first three options under this alternative could be met locally, and no significant adverse effects on community resources would be expected. The extreme case, total plant replacement (Option 3), would result in peak annual construction payrolls of around $64 million and an increase in retail sales for the area of about 1.9 percent above current totals.

2. Iowa Army Ammunition Plant Alternative

As with the Pantex Plant alternative, no negative impacts resulting from construction are expected with the proposed partial (Option 1) or total (Option 2) relocation of operations to the Iowa Army Ammunition Plant. The extreme case, Option 2, would result in a peak annual payroll of $79 million and an increase in retail sales for the area of about 6.0 percent above current totals.

3. Hanford Site Alternative

No negative impacts are expected with a total relocation to the Hanford Site. Total annual construction payrolls are expected to range between $70 million and $83 million, with retail sales projected to rise around 4 percent above current totals. Labor work force requirements would be met locally, with no migration of workers, because of the recent cancellation of major industrial programs in the area.

E. Comparison of Alternatives

The environmental impacts resulting from normal operations are summarized in Figure 1 for the various alternatives and their options. There are few significant differences between the impacts of those alternatives and the current conditions. The primary differences in impacts are socioeconomic, reflecting the costs and labor requirements associated with the construction efforts.

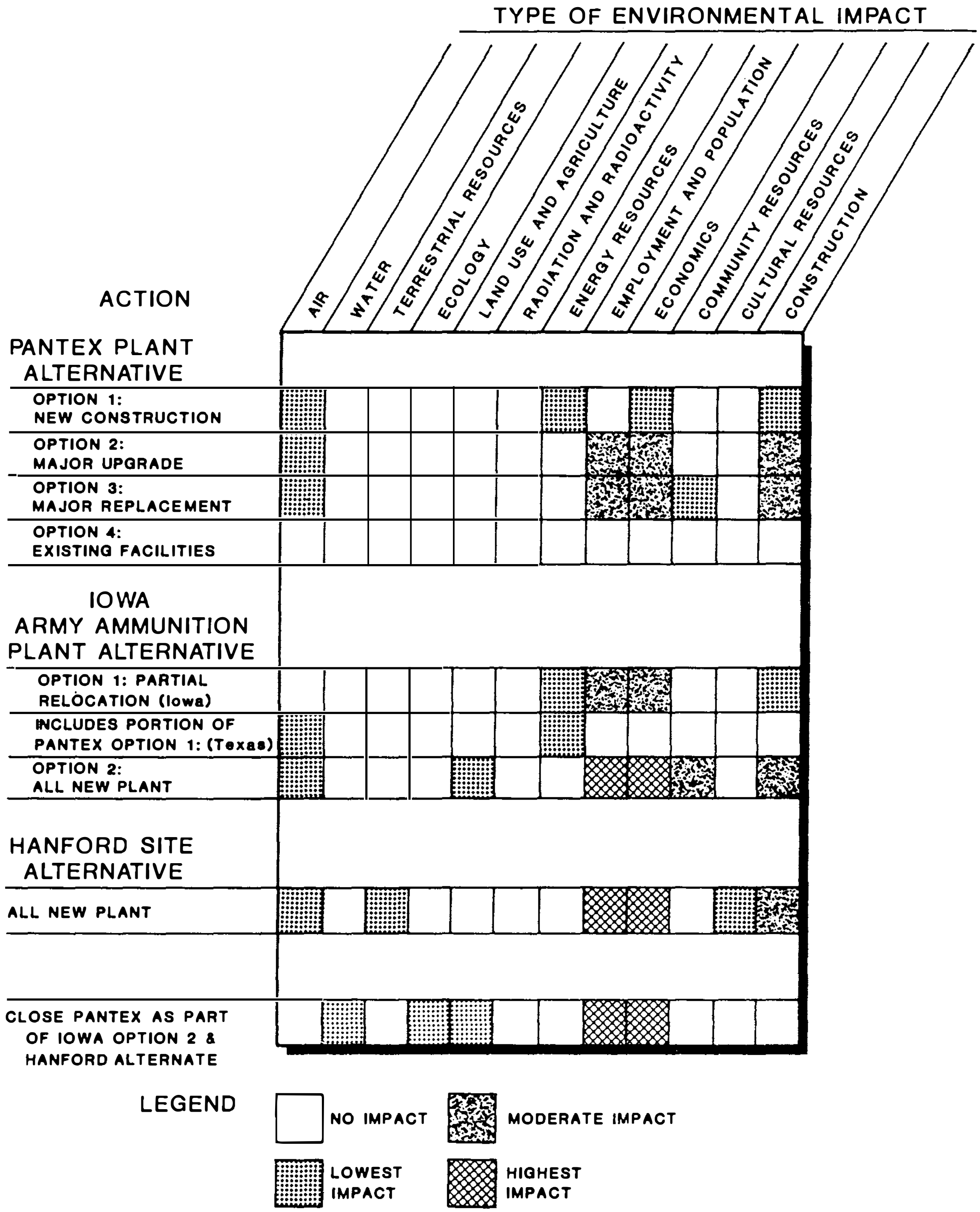


Figure 1. Comparison of environmental impacts from normal operations and construction.

More significant bases for comparison are the potential environmental impacts from accidents and the effect of mitigative measures on risk to the public. Some indicators of likelihood and consequences of maximum release accidents are given in Table II. The overall annual chance of a plutonium-releasing accident is lowest for the Hanford Site Alternative (1 chance in 1 million), intermediate for the Iowa Army Ammunition Plant Alternative (1 chance in 53,000 to 1 chance in 59,000), and highest for the Pantex Plant Alternative (1 chance in 7,300 to 1 chance in 22,000). Maximum consequences to the public or the environment are essentially the same for the Pantex Plant and Iowa Army Ammunition Plant Alternatives in terms of the maximum number of possible eventual cancer deaths or the extent of decontamination that might be required as shown in Table II. Under the Hanford Site Alternative, maximum consequences would be significantly smaller.

The chance of an aircraft crash-induced accidental release is expected to be reduced in the future as a result of implementing additional mitigating measures. Extensive interaction between the Department of Energy and the Federal Aviation Administration has identified a number of specific and conceptual operational, procedural, and system changes that could reduce the number of aircraft operations over or near the Pantex Plant and thereby reduce the likelihood of aircraft crash into Plant facilities. Some of these measures are already being planned for implementation by the Federal Aviation Administration and will contribute to reducing the likelihood of a crash-induced accident related to Amarillo Airport operations without adversely impacting normal airport operations. These measures include improvements to the Amarillo Airport instrument-landing system and changes of certain designated airways. Other measures will be further explored by the Department of Energy and the Federal Aviation Administration that could significantly reduce the likelihood of a crash-induced accident related to enroute overflights without adversely affecting normal air traffic. Initial analysis shows that it may be possible to achieve a reduction in the likelihood of aircraft crash-induced accidents by a factor of 100 or more. This would result in the likelihood of aircraft crash-induced accidents being no more than one chance in a million each year for any of the Pantex Plant options.

The chance of occurrence of transportation accidents is closely proportional to the distance traveled. The Hanford Site Alternative would, at most, double the occurrence probability for accidents that exist for the Pantex Plant or Iowa Army Ammunition Plant locations.

V. PREFERRED ALTERNATIVE

The first three options for the Pantex Plant encompass the range of possible actions currently preferred by the Department of Energy. Features of more than one of these options may be desirable. The largest adverse environmental impacts of the preferred action would result from aircraft crash-induced accidents. The mitigative measures identified in the course of preparation of this Environmental Impact Statement could reduce this risk significantly and are being examined for possible implementation.

1.0 INTRODUCTION

1.1 PURPOSE AND NEED FOR THE PROPOSED ACTION

This Environmental Impact Statement evaluates the impact of continuing operations and constructing additional facilities at the Pantex Plant near Amarillo, Texas, to meet the Department of Energy's continuing responsibilities for nuclear weapons assembly; stockpile monitoring, maintenance, and modifications; and retirements (disassembly) as mandated by Presidential direction and congressional authorization and appropriation. The Environmental Impact Statement analyzes a range of alternatives to the proposed action. The alternatives identified include:

- continued operations and construction of new facilities at the Pantex Plant;
- relocation of some or all of Pantex Plant operations to existing facilities (which would require refurbishing) or new facilities at a formerly used nuclear weapons assembly plant site near Burlington, Iowa;
- relocation of all operations to new facilities at the Hanford Site near Richland, Washington; and
- impact mitigation alternatives.

In 1978 the Department of Energy started to plan construction of specific new facilities at the Pantex Plant to handle an increasing workload. Providing these expanded facilities is the fundamental purpose of the proposed action. These new facilities would be similar to existing plant facilities and would permit increasing nuclear weapons operations. However, they would not change the basic nature of operations carried out at the Pantex Plant for the past 30 years. The new facilities would provide greater operational reliability than that afforded by many of the existing facilities.

Additional new construction to replace or modify outmoded existing structures also is being considered as part of the proposed action. Concepts for such facilities have been developed as part of a comprehensive planning and analysis task initiated in 1980 by the Department of Energy to review the status of the entire Pantex Plant. These continuing planning efforts are evaluating the possibilities and benefits of various types of structures and overall plans for future development of the Pantex Plant. The purpose is to develop plans for the entire plant that would provide for increased workloads, improved operational reliability and efficiency, and additional mitigation of potential accident consequences for the protection of workers, the general public, and the environment. Several of the alternatives discussed in this Environmental Impact Statement are based on the range of approaches being considered by the Department of Energy in its ongoing planning and evaluation process.

This Environmental Impact Statement is part of that evaluation process. It will aid Department of Energy officials in the decisionmaking process regarding modes and locations of continued nuclear weapons operations.

The requirement for the Department of Energy to provide for nuclear weapons operations is provided in Section 91 of the Atomic Energy Act of 1954 as amended (42 U.S.C. 2121). That act authorized the Atomic Energy Commission "to engage in the production of atomic weapons... to the extent that the express consent of the President of the United States has been obtained, which consent and direction shall be obtained at least once each year." The general authority of the Atomic Energy Commission was forwarded to the Energy

Act of 1974 and the Department of Energy Organization Act, respectively. The consent and direction of the President are given each year in a classified Presidential Stockpile Paper (jointly prepared for the President by the Department of Defense, the National Security Council, and the Department of Energy). Each Presidential Stockpile Paper addresses nuclear weapons operations requirements for current and future years. Annual appropriations to carry out the Presidential directives then are provided through the combined action of the House of Representatives, the Senate, and the President. It is the Department of Energy's responsibility to meet the nuclear weapons operations requirements.

1.2 RELATIONSHIP TO OTHER FEDERAL ACTIONS

One major proposed Federal action identified in the Draft Environmental Impact Statement as having potential for cumulative impacts in the Panhandle of Texas was the M-X Missile deployment. At that time, the multiple-shelter-basing concept being considered included part of the Panhandle of Texas. Currently, the United States Air Force is preparing an Environmental Impact Statement for the deployment and peacetime operation of 100 Peacekeeper (M-X) Missiles in existing Minuteman III missile silos. The locations being evaluated are in southeastern Wyoming and Western Nebraska (48FR27123, 1983).

Pursuant to its responsibilities under the Nuclear Waste Policy Act of 1982 (Public Law 97-425), the Department is conducting a program for the disposal of high-level radioactive waste in geologic repositories. As part of this program, the Department has identified two sites in the Palo Duro Basin salt formations in the Texas Panhandle as potentially acceptable sites for the location of a nuclear waste repository. These two sites, in east-central Deaf Smith County and north-central Swisher County, are among nine potentially acceptable sites in six states currently being considered for detailed site characterization before selection of the first repository site. The Secretary of the Department of Energy, pursuant to the Nuclear Waste Policy Act of 1982, is to recommend three of these sites to the President no later than January 1, 1985, for the conduct of detailed site-characterization studies.

1.3 PREPARATION OF THE IMPACT STATEMENT

Preparation of both the Draft and this Final Environmental Impact Statement included public and other agency input. Interested agencies, organizations, and the general public were requested to submit comments or suggestions to help identify significant environmental issues and develop the appropriate scope of the Draft Environmental Impact Statement. The scoping period extended from Publication of the Notice of Intent on April 24, 1981, through June 5, 1981, and included two public scoping meetings held in Amarillo on May 28, 1981 (USDOE 1981B). Fifteen main categories of issues or concerns were identified in either the written comments received or the statements made at the scoping meetings. These categories are summarized in Table 1.3-1 together with the sections of the Environmental Impact Statement where relevant information on the environmentally significant aspects may be found.

The Draft Environmental Impact Statement was issued in December 1982 and a public comment period extended until March 15, 1983. During this time, 45 written communications containing comments were received. In addition to the written comments, working meetings were held with staff of the Federal Aviation Administration and several Texas State Agencies to clarify issues. All of the written communications with comments on the Draft Environmental Impact Statement are contained in Chapter 10 of this Final Environmental Impact Statement. Chapter 10 also contains the Department of Energy responses to the comments. When appropriate, the Department of Energy responses point out sections of the impact statement that were revised in response to the comments.

TABLE 1.3-1

ISSUES RAISED DURING SCOPING PROCESS

Category of Issue or Expressed Concern	Sections of This Document Containing Relevant Information on Significant Environmental Aspects
1. Existing or potential radioactive contamination	2.3.2, 2.3.5, 2.3.6, 3.2.6, 4.1.6, 4.2.4, 8.1
2. Water quality degradation	2.3.2, 3.2.2, 4.1.2
3. Movement of contaminants through ecological pathways	2.3.4, 2.3.5, 3.2.4, 3.2.5.1, 4.1.4, 4.1.5, 4.2.7, 4.2.8, 8.1
4. Cumulative environmental impacts from past or other Federal actions	1.2, 3.2
5. Impacts of potential accidents	2.4, 2.5, 4.2, 4.3
6. Human health impacts or risks	2.3.6, 2.3.12, 2.4.3, 3.2.6, 3.2.12, 4.1.6, 4.1.12, 4.2.6, 4.2.8
7. Water availability	2.3.2, 3.2.2, 4.1.2
8. Impacts on agriculture	2.3.5, 3.2.5, 4.1.5
9. Impacts on wildlife	2.3.4, 3.2.4, 4.1.4
10. Social and economic impacts	2.3.8, 2.3.9, 2.3.10, 3.2.8, 3.2.9, 3.2.10, 4.1.8, 4.1.9, 4.1.10
11. Alternate siting considerations	2.2, 2.2.3
12. Offsite transportation	2.5, 4.3
13. Construction impacts	2.3.3, 2.3.4, 2.3.5, 4.1.1.1
14. Energy use	2.3.7, 3.2.7, 4.1.7
15. National Security Policy	1.1

1.4 GENERAL DESCRIPTION OF DEPARTMENT OF ENERGY NUCLEAR WEAPONS ACTIVITIES

The Department of Energy is responsible for the design and development, testing, manufacture, maintenance, and disassembly of nuclear weapons. Any given weapon program proceeds through a series of stages starting with conceptual design, engineering feasibility, and cost studies. If the weapon is adopted by the military, there will be extensive development and production engineering of fabrication processes, equipment, and facilities. The required numbers of weapons are then produced for the military stockpile. While in the stockpile, some weapons are returned periodically to the Department of Energy from the military for required maintenance and modifications, and others are returned for testing or evaluation to assure reliability. When no longer required by the military, the weapons are retired from the stockpile and disassembled.

The three main types of nuclear weapons operations discussed in this Environmental Impact Statement are (1) production of new nuclear weapons; (2) maintenance, modification, and quality assurance testing of existing nuclear weapons in the military stockpile; and (3) retirement or disassembly of nuclear weapons no longer needed by the armed forces. The terms "nuclear weapons operations" and "workload" are used throughout this Environmental Impact Statement to refer collectively to all three types of operations. These are the operations that now are performed at the Pantex Plant and would be conducted in new facilities at the Pantex Plant or elsewhere under the various alternatives.

A related activity now conducted at the Pantex Plant is research and development work on high explosives in support of weapons design and development and production engineering for the Department of Energy. This activity also would be carried out in the future at the Pantex Plant or in conjunction with one of the other alternatives.

1.4.1 Nuclear Weapon Production

Producing nuclear weapons involves the fabrication of conventional high-explosive components. This starts with raw chemical high explosives and other materials, such as plastic binders, in a granular or powdered form supplied by chemical manufacturers and shipped by common carrier. These materials are mixed, heated, and pressed into various solid shapes. The shapes are machined to final dimensions. Quality and tolerances are monitored by testing (including radiography), inspections, and test detonations of high-explosives samples. Most test detonations involve only conventional high explosives; a small number include depleted uranium. Scraps and unacceptable pieces of high explosives are burned.

In the next phase, chemical high-explosive parts are assembled with nuclear material components and encased in a protective shell. The nuclear material components are received in sealed or encapsulated form for assembly. They are shipped from other manufacturers in special Department of Energy vehicles designed to safely transport nuclear materials and classified components. Work with bare (or uncased) high explosives is carried out with many safety precautions because it is more susceptible to being accidentally detonated before being placed in the protective shell. The operations involving uncased high explosives, together with plutonium-containing nuclear material components (which also may include enriched uranium and tritium), are performed in an "assembly cell." Assembly cells are special structures designed to mitigate the consequences of an accidental detonation of the high explosive, including both physical blast effects and dispersion of radioactive materials. Once the high explosive/nuclear material component unit is enclosed in a protective shell, it is called a "physics package."

The remaining operations include adding other components to the cased physics package and placing the completed unit into a bomb case or warhead. All of these additional components are supplied by other manufacturers. Extensive quality assurance checks and testing are carried out at many points in the sequence. These operations involving cased nuclear explosive assemblies or physics packages are carried out in "assembly bays." The potential for an accidental detonation during these operations is less than in the operations described earlier where bare high explosive is involved. Nonetheless, assembly bays are intended to provide mitigation of consequences from an accidental detonation should one occur. They would limit the physical blast effects (such as overpressures and flying debris) that could injure workers or induce additional explosions in adjacent work areas.

Weapons are delivered to or returned from the military in special Department of Energy vehicles called Safe Secure Trailers or Safe Secure Railcars.

1.4.2 Weapons Maintenance, Modification, and Reliability Evaluation Programs

Maintenance and modification of weapons in the military stockpile require replacement of components. For these purposes, disassembly only proceeds far enough for access to the particular components. After replacement, the weapon is reassembled, given quality assurance tests, and returned to the military.

Reliability assurance programs for nuclear weapons from the military stockpile include both laboratory tests of weapons and preparation of special flight test units for the military. The laboratory tests are performed on a statistically selected number of nuclear weapons. Inspections and safety checks are performed to determine if any flaws exist. After disassembly, each component is subjected to a series of functional reliability tests. Testing of some components includes destructive testing to determine how a component behaves. Nondestructive testing is performed with advanced instruments to detect hidden flaws. Finally, the weapons are reassembled, given quality assurance tests and inspections, and returned to the military stockpile.

The preparation of flight test units follows the same pattern as laboratory tests through the disassembly stage. Then actual nuclear components are replaced by simulated components and the weapon is reassembled with instrumentation to measure the weapon components' response to dynamic tests. This reassembled device is called a joint test assembly and is given all quality assurance tests and inspections that a real weapon receives. When the joint test assembly passes all inspections, it is delivered to the Department of Defense to be tested at a military range.

1.4.3 Weapons Retirement

Weapons retirement is the complete disassembly of a weapon no longer desired in the military stockpile. The disassembly proceeds beyond that described for maintenance and modification. The high-explosive components are separated from other components and then disposed of by burning. The nuclear material components are returned to other Department of Energy facilities for reclamation or recycling. The other weapon components are disposed of by returning them to other manufacturers for refurbishment, salvage, or ultimate disposal.

1.4.4 High-Explosives Research and Development Activities

This research and development work is to prepare high explosives that have specific performance characteristics and other desirable physical, chemical, and thermal properties for use in nuclear weapons. No nuclear material components are involved. This research requires the synthesis of new high explosives by chemically processing raw materials available from commercial sources. These new explosives then are subjected to a variety of tests and formulation processes to determine their compatibility with fabrication processes. Safety tests are performed to determine detonation sensitivity under various conditions. Explosives are tested for machining characteristics and explosive performance.

1.5 SAFEGUARDS AND SECURITY FEATURES

The objectives of the Department of Energy Safeguards and Security program are to protect the health and safety of the public and to assure program continuity. Protection is afforded against intentional threats or acts of theft.

The Department of Energy weapons production facilities are protected in accordance with the safeguards and security requirements of USDOE Orders:

- DOE Order 5630.1: Control and Accountability of Nuclear Material,
- DOE Order 5630.2: Control and Accountability of Nuclear Materials, Basic Principles,
- DOE Order 5632.1: Physical Protection of Classified Matter, and
- DOE Order 5632.2: Physical Protection of Special Nuclear Material.

The Safeguards and Security program is an integrated plan intended to prevent a breach of security. Furthermore, the program is designed such that the consequences of a security breach would be minimized.

The Safeguards and Security program for the Pantex Plant is specifically designed to prevent loss, theft or diversion of materials; to protect classified information, and to protect against damage theft, loss, or other harm to government property. The Safeguards and Security function includes: physical security, material control and accountability, and emergency preparedness.

Specific details of the Safeguards and Security program as it would apply to the proposed action are classified. The program is continuously evaluated to assure adequacy.

2.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This chapter has four main objectives.

- To provide background information on the Pantex Plant to establish a context for criteria being considered as a basis for facility designs included in some of the alternatives (Section 2.1).
- To identify the alternatives considered in this Environmental Impact Statement (Section 2.2). These descriptions include the major assumptions for each alternative and form the basis for analysis of impacts.
- To present conclusions regarding environmental impacts of Normal Operations and Construction, Potential Accidents, and Related Transportation (Sections 2.3, 2.4, and 2.5). These summary conclusions are given in comparative form to highlight issues and provide a basis for judging significant differences between the alternatives. The conclusions are based on the more detailed information found in Chapter 3, which covers descriptions and analyses of existing environmental conditions, and Chapter 4, which covers evaluations of environmental impacts expected in the future from each of the alternatives.
- To identify the Department of Energy's preferred alternatives and mitigating measures identified during the course of the study (Section 2.6).

2.1 BACKGROUND INFORMATION

2.1.1 Background Information on Existing Pantex Plant Facilities

The 3,700-hectare (9,100-acre) Pantex Plant is located in the Panhandle of Texas in Carson County about 27 kilometers (17 miles) northeast of downtown Amarillo, and 16 kilometers (10 miles) west of downtown Panhandle (see Figures 2.1.1-A and 2.1.1-B). It was first used in 1942 by the Army Ordnance Corps for loading conventional ammunition shells and bombs during World War II. In 1950 the Atomic Energy Commission started rehabilitating portions of the original plant and building new facilities for fabricating chemical high explosives used in nuclear weapons and for final assembly of nuclear weapons. During the 1960's and 1970's similar operations from facilities at Clarksville, Tennessee; Medina, Texas; and Burlington, Iowa, were consolidated at the Pantex Plant. During the entire history of the Pantex Plant, new construction has been undertaken periodically to provide additional facilities or to upgrade or replace outmoded structures.

The major operational areas and facilities include

- the High-Explosives Fabrication and Weapon Assembly/Disassembly facilities, where the operations described in Sections 1.4.1, 1.4.2, and 1.4.3 are carried out;
- the Temporary Holding facilities, where high-explosive supplies are kept and where weapons are temporarily held;
- the High-Explosives Research and Development Area, where the operations described in Section 1.4.4 are carried out;

Figure 2.1.1-A. Pantex Plant, view to the northwest.

- the Firing Sites, where quality assurance test detonations are carried out including those involving depleted uranium, and where experimental detonations related to research described in Section 1.4.1 and 1.4.4 are performed;
- the Burning Ground, where high explosives wastes are disposed; and
- the Water Supply and Sewage Treatment facilities.

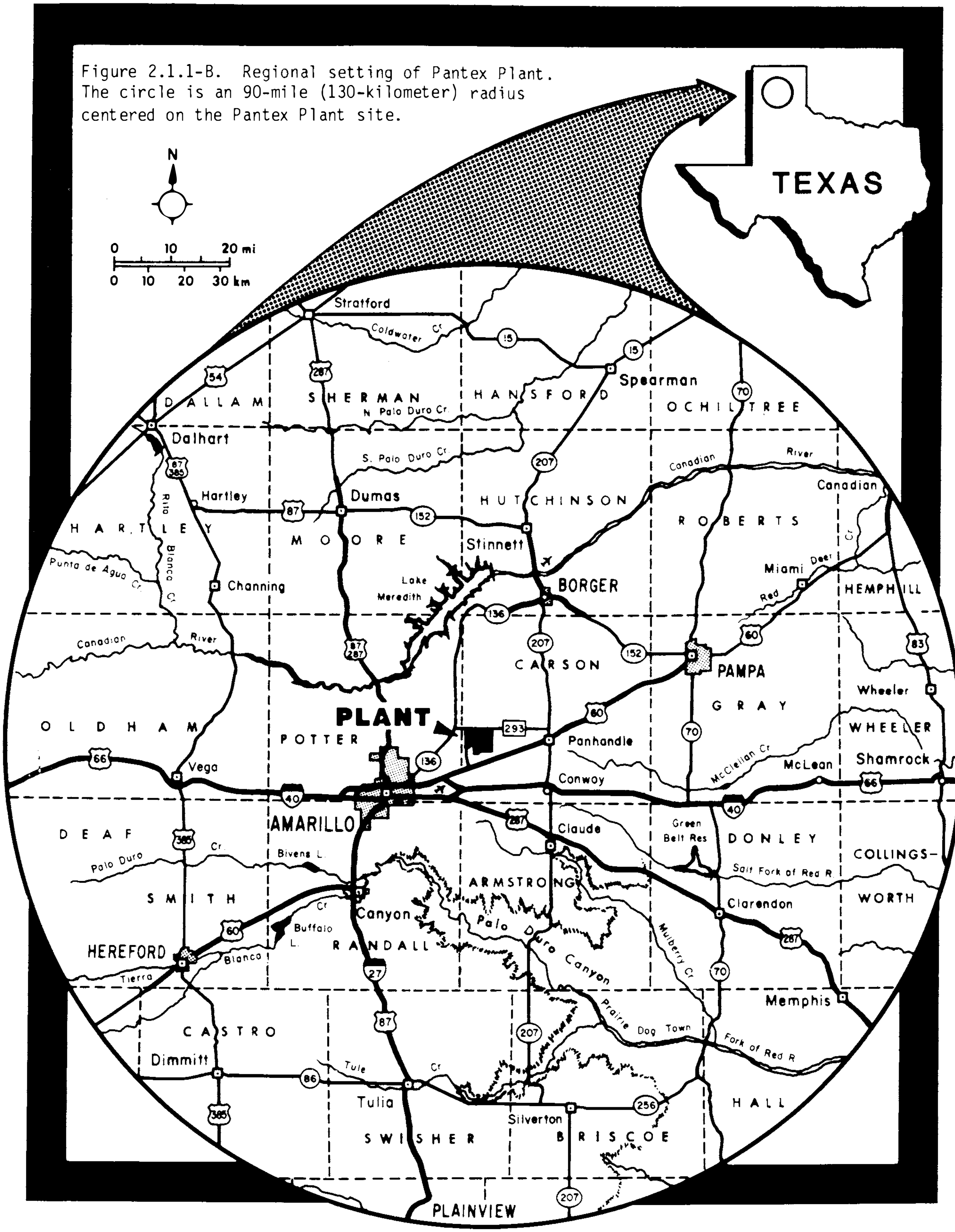


Figure 2.1.1-B. Regional setting of Pantex Plant. The circle is an 90-mile (130-kilometer) radius centered on the Pantex Plant site.

Special facilities at the Pantex Plant include Assembly Cells, Assembly Bays, and Igloos. Additional information on the existing facilities is in Section 3. Assembly cells are where the chemical high-explosive materials and nuclear materials are joined to form a physics package (Section 1.4.1). The existing assembly cells are specially designed structures called "Gravel Gerties." Assembly cells are designed to mitigate the consequences of an accidental detonation of the high explosive. The Gravel Gertie would limit the physical blast effects, such as overpressures or flying debris, that could injure workers or induce additional explosions in adjacent work areas. The gravel roof is intended to limit potential release of radioactivity by filtering out much of the nuclear material that could be dispersed by the detonation of the chemical high explosive.

Assembly bays are where the physics packages from the assembly cells are put together with the rest of the weapon (Section 1.4.1). The Assembly Bays include two structure types that differ significantly in their capability to mitigate the potential consequences of an accidental detonation. Bays of the first type are rooms in World War II munitions buildings adapted by constructing reinforced concrete separating walls. These bays are housed in buildings with exterior walls designed to blow out and relieve blast pressure without structural collapse of the building. The second type was constructed in the 1960's. These are reinforced-concrete rooms separated by earth and have concrete slab roofs covered by earth. They are designed to withstand fully the effects of an accidental detonation in an adjacent work place.

Igloos include several types of earth-covered bunker structures where high-explosive supplies are kept and where weapons are held temporarily.

2.1.2 Background on Design Features Included in the Alternatives

Two of the biggest differences between the types of facilities incorporated in the definitions of the various alternatives are the degree of improved operational reliability they would provide and the degree to which they would reduce the likelihood of occurrence or mitigate the consequences of accidental detonations of high explosives. This section provides the basic descriptions of the features incorporated in existing structures or assumed to be incorporated in the proposed structures. The structural design differences are the principal reason for the differences in the amount and cost of construction associated with the various alternatives.

Three levels of operational reliability and mitigation of potential accidents are encompassed by the various alternatives.

- Existing Facilities--characterized by the capabilities of existing facilities at the Pantex Plant and the Iowa Army Ammunition Plant.

- Current Criteria--characterized by the expected capabilities of new facilities designed to meet the Department of Energy's current criteria applicable to new construction.

- Enhanced Goals--characterized by the expected capabilities of new facilities designed to meet enhanced goals for operational reliability and accident mitigation. The goals were identified as part of the Department of Energy's planning process and are being considered for future projects based on feasibility and benefits derived (Section 1.1). These goals are more stringent than those required by the current criteria and in most cases involve significantly higher costs for replacement facilities than current criteria.

The significance of each of these levels is discussed briefly below.

Existing Facilities

Many of the structures at the Pantex Plant and the Iowa Army Ammunition Plant were designed and built during World War II for conventional munitions operations. The criteria used at that time addressed the safety aspects of conventional high explosives. They provided features to prevent propagation of accidental explosions in other high-explosive work areas and to limit injury from blast pressure or flying debris in nonexplosive operations areas, plant boundaries, or major personnel concentration areas. These structures were not built to protect workers within the structure or specifically to contain the release of radioactive materials in the event of an accident.

The facilities built during the 1950's and 1960's were built to increase operational reliability and provide additional accident mitigation. These facilities addressed additional factors applicable to nuclear weapons operations and were designed to limit the effects of an accident so that operations could continue without disruption in the rest of the plant. Examples include the Gravel Gertie Assembly Cells, with capability for limiting release of radioactive material dispersed by an accidental detonation, and the Earth-Covered Assembly Bays, with the capability for protecting workers in one bay against blast pressures from an accidental detonation in an adjacent bay.

Current Criteria

The Current Criteria contain specific operational reliability design requirements for structures housing certain classes of operations involving high explosives (USDOE 1981D). These requirements prevent disruption of operations after an accident and result in improved plant safety. These requirements are

(1) preventing propagation of accidental explosions,

(2) preventing fatalities or injuries to workers by limiting pressure pulses in regularly occupied work areas outside the room in which an accidental explosion occurs,

(3) preventing fatalities or injuries to workers by limiting structural collapse or flying debris in regularly occupied work areas outside the room in which an accidental explosion occurs,

(4) limiting the amount of radioactivity that could be released from an Assembly Cell in which an accidental explosion occurs, and

(5) providing special protection for Assembly Cells and Assembly Bays to prevent the initiation of an accidental detonation by a tornado or earthquake.

Most of the Current Criteria design requirements were refinements of designs used for the facilities built during the 1950's and 1960's. As a result, most of these existing facilities meet some aspects of the Current Criteria.

Enhanced Goals

Some design goals providing operational reliability features, in addition to Current Criteria, are now being evaluated by the Department of Energy for feasibility and benefits as part of the ongoing planning and evaluation process described in Section 1.1. These enhanced goals address the same five principal requirements described for the Current Criteria but would provide higher levels of operational reliability and accident mitigation (MHSM 1979C). The Enhanced Goals would protect people from pressure pulses, structural collapse, and flying debris in all areas outside the room of occurrence, in addition to the regularly occupied work areas, as required by the Current Criteria. The Enhanced Goals would require Assembly Bays, as well as Assembly Cells, to limit the release of radioactivity that could be dispersed by an accidental detonation. Finally, the Enhanced Goals would require more types of operations involving high explosives to be housed in structures providing the highest level of overall reliability and greatest protection from potential accidents.

2.2 DESCRIPTION OF ALTERNATIVES

Three basic alternatives are considered in this environmental impact statement. These alternatives include possible actions that would meet the requirements both for continued operations and for new facilities to accommodate established increased workload schedules. They provide a range of options for levels of improvement in reliability, safety, and environmental protection. These three alternatives encompass (1) continued operation and construction of new facilities at the present Pantex Plant, which currently is considered the preferred alternative, (2) resuming operations at the formerly used Iowa Army Ammunition Plant, and (3) relocating all operations to the Department of Energy's Hanford Site. A consideration treated as part of Alternatives 2 and 3 is terminating all Department of Energy's nuclear weapons operations at the Pantex Plant.

The alternatives are identified by the associated site name, as shown in the first column in Table 2.2-1, Summary of Alternatives. The table summarizes the major features of the alternatives, including various options within each alternative, the approximate period of construction, the total estimated construction costs, and the design goals for operational reliability and mitigation of impacts on the environment and workers if an accident were to occur. All estimated construction costs are given in constant 1981 dollars. This allows the economic implications and relative feasibilities of the alternatives to be compared directly. Actual expenditures in future years may be higher because of inflation. Additional detail on the definitions of the alternatives and cost estimating is provided in Schnurr 1982B.

The all-new plant options under the Iowa Army Ammunitions Plant and Hanford Site Alternatives are assumed to be designed to meet the Enhanced Goals for operational reliability. This was considered appropriate because the incremental difference in total cost between constructing an all-new plant (as opposed to major replacement of key facilities such as in Pantex Plant Option 3), based either on Current Criteria or Enhanced Goals, is relatively small. Consequently, assuming the options based on Enhanced Goals would be the most reasonable basis for analysis. This cost consideration between the two levels of operational reliability does not necessarily hold for the Pantex Plant Option 3, because there are other existing facilities that would continue to be used.

TABLE 2.2-1

SUMMARY OF ALTERNATIVES

Action	Estimated Dates for Completion of Construction	Estimated Cost ($ Millions) (1981 values)	Operational Reliability Design Level*
PANTEX PLANT ALTERNATIVE			
Option 1: New construction of specifically identified facilities	1982-1987	198	Existing facilities and Current Criteria applied to new construction only
Option 2: Major upgrade of existing facilities including significant new construction	1991-1993	664	Current Criteria applied to upgrading and new construction
Option 3: Complete replacement of certain major plant facilities with new construction	1993-1996	1239	Enhanced Goals for new construction
Option 4: Existing facilities and facilities currently under construction ("No Action")	--	53	Existing facilities, Current Criteria applied only to facilities currently under construction
IOWA ARMY AMMUNITION PLANT ALTERNATIVE			
Option 1: Partial relocation of workload (includes portion of Pantex Plant Option 1)	1985	216	Existing facilities, Current Criteria applied only to new construction
Option 2: All-new Plant (complete relocation of workload)	1993-1996	1488	Enhanced Goals for new construction
HANFORD SITE ALTERNATIVE			
All-new Plant (complete relocation of workload)	1993-1996	1552	Enhanced Goals for new construction

*See Section 2.1.2.

2.2.1 Pantex Plant Alternative

The Pantex Plant Alternative includes four options. The first three options provide various levels of operational reliability. The fourth option assumes continuing operations in the existing facilities and that no new construction is begun after 1982. It is defined as the "No Action" alternative for the purpose of this environmental impact statement. The cost indicated for this option is associated with the construction projects that currently are underway.

2.2.1.1 Option 1--New Construction

Option 1 assumes continuing operations in existing facilities and construction of 11 new projects. These projects are expected to be constructed in the period from 1982 through 1988 as shown in Table 2.2.1-1. These projects are intended to meet the Current Criteria. Existing structures will continue to be used and would not necessarily meet all the requirements of the Current Criteria for new construction. The total cost for the 11 projects was estimated for the Draft Environmental Impact Statement as $196 million. Estimates for the construction projects as of June 1983 show an overall decrease of about 9 percent in this cost. The difference is not large enough to warrant reevaluation of socioeconomic impacts. Therefore, the $196 million is used for this Final Environmental Impact Statement. Razing the old buildings would cost approximately $2 million, bringing the total cost for this option to $198 million.

Projects 1 through 5 and Project 10 are nuclear weapons operations facilities. They include the construction of additional Assembly Cells and Assembly Bays and various related support facilities as listed.

TABLE 2.2.1-1

PANTEX PLANT ALTERNATIVE, OPTION 1: NEW CONSTRUCTION

No.	Facility	Approximate Cost ($M)	Approximate Construction Period
1	Production and Assembly Facilities, 2 assembly cells, 7 assembly bays, 1 linac bay, HE service magazine, 7 production magazines	23.0	09/81 - 07/83
2	Weapons Assembly Facilities, 2 assembly cells, 7 assembly bays, 1 linac bay	41.0	12/83 - 04/86
3	Weapons Assembly Facilities, 1 assembly cell, 4 assembly bays	24.5	12/83 - 04/86
4	Weapons Assembly Facilities, 1 assembly cell, 9 assembly bays	28.3	12/83 - 04/86
5	Remote Hole-Drilling Facility and Aging Facility	5.6	12/82 - 03/84
6	High-Explosives Development Machining Facility	10.6	07/82 - 03/84
7	Universal Pilot Plant	12.6	Not determined
8	Alternate Energy Source Project	46.6	04/85 - 10/88
9	Main Substation	3.3	08/83 - 04/85
10	Explosives Staging Facility	0.7	03/82 - 08/83
11	Interim Test-Fire Facility	0.7	Operational target 07/83

The two Assembly Cells now under construction as part of Project 1 will be similar in design to the existing Gravel Gerties. These two assembly cells will limit the potential release of radioactive materials to the degree required by the Current Criteria. Detailed quantitative information on the filtering capabilities of the gravel roof was provided by an actual field test conducted at the Nevada Test Site. This test was performed with a full-sized structure using maximum limits of high explosive.

The additional new assembly cells in the other projects will be new-design Gravel Gertie structures. These new-design Gravel Gertie structures will have heavy blast doors and will be built to the proven design tested at the Nevada Test Site to limit the release of radioactive material from an accidental detonation.

The Assembly Bays now under construction as part of Project 1 have heavily reinforced concrete walls. The remainder of the new Assembly Bays will be essentially the same as the existing earth-separated Assembly Bays. Both types of new Assembly Bays will have concrete slab, earth-covered roofs similar to those on the existing earth-covered Assembly Bays. This design meets current criteria.

Projects 6 and 7 (project 7 is being considered for later funding) are facilities to be built in the High-Explosives Research and Development area. These facilities will include remote controlled high-explosive machining bays to provide greater operational reliability and will be used for synthesis of high explosives and development of new high-explosive manufacturing processes. Both projects are basically replacement facilities.

Project 8 is a small cogeneration plant producing electrical power (up to 2.9 megawatts) and steam. It would replace the existing old power plant. This plant is currently being planned as a gas-fired facility with a fuel oil backup; however, the plant will be designed to retain the future option to use coal. The coal-fired option would result in the greatest environmental impact, and therefore, the coal-fired option is analyzed in this Environmental Impact Statement. Coal storage and handling facilities would include a new rail line; a railroad coal car unloading facility; a coal pile, conveyors, and dry-ash handling facility; and an ash-settling area. This new plant would be designed to meet the applicable Environmental Protection Agency and Texas Air Control Board standards. Baghouse filters would clean flue gas before discharge.

Project 9 is a new power substation including switchgear, a transformer, a capacitor bank, utility metering, distribution equipment, and onsite power lines for connection to local utility and existing Plant distribution systems.

Project 11 is a new high-explosive test-fire facility designed to contain the detonation products of a new type of test shot involving both beryllium and depleted uranium. (Beryllium has not been involved in previous test shots.) This facility will contain the high-pressure gas over a long period of time to permit settling of particulate matter and will bleed off the gas through high-efficiency-particulate (HEPA) filters. These filters are at least 99.97 percent effective in removing particulates. This will prevent beryllium and depleted uranium emissions to the environment. Because the new facility will have no emissions except filtered detonation gases and vapors (mostly water, nitrogen, and carbon dioxide), it will comply with Texas State Air Quality Standards. The facility is being designed to contain only the new test shots with beryllium and relatively small amounts of high explosives. The test shots involving only depleted uranium will continue to be performed in the open as has been done in the past.

2.2.1.2 Option 2--Major Upgrade

The Pantex Plant Alternative Option 2 would involve a major upgrading of the nuclear weapons operations area and the high-explosives development area. This option assumes the prior completion of Option 1 (new construction) described above and proposes additional new facilities and refurbishment of existing facilities. Many of the existing facilities would be replaced or modified to accommodate less hazardous operations. Once replaced, the older facilities could be decommissioned and removed. The additional new construction could be started between 1986 and 1988. Construction would take about 5 years and could be completed between 1991 and 1993. Upon completion, the entire plant would meet the Current Criteria applicable to new construction for protective design features (Section 2.1.2). The estimated costs for the additional construction are about $466 million, bringing the total estimated cost, including prior completion of Option 1, to about $664 million.

The existing high-explosive fabrication area now housed in World War II structures would be totally replaced by a new fabrication complex. This new complex would have bays of a monolithic reinforced design for high-accident potential, high-explosive operations. The new bays for moderate accident potential high-explosives operations would be earth covered and roof vented.

The weapons assembly/disassembly area would use the existing Gravel Gertie assembly cells and the existing earth-covered assembly bays for lower-hazard operations or with lower limits on allowable quantities of high explosives. The new assembly cells would be new-design Gravel Gertie structures. The new assembly bays would be similar to the existing earth-covered bays. Operational efficiency would improve compared with the current facilities because material handling distances would decrease by approximately 80 percent in most new facilities. With some modification and expansion, most of the support facilities would continue to be used.

Most of the existing facilities in the High-Explosives Development Area would be replaced by new facilities. New facilities would include a high-explosives formulation facility, a high-explosive pressing facility, a special projects facility, a material analysis laboratory, and a high-explosives analysis facility.

2.2.1.3 Option 3--Major Replacement

This option assumes the completion of substantial portions of Option 1 (new construction) to meet established workload schedules on an interim basis.

Option 3 is a complete replacement of portions of the Pantex Plant: the high-explosive fabrication area, the nuclear weapon assembly/disassembly area, and the high-explosives development area.

In all cases, the new facilities would meet the Enhanced Goals for operational reliability design features. Operational efficiency would improve the most compared with existing facilities because materials-handling distances would decrease by 80 percent. In addition, these new facilities would provide the highest degree of accident mitigation.

The new construction could be started between 1986 and 1988. Construction would take 7 to 8 years and could be completed between 1993 and 1996. As part of Option 3, the existing facilities would be decommissioned and removed. Estimated costs for the additional construction are $1,139 million, bringing the total estimated costs, including prior completion of some projects in Option 1, to $1,239 million.

The high-explosives fabrication portion of the all-new facility would be similar to the new structures proposed under Option 2. All of the bays would be of the monolithic reinforced-concrete design.

The weapons assembly/disassembly area of the all-new facility would employ some of the same types of structures proposed under Option 2. The new assembly cells would be new-design Gravel Gertie structures. Assembly bays in the all-new facility would be monolithic reinforced-concrete new-design bays.

The high-explosives development area would be replaced completely by a modular structure based on the same type of bay design described above for the high-explosives fabrication area. All facilities would meet the Enhanced Goals for protective design features.

Option 3 assumes the continued use of existing facilities in other parts of the Plant. These include the temporary holding area, the test fire and burning grounds, the water supply system and sewage treatment plant, and some warehouses. The Alternate Energy Source Project from Option 1 also would be used.

2.2.1.4 Option 4--Existing Facilities Only

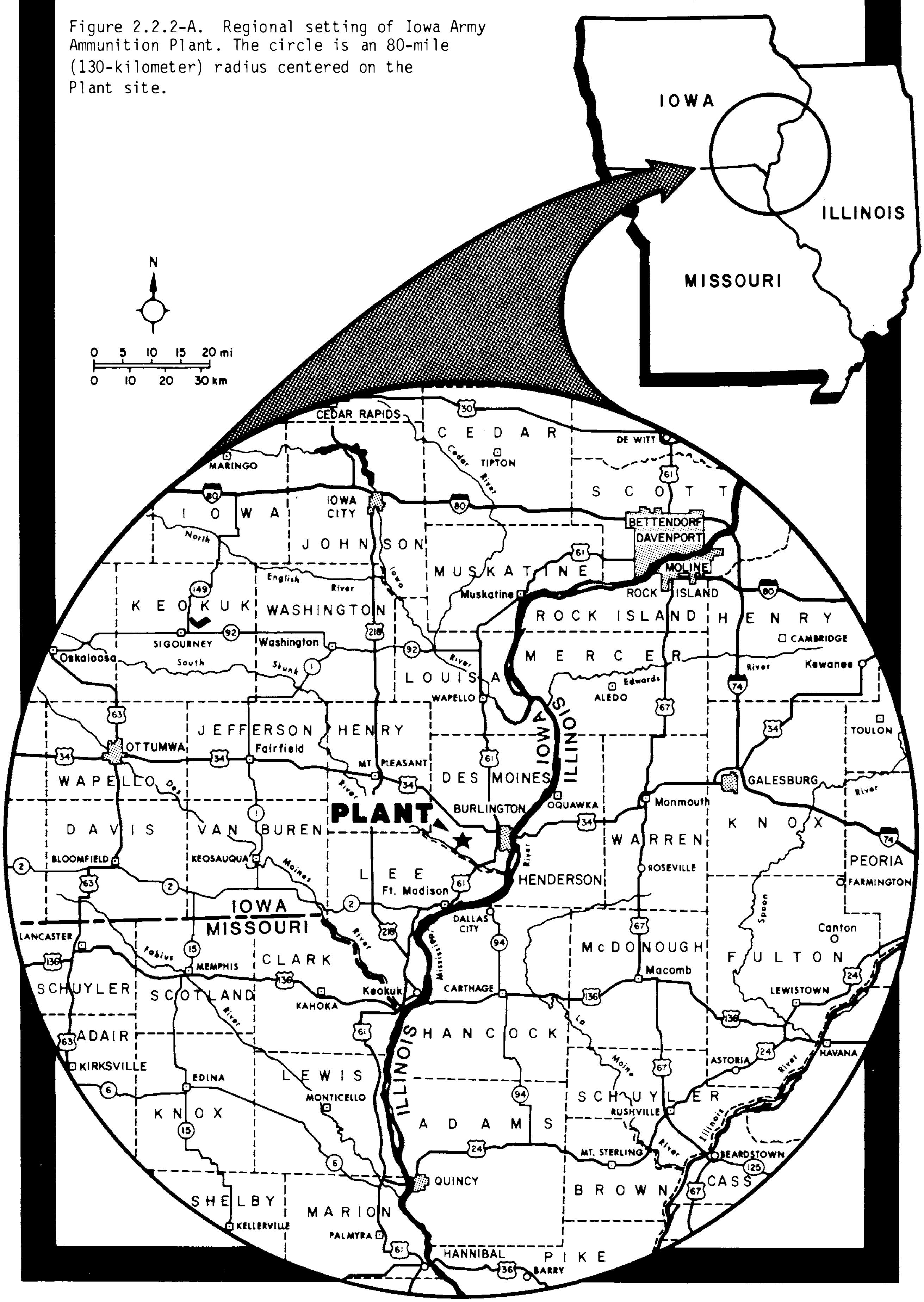
This option assumes continuation of current operations at the Pantex Plant in the existing facilities and those new facilities already under construction by the end of 1982 (Table 2.2.1). (Project 7 was scheduled to start construction in 1982. It was postponed, but it is still included in Option 4 because it is an important replacement facility to maintain current capabilites.) In all cases, the new construction would meet the Current Criteria for protective design features (Section 2.1.2.). For analyzing socioeconomic impacts, the work force is assumed to remain at the current size.

Option 4 represents the "No Action" alternative. The Pantex Plant has been in operation for 30 years; continued operations in the existing facilities represent the least change from current conditions, that is, maintenance of the status quo. The facilities and operations are those described in the introductory part of Chapter 1. Option 4 provides no improvements in operational reliability design features for the existing facilities. The existing facilities do not offer the full level of protection that would be required of new facilities constructed to meet the Current Criteria (Section 2.1.2).

2.2.2 Iowa Army Ammunition Plant Alternative

The 7,800-hectare (19,300-acre) Iowa Army Ammunition Plant, approximately 16 kilometers (10 miles) west of downtown Burlington (Fig. 2.2.2-A), Iowa, is now operated for the U.S. Army to produce conventional munitions for the military. A portion of this plant was used from 1947 through 1975 by predecessors of the Department of Energy for production of nuclear weapons before consolidating the nuclear weapons operations at the Pantex Plant. Thus, some of the special function facilities--assembly cells and assembly bays--similar to those existing at the Pantex Plant could be considered for reuse. Also, there are many related support facilities that could be considered for joint use in support of continuing Army operations and relocated Department of Energy nuclear weapons operations.

Figure 2.2.2-A. Regional setting of Iowa Army Ammunition Plant. The circle is an 80-mile (130-kilometer) radius centered on the Plant site.



The Iowa Army Ammunition Plant Alternative includes two options. Both options assume common use of as many support facilities as would be practicable under a joint-management agreement between the U.S. Army and the Department of Energy. The facilities that would fall under this category include existing temporary holding bunkers, high-explosives waste disposal incinerators, and existing basic utilities systems. The first option also assumes reuse of the special purpose facilities. The second option assumes construction of an all-new facility. Both options meet the requirement for continued nuclear weapons operations and the established increased-workload schedule.

2.2.2.1 Option 1--Partial Relocation of Workload

Option 1 is a partial relocation of nuclear weapons operations from the Pantex Plant to the Iowa Army Ammunition Plant. In addition to the joint use of support facilities, this option assumes the reuse of the portion of the Iowa Army Ammunition Plant formerly used for nuclear weapons operations. This would include both direct reuse of existing facilities with varying degrees of refurbishment and some new construction. Thus, the operational reliability and accident mitigation capabilities of the structures would be a mixture of Existing Facilities and Current Criteria (Section 2.1.2). This option assumes that approximately 25 percent of the workload projected for 1985 and beyond would be handled at the Iowa Army Ammunition Plant and 75 percent would be handled at the Pantex Plant.

The special-purpose and other previously used facilities are being used currently for a variety of U.S. Army operations including munitions production, research, warehousing, and reserve facilities for mobilization. Several of the existing Gravel Gertie structures, identical to those at the Pantex Plant, would be refurbished with improved blast doors and used as assembly cells; the other Gravel Gerties would be used as assembly bays. Some of the existing earth-covered assembly bays would be reused and additional assembly bays would be constructed.

High-explosives fabrication would be accomplished in facilities previously used for such operations. The best remaining structures would be selected from the existing below-ground and above-ground bays to provide an adequate number of bays for high-explosives fabrication. Other structures that would be reused include inert assembly and storage areas, laboratory areas, radiography facilities, machine shop and repair facilities, a steam generation plant, a changehouse and cafeteria, and several administrative and technical buildings.

The Pantex Plant would continue to operate in its existing facilities and the new facilities already under construction in 1982 (Table 2.2.1-1). These structures are assumed to be completed and used at the Pantex Plant.

The final major feature of the Iowa Army Ammunition Plant Option 1 is the need to provide alternative replacement facilities for the displaced U.S. Army operations. In particular, the Army has identified specific loading capabilities and press-loading capacities important to their production requirements (USDOE 1981B). The review of facilities undertaken for this environmental impact statement also identified research and development functions and significant space being maintained in readiness for mobilization. These would have to be replaced. A preliminary evaluation indicates that the Army replacement facilities would cost about $100 million.

The estimated costs for refurbishment and new construction to resume nuclear weapons operations are about $63 million. The costs for the new construction assumed to be completed at the Pantex Plant under this option are about $53 million. Therefore, the estimated total costs for implementation of all of this option would be about $216 million. Most of the required construction probably could be accomplished by 1985.

2.2.2.2 Option 2--All-New Plant

This option assumes the complete relocation of all Department of Energy nuclear weapons operations from the Pantex Plant to an all-new plant located within the Iowa Army Ammunition Plant. The all-new plant is assumed to be the same conceptual design as proposed for the major replacement option at the Pantex Plant (Pantex Plant Alternative, Option 3). The entire facility would meet the Enhanced Goals for operational reliability and accident mitigation. This option would not require moving the Army operations from the formerly used nuclear weapons facilities. Test fire areas, high-explosive disposal facilities, explosive holding areas, and other support functions would be shared with the Army.

The all-new plant would be located in a currently undeveloped portion of the Iowa Army Ammunition Plant. To provide space and process heating, a coal-fired cogeneration plant (the same as identified as Project 8 in Pantex Plant alternative, Option 1) would be built close to the all-new plant. A new sanitary sewage treatment facility would also be required. Depending on when a decision could be made to implement this option, some portions of the Pantex Plant Alternative, Option 1, would already be under construction. These facilities would be used for continuing operations over the next several years. Thus, some construction impacts and additional costs would be incurred at the Pantex Plant before all operations could be transferred to the Iowa Army Ammunition Plant. The termination of operations at the Pantex Plant is discussed in Section 2.2.4. This option could probably be completed within the same period estimated for implementing the major replacement option at the Pantex Plant (Pantex Plant Alternative, Option 3).

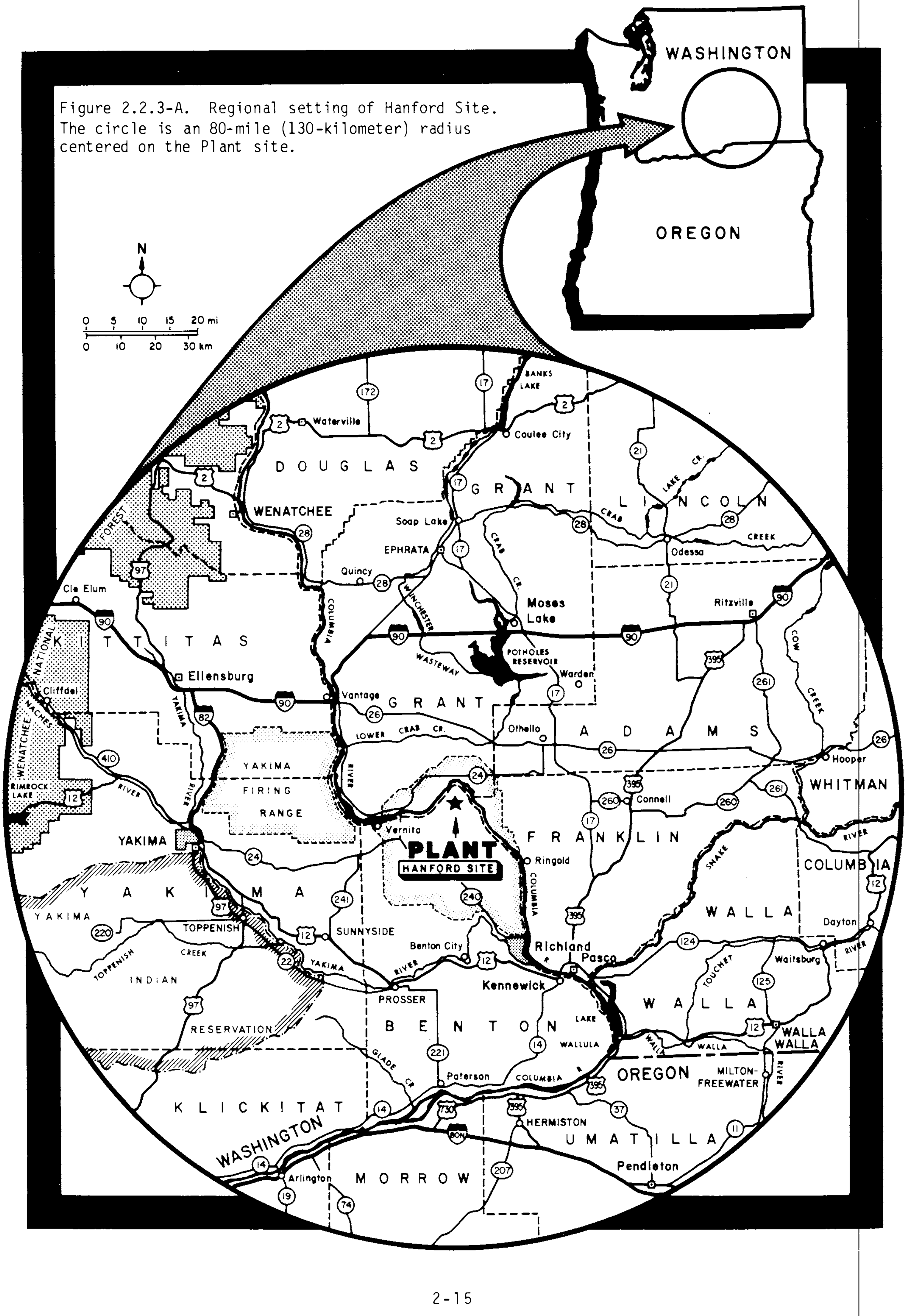
The estimated cost for the construction and refurbishment of facilities at the Iowa Army Ammunition Plant is $1,318 million. Additional estimated costs include $32 million for temporary holding facilities, $7 million for security, $16 million for additional roads, $42 million for electrical and water distribution systems and a sanitary sewage treatment plant, and $20 million for decontamination and decommissioning of the Pantex Plant. The costs for new construction assumed to be completed at the Pantex Plant are $53 million. The total estimated cost of this option is $1,488 million.

2.2.3 Hanford Site Alternative

The Hanford Site alternative assumes building an all-new plant within the 147,800-hectare (360,100-acre) Department of Energy Hanford Site near Richland, Washington (Fig. 2.2.3-A). The Hanford Site was selected as a new location for an all-new plant by a detailed suitability evaluation of potential sites (LATA 1981).

The new construction would be essentially identical to that proposed in Pantex Plant Alternative, Option 3 (Major Replacement, Section 2.1.1.3). This option would result in meeting the Enhanced Goals for operational reliability and protective design features. Related support facilities also would have to be constructed at the Hanford Site, as no such facilities now exist there. These include temporary holding areas, test firing sites, and waste high-explosives disposal facilities. A coal-fired, cogeneration plant (the same as identified as Project 8 in the Pantex Plant Alternative, Option 1) would be built close to

Figure 2.2.3-A. Regional setting of Hanford Site. The circle is an 80-mile (130-kilometer) radius centered on the Plant site.



the all-new plant for electricity and space and process heating. A sanitary sewage treatment facility also would be built.

Some portions of the Pantex Plant Alternative, Option 1 (New Construction), would be under construction already. These structures would be needed for continuing operations over the next several years. Thus, some construction impacts and additional costs would be incurred at the Pantex Plant before all operations could be transferred to the Hanford Site. The termination of operations at the Pantex Plant is discussed in Section 2.2.4. This option probably could be completed within the same 10- to 13-year period estimated for implementing the major replacement option at the Pantex Plant (Pantex Plant Alternative, Option 3).

The estimated costs of the Hanford Site alternative include $1,379 million for nuclear weapons operation facilities, $33 million for temporary holding facilities, $7 million for security, $16 million for additional roads, $44 million for electrical and water distribution systems and a sanitary sewage treatment plant, and $20 million for the decontamination and decommissioning of the Pantex Plant. The costs for new construction assumed to be completed at the Pantex Plant under this option are $53 million. The total cost of this alternative is $1,552 million.

2.2.4 Termination of all Department of Energy Nuclear Weapons Operations at the Pantex Plant for Comparison Purposes

Termination of operations at Pantex Plant is addressed to provide a basis for evaluating the environmental consequences of the Iowa Army Ammunition Plant Option 2 and the Hanford Site Alternative that includes closing the Pantex Plant. An immediate shutdown of the Pantex Plant would involve removing all equipment, shutting down power systems, locking doors, and leaving, and it is estimated to cost $13 million. This would keep the facility potentially usable for other government operations, subsequent remobilization to perform nuclear weapon maintenance and retirement operations, or the possible sale or lease to private industry. A more extensive shutdown would involve cleanup of all high-explosives residues and demolition of all structures. Limited cleanup and restoration of some portions of the site (such as depleted uranium in the test-firing areas and the high-explosives disposal areas) would be needed. This action is estimated to cost at least $20 million. Once such a cleanup and demolition were accomplished, the site could be used safely for almost any purpose, from farming and ranching to some entirely different industrial operation. The cost of construction that is already underway at the Pantex Plant is $53 million. The estimated total cost of termination is $73 million.

2.3 ENVIRONMENTAL EFFECTS OF NORMAL OPERATIONS IN PLANT FACILITIES AND NEW CONSTRUCTION

This section summarizes environmental impacts from normal operations and construction associated with each of the alternatives. The evaluations are presented in comparative form to emphasize contrasts or similarities between the alternatives.

Major environmental topical areas are treated in separate subsections with comparative information on all alternatives contained within that topic. This same pattern is used in Chapters 3 and 4 to aid in cross-referencing for additional detail. The major topical areas include the following:

- Air
- Water
- Terrestrial Resources
- Ecology
- Land Use and Agriculture
- Environmental Radiation and Radioactivity
- Energy Resources
- Employment and Population
- Economics
- Community Resources
- Cultural Resources and Native Americans
- Health and Safety

Most of the information in this impact statement pertaining to current conditions is based on data for calendar year 1981. This was done to provide a common basis for comparisons. In the particular case of economic conditions, some changes have occurred in 1982 that undoubtedly have affected quantitative values for such things as unemployment and sales. However, for economics as well as other areas of the natural or social environment, there is no reason to believe that use of 1982 calendar year data would change any fundamental conclusions.

2.3.1 Air

Air quality at all three sites is generally good. Ambient air concentrations of pollutants from nuclear weapons operations are quite small (typically less than 1 percent) compared with Federal or state standards (Section 3.2.1.1). This increment would not cause a violation of ambient air standards for any location considered under the various alternatives.

2.3.2 Water

Water Supply

An adequate water supply for nuclear weapons operations exists at all three locations. Normal plant activities will not significantly affect the availability of either surface or ground water at or adjacent to the sites. The expected annual use of about 1.5 billion liters (400 million gallons) is about the same at all three sites.

Water pumpage for the Pantex Plant is about 1 percent of the total for Carson County. The use at the Pantex Plant is about the same as is used to irrigate 490 hectares (1,200 acres) of crop land under typical limited-irrigation practices in the area. An area equal to the entire Pantex Plant site uses about 8 times more water for agricultural irrigation than is used for the plant operations (Sections 4.1.2.1 and 4.1.2.4).

Water usage at the Iowa Army Ammunition Plant would essentially double. Water availability from the city of Burlington presents no problem. The shallow water table will require fitting buildings with waterproof foundations and drainage tile systems (Sections 3.2.2.2 and 4.1.2.2).

The additional water usage at the Hanford Site would represent less than 1 percent of current use; moreover, an abundant supply is available from the Columbia River.

Liquid Wastes

The Pantex Plant liquid effluents have no significant impacts on water quality and conform to Texas discharge requirements. None of the proposed projects would significantly affect the quantity, quality, or points of discharge of the liquid effluents. The effluents would be similar in quantity and quality for each alternative. These effluents do not create a toxic chemical problem for the Pantex Plant, and no problem is expected at either alternative site.

Liquid effluents are discharged and contained onsite at the Pantex Plant. Most evaporate; some accumulate in an onsite playa and have been used for irrigation. Plant operations have produced no significant effects on the quality of surface or ground water. The quality of water produced by onsite supply wells in the Ogallala aquifer shows no evidence of any change in chemical quality since 1942, when the first well was drilled.

Treated liquid waste effluents would be discharged into surface water at the Iowa Army Ammunition Plant (Section 4.1.2.2). These would require an Environmental Protection Agency National Pollutant Discharge Elimination System permit for discharge to surface water (Section 3.2.2.2). At the Hanford Site, infiltration ponds would be constructed for disposal of the treated effluents (Section 4.1.2.3).

2.3.3 Terrestrial Resources

Natural resources will not be affected by normal plant operations at any alternative site. Procedures have been established for proper treatment and handling of radioactive or hazardous wastes to assure there will be no hazard to the offsite environment.

The largest volume of solid waste generated at the Pantex Plant is uncontaminated ordinary trash, cafeteria waste, and construction debris. These are adequately handled by sanitary landfill operations. Similar operations could be established at either alternate site for this kind of waste without creating significant environmental impacts. The options involving major construction and demolition of old buildings would contribute larger volumes of construction debris for limited periods of time.

Only one unique terrestrial resource is found at any of the three sites. The last free-flowing reach of the Columbia River passes through the Hanford Site (Section 3.2.4.3).

The Hanford Site has some soil contamination from radionuclides and has shallow ground water aquifers that show some contamination from radioactive wastes (Section 3.2.3.3). There is evidence of soil and sediment contamination at the Iowa Army Ammunition Plant by heavy metals and high explosives. There is also evidence of shallow ground water and surface water contamination by chemicals and high explosives at the Iowa Army Ammunition Plant.

No geologic hazards (such as major faults, land subsidence, or high seismic potential) are found at either the Pantex Plant or Iowa Army Ammunition Plant. However, faulting has recently been found on the Hanford Site considered capable of triggering an earthquake (Section 3.2.3.3). None of the three sites are known to have mineral deposits that could be profitably mined. None of the sites currently have erosion or flooding potential that might be aggravated by plant activities (Sections 3.2.3.1, 3.2.3.2, 3.2.3.3).

2.3.4 Ecology

All three sites are equally acceptable from a purely ecological standpoint. Although species diversity varies greatly among sites and three distinctly separate ecosystems are involved, none of the sites contain unique habitats required for known threatened or endangered species. In addition, none of the proposed sites adversely restricts known or established migratory corridors used by wildlife.

An active ecological management program exists at the Iowa Army Ammunition Plant; however, a detailed threatened and/or endangered species evaluation has not been performed. To ensure that no problems exist, such a study of the proposed construction site would be necessary before construction. Further studies are not needed at the other two sites (Section 3.2.4).

Despite temporary construction-related disruption, releases to the environs will not constitute a health hazard nor will the releases adversely affect the established natural food chains at any of the three alternate sites. Small portions of the ecosystems would be destroyed by construction; however, none of the undisturbed portions of the ecosystems would show significant adverse impacts from the destruction of the anticipated 20 hectares (50 acres) of habitat.

2.3.5 Land Use/Agriculture

Land Use

None of the Alternatives or their Options should result in any significant changes in land uses surrounding the Federal government-owned sites. No new land would have to be acquired to implement any of the construction alternatives. Normal plant operations will not result in negative land-use impacts.

Agriculture

Normal plant operations should not affect agricultural practices surrounding any of the three sites. A special study was done to evaluate the impacts of potential contaminants on agricultural products grown on or near the Pantex Plant (Wenzel 1982A, Buhl 1982). This study has shown that normal operations at the Pantex Plant do not result in radioactivity measurable above background levels in any of the agricultural products (Section 3.2.5.1).

The Hanford Site is the area least valuable from an agricultural standpoint. All crops in the region surrounding the Hanford Site require supplemental irrigation to grow well. The carrying capacity of natural range for supporting grazing livestock is quite low (Section 3.2.5.3).

The area around the Pantex Plant is intermediate in agricultural value. Rainfall is variable and crops frequently require supplemental irrigation. Ranching in the region is characterized by cow-calf operations. Natural ranges have an intermediate carrying capacity for grazing (Section 3.2.5.1).

Of the three alternate sites, the Iowa Army Ammunition Plant is located on the most productive agricultural land. The growing season and rainfall patterns permit growing nearly any row crop. No supplemental irrigation is required for crops. Livestock operations are run typically as small feedlots; the carrying capacities of ranges for grazing are very high (Section 3.2.5.2).

Prime and Unique Farmland, as defined by the U.S. Soil Conservation Service, exists at both the Pantex Plant and Iowa Army Ammunitions Plant. This classification at the Pantex Plant is applicable only when the land is irrigated (Section 3.2.5.1).

2.3.6 Environmental Radiation and Radioactivity

Radiological Effects

All three basic alternatives are equally acceptable from a radiological standpoint in that the effects of normal operations are negligible. The average added lifetime risk of cancer to an individual would be less than 1 chance in a billion per year of exposure for each of the three sites. The average added risk of genetic disorder in all subsequent generations is less than 1 disorder per billion offspring for each site per year of exposure. For comparison, these risks are all less than 0.001 percent of those from natural background radiation.

The highest added lifetime risk of cancer for the maximum exposed individual for any option considered here is 1 chance in 31 million per year of exposure. Estimates of the corresponding genetic risk for the maximum exposed individual ranged from 1 disorder in 500 million offspring to 1 disorder in 31 million offspring per year of exposure.

Radiological Doses

The incremental radiation dose from normal plant operations is extremely small compared with natural background radiation. Table 2.3.6-1 presents the background doses and operational doses for the maximum exposed individual at each site. These doses are all small fractions of the applicable Department of Energy Radiation Protection Standards (USDOE 1980A). They are also well within the proposed Environmental Protection Agency regulations on emissions of airborne radioactivity (48FR15076; April 6, 1983).

TABLE 2.3.6-1

RADIOLOGICAL DOSES FROM BACKGROUND AND NORMAL OPERATIONS
Dose in millirems per year of exposure*

	Pantex Plant			Iowa Army Ammunition Plant			Hanford Site		
	Whole Body	Lung	Bone	Whole Body	Lung	Bone	Whole Body	Lung	Bone
Background	106	306	291	85	285	270	82	282	267
Current operations**	<0.01***	<0.01	0.08	<0.01	<0.01	<0.01	0.4	0.02	1.3
Future operations** including maximum impact from any option	0.23	0.68	3.1	0.19	0.56	2.5	0.03	0.08	0.35

*The Department of Energy Radiation Protection Standard for individuals in the general public is 500 millirems a year whole body and 1500 millirem a year lungs and bone.
**Doses are 50-year dose commitments per year of exposure.
***< means "less than."

Radiological Releases

The doses in the previous section are based on all the releases discussed in the next three paragraphs. No releases of plutonium would occur under normal operations regardless of location.

Depleted Uranium. Routine releases of depleted uranium result from explosive test shots and to a much lesser extent, from operations at the burning ground. The number of tests has declined significantly in recent years. Test shots are expected to result in future releases of depleted uranium of less than 10 kilograms (22 pounds) a year. A special air sampling program conducted for this environmental impact statement showed current ambient air concentrations of depleted uranium at and beyond the boundary of the Pantex Plant to be less than 0.01 percent of the Department of Energy Concentration Guides. Similar releases of uranium would be expected under any of the alternatives.

Tritium. Tritium emissions from nuclear weapons operations would be negligible under any of the alternatives. Evaluation of current operations at the Pantex Plant have shown annual airborne emissions to be less than 0.1 curie.

Coal-Fired Power Plant. Naturally occurring radioisotopes of uranium and thorium and their decay products would be released by the proposed coal-fired power plant under any of the alternatives. These radioisotopes are found in trace amounts in all coal.

Radiological Wastes

The Pantex Plant generates about 6 to 7 cubic meters (200 to 250 cubic feet) of solid waste with low levels of radioactive contamination annually from nuclear weapons operations. This waste is currently shipped to the Nevada Test Site for disposal. Future wastes from operations at the Pantex Plant or the Iowa Army Ammunition Plant would be sent to the Nevada Test Site. Future wastes from operations at the Hanford Site would probably be disposed of at the Hanford Site. Residues from military accidents with nuclear weapons had been stored at the Pantex Plant since 1966. Containers with these residues and contaminated soil associated with retrieving the residues should be removed from the Pantex Plant by early 1984. No significant environmental risks are associated with these operations.

2.3.7 Energy Resources

Energy resources exist at all three sites at levels adequate to support nuclear weapons operations (Section 3.2.7). Expansion of operations may require installing new energy distribution systems; however, regional resources appear to be adequate to handle any anticipated needs. The total energy requirements for a nuclear weapons plant are relatively modest compared with most manufacturing plants having comparable total floor space.

Electricity from the proposed coal-fired cogeneration plant would not supply all the power needed. However, the additional electrical energy needs could be purchased from local utilities, and this purchase would not require the construction of new offsite power lines.

Major components of the energy budget for a nuclear weapons facility include heating and cooling of buildings, lighting, and process energy. Process energy (about 10 percent of the total used) and lighting requirements are largely independent of location. Major differences in energy consumption for the various alternatives depend on requirements for heating and cooling buildings. Thus, with energy-efficient new buildings, energy requirements will go down for almost all options.

Several alternatives require the continued use of old buildings. For those alternatives, it was assumed that an automated energy management system would be installed and ceiling insulation would be added where appropriate. The only exception was the "No Action" alternative at the Pantex Plant, which does not include these energy-saving measures.

The results of the energy use analyses are presented in Table 2.3.7-1. The savings resulting from the energy conservation measures and/or new buildings designed to meet current energy conservation standards can be approximated by comparing each alternative with the "No Action" alternative. The energy savings would range from a low of 8 million kilowatt-hours annually for partial relocation at the Iowa Army Ammunition Plant to a high of 56 million kilowatt-hours annually for a totally new plant at the Pantex Plant.

The effect of weather on energy use can be seen by comparing the energy use of a totally new facility at each alternate site. The last column of Table 2.3.7-1 shows that the energy use would be 7 million kilowatt-hours higher annually at the Hanford Site and 28 million kilowatt-hours higher annually at the Iowa Army Ammunition Plant for a totally new facility than at the Pantex Plant.

TABLE 2.3.7-1

COMPARISON OF TOTAL ANNUAL ENERGY CONSUMPTION* FOR ALL ALTERNATIVES AND OPTIONS
(expressed in millions of kilowatt-hours)

	Total	Difference From No Action	Difference From "Replace Plant" at the Pantex Plant
Pantex Plant			
New construction	112	-41	15
Upgrade Plant	127	-26	30
Replace Plant	97	-56	0
No action	153	0	56
Iowa Army Ammunition Plant			
Partial relocation	145	-8	48
Total relocation	125	-28	28
Hanford Site			
Total relocation	104	-49	7

*This total includes natural gas and electricity and is based on heating and cooling requirements for all facilities plus process energy consumption.

2.3.8 Employment and Population

The construction of new facilities or refurbishment of existing facilities to meet any of the alternatives would result in positive impacts on local employment without excessive increases in local populations. All three siting locations have access to large unskilled labor pools, and skilled crafts are available in all locations currently associated with local construction projects. Analyses indicate that any of the locations would benefit from the necessary construction activities (Section 4.1.8).

TABLE 2.3.8-1

SUMMARY OF EMPLOYMENT AND POPULATION IMPACTS

	Normal Operations		Construction Period		
	Operational Work Force	Induced Population Growth (percent)	Peak Construction Work Force Basic and Nonbasic Onsite	Induced	Related Population Increment (percent)
PANTEX PLANT ALTERNATIVE					
Option 1: New construction	2,600	negligible	459	312	0
Option 2: Major upgrade	2,600	negligible	1,000	680	0
Option 3: Major replacement	2,600	negligible	1,600*	1,088	2.1
Option 4: Existing facilities only	2,400	0	217	148	0
IOWA ARMY AMMUNITION PLANT ALTERNATIVE					
Option 1: Partial relocation of workload includes portion of Pantex Option 1	1,000 (Iowa) 2,500 (Texas)	negligible negligible	100 217	68 148	0 0
Option 2: All-new Plant	2,600	negligible**	1,800	1,224	4.8 in trade area
HANFORD SITE ALTERNATIVE					
All-new Plant	2,600	negligible**	1,800	1,224	3.9 in trade area
TERMINATION					
Close Pantex; occurs with Iowa Army Ammunition Plant Option 2 and Hanford Alternative	-2,400	-4.7%	0	0	0

*The peak construction work force for the Pantex Plant Option 3 is 200 workers less than that required for the all-new Plants at either the Iowa Army Ammunition Plant or the Hanford Site because of support facility construction not required at the Pantex Plant.

**These are considered negligible because virtually all of the operational work force could be recruited locally.

Employment levels and population effects expected to be associated with the various basic Alternatives and their Options are summarized in Table 2.3.8-1.

2.3.9 Economics

The economy at any of the three alternate sites would experience increased material purchases and payrolls associated with construction activities. Permanent jobs associated with normal operations would contribute to local economies at either the Hanford Site or Iowa Army Ammunition Plant areas. Relocation to either of those two sites would eliminate $106.4 million per year (purchases plus direct and indirect payrolls) from the local economy in the Pantex Plant area.

The Pantex Plant alternative would have the least overall economic impact. The options associated with this alternative would avoid disruption of the current permanent work force. They would avoid loss of a significant cash flow into the local economy. In addition, once the peak of construction-related cash flow passed, relatively few new permanent employees would be required (about 200) and the economy would quickly stabilize.

TABLE 2.3.9-1

SUMMARY OF ANNUAL DIRECT ECONOMIC CHANGE FROM CURRENT 1981 OPERATIONS

Action	Normal Operations		Construction Period		Percent Contributed to Retail Sales, 1980	
	Payroll ($ million)	Other Operating Expenditures ($ million)	Peak Construction Payroll ($ million)	Total Construction Expenditures ($ million)	Operating Work Force	Construction Work Force
PANTEX ALTERNATIVE						
Option 1: New construction	+8.68	+0.02	18.36	198	0.3	0.54
Option 2: Major upgrade	+8.68	+0.02	39.93	664	0.3	1.2
Option 3: Major replacement	+8.6[illegible]	+0.02	63.89	1239	0.3	1.9
Option 4: Existing facilities only	0	0	8.67	53	0	0.3
IOWA ARMY AMMUNITION PLANT ALTERNATIVE						
Option 1: Partial relocation (Iowa)	+37.1	+1.75	4.39	163	2.8	0.3
Includes portion of Pantex Option 1 (Texas)	+4.34	0	8.67	53	0.1	0.3
Option 2: All-new plant	+96.4	+3.52	79.03	1488	7.6	6.0
HANFORD SITE ALTERNATIVE						
All-new plant	+114.0	+3.52	83.03	1552	6.0	4.3
TERMINATION						
Close Pantex, occurs with Iowa Army Ammunition Plant Option 2 and Hanford Site Alternative	-106.4	-3.5	0	0	-2.8	0

Direct economic impacts projected to be associated with the various basic Alternatives and their Options are summarized in Table 2.3.9-1. For additional discussion of economics, see Sections 3.2.9 and 4.1.9.

2.3.10 Community Resources

Community resources at all locations could accommodate the transient work force associated with new construction without major changes in basic services (Section 4.1.10). The area surrounding the Hanford Site may be the least impacted.

The Pantex Plant and Iowa Army Ammunition Plant alternatives would result in minor perturbations to local community resources by inducing a small population increase resulting from the construction activities. Current community resources surrounding both the Iowa Army Ammunition Plant and the Pantex Plant are capable of handling anticipated population increases.

2.3.11 Cultural Resources and Native Americans

None of the alternate siting locations contain archaeological or cultural resources listed on the National Register of Historic Places that could be impacted by new construction. However, all locations were used by native American hunters before settlement, and all sites contain artifacts (Section 3.2.11).

Though none of the alternate siting locations impact known shrines or other areas of religious significance, the Hanford Site contains many campsites and fishing grounds used from prehistoric times until forced evacuation in 1943. As groups of native Americans still live near the Hanford Site, the potential exists for negative public sentiments about use of this site. Neither of the other two locations, the Iowa Army Ammunition Plant or the Pantex Plant, have groups of native Americans still living near the considered sites (Section 3.2.11).

The Pantex Plant is the only considered location that has been examined for cultural resources by a detailed archaeological survey. The State Historic Preservation officers from Iowa and Washington would require cultural resource surveys for either the Iowa Army Ammunition Plant or Hanford Site before construction. At the Hanford Site, a historic irrigation ditch (the Hanford ditch) passes through the proposed construction area. This ditch is a potential candidate for inclusion on the National Register of Historic Places, and special handling of this resource would be required (Section 4.1.11.3).

2.3.12 Health and Safety

An epidemiology study investigated cancer mortality in counties near the Pantex Plant and found no indication of unusual cancer patterns or any effect attributable to the plant (Section 3.2.12.1). Data from the 1970's received the most intense scrutiny because that decade would be most likely to show any effects allowing for cancer latency periods, yet no significant differences were found in comparison with statistics for the State of Texas as a whole. As discussed in Section 2.3.6, the small quantities of radioactive emissions expected in the future lead to estimated risks of cancers or genetic effects that are negligibly small fractions of similar effects from natural background radiation. Therefore, no effects on public health would be expected in the future from normal operations at the Pantex Plant or from nuclear weapons operations conducted at the other sites.

A detailed epidemiological study of mortality patterns of the current and historic work force at the Pantex Plant was done. The final results of this study showed no evidence that mortality from any cause of death (all cancers, arteriosclerotic heart disease, and digestive diseases) was affected as a result of employment at the Pantex Plant. Work force mortality was less than would be expected from statistical projections based on United States death rates (Section 3.2.12.1).

Worker health and safety receives major attention in the operation of the Pantex Plant and would continue to receive major attention under any of the alternatives or their options. The Pantex Plant has a well-defined health and safety program for protecting the worker. There is no evidence of significant exposure of workers to toxic chemicals or radiation from x-ray procedures or radioactive materials (section 3.2.12.2). Attention to safety is of primary concern in worker training, development of operating procedures, routine medical examinations, and review of procedures. Investigations of incidents regularly lead to improvements designed to lower the likelihood and severity of similar accidents recurring. In the future, a larger proportion of explosives that are less sensitive to accidental detonation will be used.

A statistical study of the historic worker injury and property loss records for Pantex Plant was conducted (Section 3.2.12.3). Overall, the injury and loss rates are less than the United States explosives industry as a whole, other Department of Energy operations, and most private industry. The record has shown steady improvement over the last several years. Part of this improvement is attributed to an intensified review and modification of procedures following a serious accident in March 1977 in the high-explosives research and development area that killed three workers. These were the only fatalities resulting from a detonation of high explosives in the 30 years of operations at the Pantex Plant and about 25 years of similar operations at the Iowa Army Ammunition Plant.

The new facilities and operations also are being planned with the radiation protection philosophy of limiting planned radiation exposures to workers at levels as low as can be reasonably achieved. The specific goal adopted for the new facilities is 1 rem a year or less for radiation workers (Federal standards for workers permit up to 5 rem a year). Further, as technology changes and new chemicals are required for operations, they will be reviewed for health and safety considerations so that the most suitable protective equipment and procedures can be adopted.

Studies of the existing Pantex Plant have not shown any direct measurable effects on the health and safety of the general public (MHSM 1982, Macdonell 1982, Wiggs 1982). Evaluations indicate that all alternatives meeting production requirements are equally acceptable for the health and safety of the general public (Section 4.1.12).

2.4 ENVIRONMENTAL IMPACTS OF POTENTIAL PLANT ACCIDENTS

2.4.1 Types of Accidents Considered

Potential accidents that could result from nuclear weapons operations were evaluated from two perspectives. These are (1) the probability, or likelihood, of occurrence, and (2) the potential consequences should the accident occur. This impact statement summarizes findings for those potential accidents determined to be both credible and having significant environmental impacts. (Section 4.2.2 lists the types of accidents considered.) For the purpose of this document, credible accidents were defined as those potential accidents with a chance of at least one in a million of happening in a year of operation. Significant environmental impact accidents were defined as those with some combination of important offsite effects, uncorrectable consequences, or long-term implications. These definitions served the practical purpose of focusing attention on those types of potential accidents that represent the upper limits of environmental risks associated with the various alternatives and those that may be amenable to additional mitigating measures.

Many types of accidents were evaluated that were not credible or did not have the potential for any significant environmental impact. For example, spills of process chemicals or fuel would be contained within the plant site and could be cleaned up with no long-term effects. Potential accidents involving only high explosives with no radioactive materials are not significant in terms of risk to the environment or the general public. The airborne releases from such accidents would be no different than those from the routinely conducted test explosions.

Risk of Nuclear Detonation

The physics of a nuclear explosion requires precise timing mechanisms for even a very small nuclear yield. Therefore, a nuclear chain reaction can occur only if all the high explosives are ignited at precisely timed intervals. This careful timing can only be accomplished by sophisticated, specially designed electronic equipment. Any ignition of the high explosives that does not meet the timing requirement will result in dispersal of the radioactive material but no chain reaction. Nuclear weapons also incorporate redundant, fail-safe electronic equipment that preclude normal functioning of the electronic timing circuits in the event of accidents. Therefore, the probability of an accidental nuclear detonation of a nuclear weapon at the Pantex Plant, even given the occurrence of a major accident such as an airplane crash, accidental detonation of other high explosives, or fire, is well below the limit of credibility.

2.4.2 Analysis of Potential Accidents

All types of potential plant accidents were evaluated. The only ones assessed to be both credible and having possible significant environmental impacts involved the accidental detonation of conventional high explosives resulting in the offsite dispersal of radioactive material (Sections 4.2.1 and 4.2.2). No member of the general public would be expected to experience any short-term effects. The greatest risk would be the potential for contracting cancer after a latency period of 5 to 20 years and eventually dying from that cancer. The maximum exposed individual would have an overall annual risk of 1 chance in 17 million of eventually dying of cancer as a result of a plutonium-dispersing accident under any alternative.

Three types of initiating events that could lead to an explosion resulting in release of radioactive material were found to be credible. These initiating events are (1) an aircraft crash, (2) a tornado, and (3) an accidental drop of high explosives. Aircraft crashes could penetrate structures with the resultant damage leading to a detonation of high explosives. A tornado could cause sufficient structural damage to result in an explosion. An accidental drop of high explosives components during one phase of operations could result in a detonation (Sections 4.2.2 and 4.2.3).

Each of these initiating events could lead to an explosion in areas where nuclear materials are present and could result in the spread of radioactivity. The explosion would aerosolize, or cause to become airborne, the nuclear material components as mostly small particles. The particles would be expelled from the structure by the physical effects of the explosion (Section 4.2.4). They then would be spread or dispersed by wind beyond the plant boundaries where they could be inhaled or deposited on the ground (Section 4.2.5). If inhaled or deposited, the radioactivity could result in radiation doses that could lead to possible health effects (Sections 4.2.6, 4.2.7, and 4.2.8). Radiation doses are given only for the plutonium that could be dispersed by accidents. The doses from other radioactive materials, such as uranium and tritium, that could be involved in such accidents were all found to contribute less than 1 percent of the doses attributable to plutonium.

Each of the steps in this general chain of possible events was analyzed for the particular sites, types of structures, operating conditions, and meteorological dispersion. At each step, the analyses included methods or assumptions that would overestimate adverse consequences whenever directly applicable data were not available. Therefore, the final estimates of likelihood and possible consequences represent upper limits or "extreme case" evaluations. These estimates were calculated by the same methods for each alternative and option to provide a uniform basis for comparing the risk from potential accidents.

2.4.3 Comparative Summary of Accident Risks

Two aspects of accident risk were evaluated for each type of credible, environmentally significant potential accident for each alternative: first, the likelihood of such an accident occurring and, second, the possible consequences should such an accident occur. This section summarizes selected indicators of these two aspects of risk for each alternative.

Two indicators of likelihood are given in the first two divisions of Table 2.4.3-1 for each of the alternatives and options.

1. Overall Chance of Occurrence of Plutonium-Releasing Accident in 1 Year of Operation. This is the overall chance of any one of the three types of credible initiating events resulting in the dispersal of plutonium by an accidental detonation of conventional high explosives. This is expressed as a chance in any 1 year of plant operation. This overall chance is the sum of the probabilities for each type of initiating event.

2. The Chance Attributable to Accident Type. This is the chance attributable to each of the three types of credible initiating events. It is expressed as the chance in any one year of operation.

Three indicators of possible consequences are given in the next three divisions of Table 2.4.3-1.

3. The Maximum Total Number of Eventual Cancer Deaths. These are the total lung, liver, and bone cancer deaths that might occur after latency periods of 5 to 20 years in the potentially exposed populations as a result of inhaling plutonium dispersed in an accident. No short-term or acute effects would be expected in any member of the general public. Separate values are given for the most serious potential accidents resulting from each of the three types of initiating events. The values resulted from analyses that included assumptions of wind direction toward the largest metropolitan area and unfavorable atmospheric dispersion conditions. These wind directions occur 2.5 percent of the time in the Pantex Plant area, 4 percent of the time in the Iowa Army Ammunition Plant Area, and 6.1 percent of the time in the Hanford Site area. The unfavorable atmospheric conditions assumed for calculating consequences occur during only part of the time these wind directions occur. For other wind directions and more favorable dispersion conditions, the maximum numbers of potential cancers are smaller. The maximum total number of eventual cancer deaths that might result at each location under the extreme case assumptions were estimated to be 68 for the Pantex Plant Alternative, 69 for the Iowa Army Ammunition Plant Alternative, and 1 for the Hanford Site Alternative. These values may be compared with the normally expected number of deaths from the same three types of cancer from all other causes. In the Amarillo, Texas, area, 4,900 such cancer deaths normally would be expected from all other causes in the 142,000 persons potentially affected by the most serious accident. The comparable figures for the Burlington, Iowa, area are 1,180 normally expected lung, liver, and bone cancer

TABLE 2.4.3-1

COMPARATIVE SUMMARY OF UPPER LIMITS ON ACCIDENT RISK

Alternative/Option	1. Overall Chance of Occurrence of any Plutonium-Releasing Accident in 1 Year of Plant Operation (chance/year)	2. Chance Per Year Attributable to Specific Accident Type			3. Maximum Number of Possible Eventual Cancer Deaths Attributable to Most Serious Release From Accident Caused by:			4. Upper Limit on Chance for Maximum Exposed Individual of Eventual Cancer Death from any Plutonium-Releasing Accident in 1 Year of Plant Operation (chance/year)	5. Maximum Costs to Clean Up Contaminated Area by Type of Accident (millions, 1981 dollars)		
		Aircraft	Tornado	Operational	Aircraft	Tornado	Operational		Aircraft	Tornado	Operational
Pantex Alternative											
Option 1: New construction	1 in 7,900	1 in 9,400	1 in 50,000	1 in 1,000,000	68	1	9	1 in 17,000,000	890	890	590
Option 2: Major upgrade	1 in 7,300	1 in 7,400	--	1 in 1,000,000	68	--	2	1 in 28,000,000	890	--	22
Option 3: Major replacement	1 in 22,000	1 in 23,000	--	1 in 1,000,000	68	--	2	1 in 44,000,000	890	--	22
Option 4: Existing facilities	1 in 9,700	1 in 12,000	1 in 50,000	1 in 1,000,000	68	1	9	1 in 19,000,000	890	890	590
Iowa Army Ammunition Plant Alternative											
Option 1: Partial relocation (risk in Iowa added to Pantex Plant Option 4)	1 in 59,000	1 in 59,000	--	1 in 4,000,000	69	--	1	1 in 125,000,000	740	--	17
Option 2: All-new Plant	1 in 53,000	1 in 55,000	--	1 in 1,000,000	69	--	1	1 in 55,000,00	740	--	17
Hanford Site Alternative											
All-new Plant	1 in 1,000,000	--		1 in 1,000,000	--	--	1	1 in 500,000,000,000	--	--	21 (all onsite)

deaths in a population of 34,400 and for the Richland, Washington, area, 4,100 normally expected deaths from such cancers in a population of 119,000.

4. The Chance that a Maximum Exposed Individual Might Eventually Die of Cancer. This is the chance that an individual near the plant boundary, where exposures were calculated to be the highest, might eventually contract and die from lung, liver, or bone cancer after a latency period of 5 to 20 years as a result of inhaling plutonium dispersed by an accident. The values given are expressed as chance per year of plant operation that an individual at the location might die of cancer from any of the credible accidents. It is the sum of the maximum individual risks for all credible accidents analyzed for each option and includes the probabilities of individual accidents, the fraction of the time the wind blows in the particular direction, and the chance of contracting cancer, assuming the accident actually happened. The greatest chance that a maximum exposed individual might eventually die of cancer from a plutonium-dispersing accident at each location was estimated to be 1 chance in 17 million a year for the Pantex Plant Alternative (Option 1), 1 chance in 55 million a year for the Iowa Army Ammunition Plant Alternative (Option 2), and 1 chance in 500 billion a year for the Hanford Site Alternative. These values can be compared with the overall United States average chance of death from all other types of accidents, which is 1 chance in 2,000 per year.

5. The Estimated Maximum Costs to Clean Up Residual Contamination in the Area Affected by an Accident. Separate values are given for the most serious potential accidents resulting from each of the three types of initiating events. The estimates considered decontamination of structures, removal of vegetation and soil, and other measures necessary to assure that the dose guidelines for transuranium contamination in the environment proposed by the Environmental Protection Agency would be met. If no decontamination were conducted, higher levels of residual plutonium would remain. These levels, assuming no decontamination, could increase average individual risks from the maximum release accident as much as 49 percent in the case of the Pantex Plant, about 10 percent for the Iowa Army Ammunition Plant, and insignificantly for the Hanford Site.

The table provides the basis for important comparisons of accident risk among the various alternatives and options. In terms of the overall chance of occurrence of any plutonium-releasing accident (Column 1), the Hanford Site Alternative has the lowest likelihood (about 1 chance in a million per year). The other new plant options would have a greater chance. The Iowa Army Ammunition Plant Option 2 has an intermediate likelihood (1 chance in 53,000 per year) and the Pantex Plant Option 3 has the largest likelihood (1 chance in 22,000 per year). The partial relocation alternative (Iowa Army Ammunition Plant Option 1) includes some risk in Iowa (1 chance in 59,000 per year) and some risk in Texas (1 chance in 9,700 per year). The other Pantex Plant Options (1 or 2) have likelihoods (1 chance in 7,900 or 7,300 per year, respectively) that are similar and the highest of the various alternatives.

Comparison of the chance of specific types of accidents (Column 2, including its subdivisions) that could lead to release of radioactive materials highlights certain similarities and some differences between the Options. For example, the likelihood of an operational accident is the same (1 chance in a million per year) for all but one option because that likelihood is primarily dependent on the nature of the work performed and is not significantly affected by differences in structures. (The chance for an operational accident in Iowa under Iowa Army Ammunition Plant Option 1 is lower because only 25 percent of the workload would be done there.) The consequences of an operational accident, however, are reduced by improved structures proposed for all options except Pantex Plant Options 1 and 4 (Column 2). The likelihood for tornado-induced accidents is the same for Pantex Options 1 and 4 because certain existing structures would continue to be used. Under Pantex Plant Options 2 and 3 and the Iowa and Hanford Alternatives, new structures could withstand any credible tornado, thereby eliminating the chance of a tornado-induced, radioactivity-releasing accident.

The differences in the chance of aircraft-induced radioactivity-releasing accidents among the three major Alternatives are primarily attributable to differences in air traffic and the relative proximity of sites to airways and airports. The differences in the chance of an aircraft-induced accident among the Pantex Plant Options are largely affected by the size and design of proposed new structures. Pantex Plant Options 1 and 2 would increase the area of certain types of structures; thereby increasing the likelihood of and aircraft-induced accident. However, the design of the structures under Options 2 would reduce the overall consequences from such accidents, as is indicated by the maximum individual risk (Column 4). The structures proposed for Pantex Plant Option 3 would lower the likelihood that an aircraft crash could result in a release of radioactivity (Column 2). The probably of an aircraft-induced accident at the Hanford Site was found to be not creditable.

The maximum consequence accident, in terms of the maximum number of possible eventual cancer deaths (Column 3), is a particular aircraft-induced accident and is the same for all four Pantex Options (see Table II, Column 2, of the Summary). This is because the structures involved in that potential accident are included in all four Pantex Plant Options with no changes. A very similar type of accident could occur at the Iowa Army Ammunition Plant and is also estimated to result in the maximum number of possible eventual cancer deaths for either of the two Iowa Options (Column 2).

2.5 ENVIRONMENTAL IMPACTS OF RELATED TRANSPORTATION OPERATIONS

This section summarizes major conclusions on enviromental impacts associated with transportation operations. Section 4.3 contains a more detailed discussion of the topic.

Environmental impacts resulting from related transportation operations fall into either of two major categories--normal operations or accidents. Consequences were calculated for normal operations as they are now associated with Pantex Plant operations. Accidents were treated statistically by calculation of a probability of occurrence. If the probability was found to be greater than 1 chance in a million per year, the consequences were calculated to determine the significance. This is the same approach that was used for evaluating plant operations. See Section 2.4.1 for a discussion of credibility and significance definitions.

2.5.1 Normal Transportation Operations Related to the Pantex Plant Alternative

The impacts for normal operations and accidents are further separated into those that result in a radiological effect and those that are nonradiological in nature. All impacts associated with normal transportation operations were assessed to be negligible.

Radiological

The radiological impacts of Pantex Plant-related normal transportation are limited to radiation doses received by couriers, other employees, and the general public. The maximum radiological dose for a nonoccupational individual was assessed to be less than 0.5 millirem per year.

Nonradiological

Nonradiological impacts are comparable to impacts resulting from the equivalent types of traffic; that is, cars, trucks, trains, and aircraft. In all cases, for all affected areas, the Pantex Plant contribution was calculated to be less than 1 percent.

2.5.2 Transportation Accidents Related to the Pantex Plant Alternative

Radiological

The primary concern for transportation accident impacts (as it was for plant impacts) is the detonation of conventional high-explosive components that could result in the release of plutonium to the atmosphere. The crash of a Safe-Secure Trailer containing nuclear weapons with a loaded fuel tanker truck and resulting in a long-burning fire near the Safe-Secure Trailer was the only such accident calculated to have a likelihood of about 1 chance in a million per year considering the distances traveled nationwide. The probability of such an accident occurring within a 50-mile radius of the Pantex Plant is about 1 chance in 20 million a year, or about 5 percent of the nationwide risk. The assessment of potential consequences of such an accident was based on the assumption that it occurred on an interstate highway at a major exit in a large metropolitan area (population between 1/4 and 1/2 million) while enroute between the Pantex Plant and a military destination. Wind direction and atmospheric dispersion conditions were chosen to maximize effects. This evaluation estimated that as many as 38 additional cancer deaths could eventually occur in the exposed population. About 52 square kilometers could be contaminated at levels that could require cleanup to assure that proposed Environmental Protection Agency guidelines would be met. The cleanup cost could be as much as $500 million.

All other hypothesized transportation accidents involving nuclear weapons had probabilities less than the occurrence probability threshold. The Department of Energy does not ship nuclear weapons by air.

There is some possibility of accidents associated with routine Department of Energy shipments of nuclear weapons components containing radioactive material and shipments of nonweapon radioactive materials. All of these with one exception have a chance of occurrence less than 1 in a million per year. The exception is a crash and resulting fire from a chartered aircraft carrying nuclear components containing tritium. The probability of release of tritium to the atmosphere from an aircraft crash was calculated to be less than 1 chance in 25,000 per year. A consequence evaluation that assumed release of all of the tritium from all of the components predicted a maximum individual dose of less than 1 rem.

Some potential for transportation accidents is related to shipments of low-level radioactive wastes by common carrier truck freight. Such shipments are made in accordance with Department of Transportation regulations. They are considered to have low risk, both by a generic evaluation in a Nuclear Regulatory Commission environmental impact statement and by a specific assessment of consequences in this document.

Nonradiological

Nonradiological impacts were assessed for hazardous materials shipped to and from the Pantex Plant. Two postulated accidents involving high explosives and one postulated accident involving gasoline or diesel fuel were assessed to have a chance of occurrence greater than 1 in a million per year.

High explosives are shipped to and from the Pantex Plant by contractor aircraft and by commercial truck. For air shipments, the likelihood of a crash of a plane carrying high explosives to or from the Pantex Plant is about 1 chance in 300 per year. A consequence assessment of explosive damage potential and aircraft damage potential indicates that for the amounts of explosives transported, the hazards are essentially those that result from the crash of the plane itself. For commercial truck shipments, fire is the only credible circumstance that could cause detonation of the high explosives. The probability of an accident involving a fire is less than 1 chance in 1,700 per year. Approximately 25 shipments of gasoline and diesel fuel are made per year with the probability of a fire being less than 1 chance in 20,000 per year. For all of these nonradiological incidents, consequences represent a small proportion (less than 1 percent) of that type of accident in the affected area.

2.5.3 Iowa Army Ammunition Plant and Hanford Site Alternatives

All of the transportation impacts are closely proportional to distance traveled. The Iowa Army Ammunition Plant Alternative would result in an insignificant change in transportation impacts. The Hanford Site Alternative would, at most, double the normal transportation impacts and double the occurrence probability for accidents.

2.6 PREFERRED ALTERNATIVE AND ADDITIONAL MITIGATING MEASURES

2.6.1 The Preferred Alternative

The preferred alternative is to continue nuclear weapons operations and construct new facilities at the Pantex Plant in order to meet increased workload schedules. The Department of Energy intends to pursue completion of the projects identified in Option 1 and additional new facilities that would at least provide all of the operational reliability design features represented by Option 2. For some operations it is possible that operational reliability features represented by Option 3 will be found desirable or necessary.

Thus, the first three Pantex Plant Options encompass the actions considered most likely and illustrate the range of possible costs, improvements in safety, and environmental impacts. While each of the options is precisely defined to provide a sound basis for evaluation, it should be clear that they are not mutually exclusive and that features from more than one option could be combined. This Environmental Impact Statement will be instrumental in formulating the decisions regarding the implementation of these options.

2.6.2 Additional Mitigating Measures Identified for Consideration

Additional mitigating measures to address specific environmental issues were identified during the detailed evaluation of the basic alternatives.

These measures are not now part of any of the Alternatives described earlier. However, some are already being actively investigated by the Department of Energy. The measures are organized into two categories: (1) those that could reduce the probability or consequences of potential accidents; and (2) those that could reduce the degree of impact from some routine operations.

Possible Mitigating Measures for Potential Accidents

- The potential for accidents induced by aircraft crashes and resulting in the dispersion of plutonium was examined for measures that could reduce the likelihood of such accidents. A revised analysis of probability based on the most current air traffic information supplied by the Federal Aviation Administration shows that the chance of such an accident is low, less than 1 in 7,400 a year for any Pantex Plant Option. However, aircraft crash-induced accidents still have a likelihood of occurrence larger than any of the other potential major accidents associated with operating the Pantex Plant. The Draft Environmental Impactment Statement proposed two specific measures that had the potential to result in significant reduction of the likelihood of an aircraft crash into Plant structures of concern. These were to extend the prohibited airspace associated with the Plant and to move the VORTAC radio navigation device to a location further from the Plant. The goal of these proposals was to reduce the number of aircraft operations on courses that could take them over the Plant. Extensive interactions with the Federal Aviation Administration have identified other means that would be more practical to achieve the fundamental goal without incurring the operational problems at the Amarillo airport that would result from the two proposals contained in the Draft Environmental Impact Statement.

  The Federal Aviation Administration is already planning to implement some changes that will reduce the number of aircraft operations contributing to the risk. Additional changes may be possible and will continue to be explored jointly by the Department of Energy and the Federal Aviation Administration.

  A project to improve the instrument-landing system at the Amarillo Airport is planned to start in late summer of 1983. It will result in the elimination of one of the instrument approaches passing over the Pantex Plant. This will reduce the chance of an onsite crash from local airport traffic by about 50 percent. It may be possible to have more approaches from the east follow a course equivalent to the present VORTAC approach pattern. A statistical analysis based on April 1983 traffic indicates this could result in a reduction in the chance of an onsite crash-induced accident by a factor of more than 100.

  The likelihood of an aircraft crash-induced accident resulting from air traffic enroute on airways associated with the VORTAC represents the largest portion (about 89 percent) of the total aircraft risk. The probability of such accidents is currently assessed to be lower than used in the Draft Environmental Impact Statement because of the elimination of certain commercial flights. An additional incremental reduction is expected to occur when the Federal Aviation Administration eliminates one of the low-altitude airways in 1983. Additional possible measures to redirect aircraft on the low- or high-altitude airways could further reduce this component of risk. One measure that will be discussed further between the Department of Energy and the Federal Aviation Administration is the possibility of establishing an additional VORTAC that would permit redirection of more flights to reduce the number that are on courses that line up with the Pantex Plant. A statistical analysis based on the most recent air traffic data through April 1983 indicates that if all enroute flights could avoid the Pantex Plant by at least 10 kilometers, the probability of aircraft crash-induced accidents could be reduced by a factor of about 100.

  Thus, it appears possible that if further measures considered for both local traffic and enroute traffic are determined to be feasible there could be an overall reduction of the likelihood of aircraft crash-induced accidents by a factor of about 100. It may not be possible to implement changes for all involved airways and airport operations, in which case the reductions in risk would not be as much. However, the Department of Energy plans to continue working with the Federal Aviation Administration to implement the most effective practical changes to further reduce the risk of Plant-related accidents without disrupting or imposing other risks on normal aircraft operations.

Other measures being investigated are the modification or rebuilding of structures to reduce or eliminate any offsite consequences, should an aircraft crash occur. These measures include berming or burying the structures.

- Gravel Gerties are special structures with ceilings made of a suspended, thick layer of gravel designed to filter out plutonium, should an accident occur in the workspace. Engineering studies have shown that the existing access doors may fail under the accidental detonation of the maximum allowable amount of high explosive, thereby permitting unfiltered debris to be expelled. (The accident analysis for Pantex Option 1 and 4 assumed such a failure would occur.) The Department of Energy currently is investigating various methods to refit or replace these blast doors to assure against blast door failure. If the doors and entrance way could be modified to assure withstanding an accidental detonation, the maximum release of plutonium from such an accident could probably be reduced by a factor of about 40. This would reduce the number of possible eventual cancer deaths from an operational accident under Pantex Plant Options 1 or 4 from 9 to 2 (Table 2.4.3-1).

- Only one credible postulated offsite transportation accident could result in the release of plutonium. This accident involves a long-burning fuel fire resulting from an accident between a Safe-Secure Trailer transport vehicle and a tanker truck. Possible mitigating measures including modifications to either procedures or equipment are being investigated.

Possible Mitigating Measures for Normal Operation. Although various normal operations were found to have some degree of environmental impact, none were considered significant. Some mitigating measures are being considered to reduce further those already small impacts.

- A new Test-Firing Facility is being considered. This possible facility is in addition to the Interim Test-Firing Facility (Project 11, Table 2.2.1-1) now under construction. The new facility would provide containment of all emissions from all high-explosive test shots involving either depleted uranium or beryllium.

- Recycling of solvents may be accomplished in the future, reducing emissions from solvent evaporation to nearly zero.

3.0 AFFECTED ENVIRONMENTS

This chapter describes the environments of three locations (the Pantex Plant, the Iowa Army Ammunition Plant, and the Hanford Site) that might be affected by the alternative actions. Emphasis is on discussions and information deemed necessary to understand the analyses in Chapter 4 and comparisons of alternatives in Chapter 2. More detailed material is referenced or published as a separate document.

Chapter 3 has two major sections. Section 3.1 describes general conditions (within a regional context), existing facilities, and current operations at all three sites. Section 3.2 deals with the existing environmental conditions. It emphasizes those areas deemed important by the public or those areas most likely to be affected by the alternatives. The discussions of the existing environment at the Pantex Plant reflect the cumulative effects of nuclear weapons operations there over the past 30 years. The topical sections are organized in the same fashion used for Section 2.3. Each topical subsection presents information for each site in the same sequence.

3.1 GENERAL SETTINGS OF THE SITES

All three alternative sites are now under some form of Federal government control and are restricted from public access. The Pantex Plant site near Amarillo, Texas, is the location of current nuclear weapons operations and proposed new construction. The Iowa Army Ammunition Plant site near Burlington, Iowa, has facilities previously used for nuclear weapons operations and currently is used for conventional munitions operations. The Hanford Site near Richland, Washington, was selected as an example site for an all-new plant. This selection was based on a detailed study that evaluated regional and site-specific criteria to select suitable candidate sites for nuclear weapons operations facilities (LATA 1981).

3.1.1 General Environs

The local environs differ greatly among the three sites. However, each is located in relatively flat, open country away from major mountain ranges. All three locations have agricultural areas onsite under cultivation. Each site is located relatively close to urban areas and has potential ecological pathways for pollutant transfer to man through agricultural practices and game management programs.

3.1.1.1 Pantex Plant--General Environs

The 3,700-hectare (9,100-acre) Pantex Plant Site is located in the Panhandle of Texas, Carson County, approximately 27 kilometers (17 miles) northeast of downtown Amarillo (Fig. 2.1.1-A). In addition to the Pantex Plant, the Department of Energy owns a 436-hectare (1,077-acre) portion of a large playa approximately 6 kilometers (4 miles) northeast of the Plant. This property, known as Pantex Lake, is currently being used for private agricultural purposes and is being held by the Department of Energy for its long-term potential development as a water-supply well field. No plans are contemplated for such development in the foreseeable future. The water wells used to supply Amarillo with drinking water border this property.

The Pantex Plant is located in the treeless high plains of Texas; it lies on the transition zone between the North Central Plains and the Llano Estacado (staked plains) to the south. The region, settled in the late 1800's and early 1900's, is a semiarid farming and ranching area. The few trees currently there were planted for wind breaks, shade, or fruit production. The Pantex Plant is surrounded by agricultural land. Ownership is both private and institutional. Approximately 80 percent of the land within the Plant boundary is used for agricultural purposes by land lease arrangements with Texas Tech University Agriculture Research Station. Broken or rolling land is typically kept in native grass pasture and seasonally grazed whenever rainfall is sufficient to produce grass growth. Wheat fields are grazed in the late fall, winter, and early spring to stimulate tillering; grain sorghum is grazed in the fall after the crop is combine-harvested. Although dryland farming dominates this region, some fields are irrigated from local playas or from deep wells pumping water from the Ogallala aquifer.

The climate at the Pantex Plant is typical of the high great plains. It is characterized by hot summers and relatively cold winters (USDC 1981). The Pantex Plant is in a windy area with the prevailing wind direction from the south through southwest (Fig. 3.1.1.1-A). Rainfall is variable, averaging 50 centimeters (20 inches) per year with individual annual totals ranging from less than 25 centimeters (10 inches) to greater than 90 centimeters (35 inches). Thunderstorms occur about 49 days per year and can produce tornadoes. The design criteria tornado windspeed for the Pantex Plant is 112 meters per second (250 miles per hour) (Texas Tech 1974).

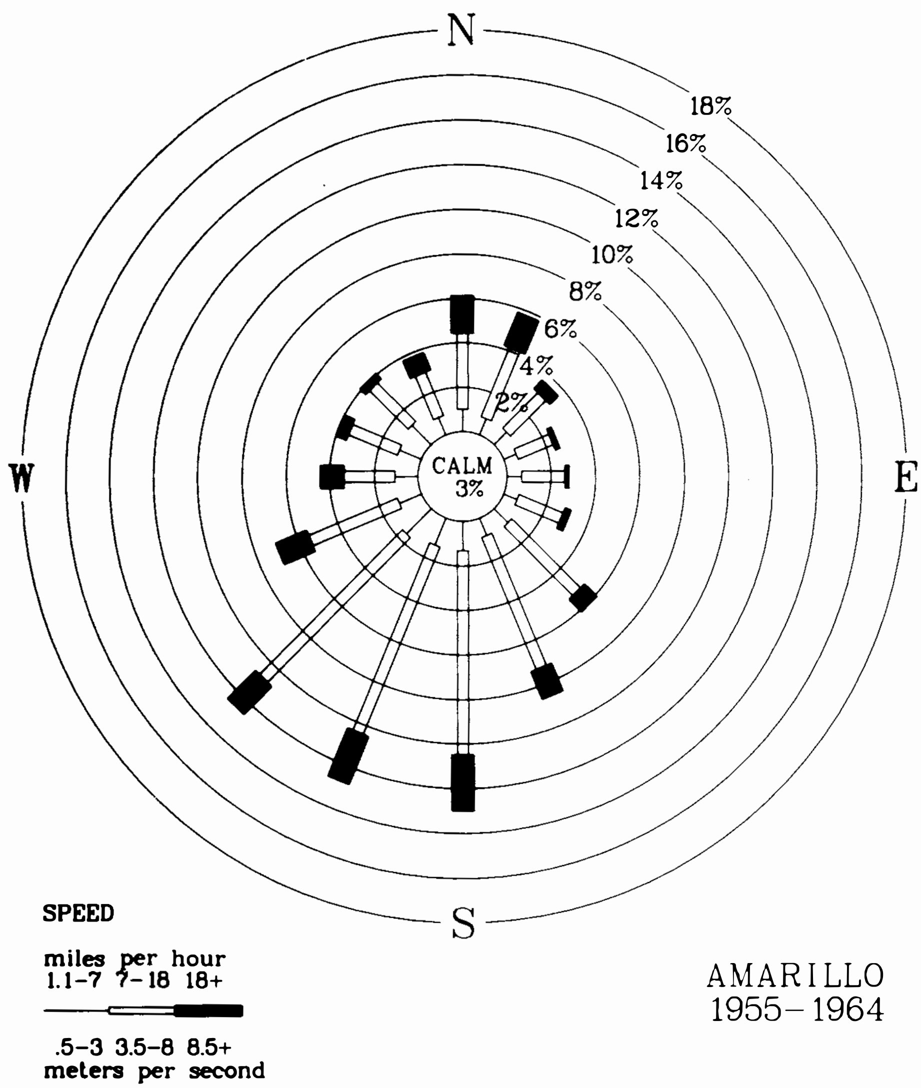
3.1.1.2 Iowa Army Ammunition Plant--General Environs

The 7,800-hectare (19,300-acre) Iowa Army Ammunition Plant is located in southeastern Iowa, Des Moines County, approximately 16 kilometers (10 miles) west of downtown Burlington. Plant headquarters are adjacent to the town of Middletown on the main line of the Burlington Northern Railroad (Fig. 2.2.2-A). This area was settled in the early 1800's and has several points of interest dating back to the Civil War era. However, no historic sites registered with the National Register of Historic Places exist within Plant boundaries.

The region contains some of the most productive farmland in the world. The terrain is mostly level to gently sloping; however, it is broken by rougher topography along drainage ravines and stream channels. The landscape, both within and surrounding Plant boundaries, is a mosaic of fields and hardwood forests. An excellent growing season is coupled to an annual rainfall pattern that eliminates most requirements for irrigation, and almost any acclimated crop can be grown. Most level land is cultivated. Corn and soybeans, the preferred crops, are planted on a crop rotation schedule to maintain high levels of soil fertility.

Approximately 70 percent of the land within the Plant boundaries is farmed (row crops or improved pastures). Land is leased to private farmers or maintained for wood production under an aggressive forest management plan. In addition, an active wildlife management plan encourages production and use of wildlife species.

The climate at the Iowa Army Ammunition Plant is typical of continental, mid-latitude locations. It is characterized by hot, humid summers and cold, relatively snowy winters (USDC 1980). The prevailing wind direction at the Iowa Army Ammunition Plant is from the south to southwest with stronger winds from the north and northwest (Fig. 3.1.1.2-A). Rainfall averages 90 centimeters (35 inches) per year with two-thirds falling during the growing season; snowfall averages 60 centimeters (25 inches) per year. Thunderstorms occur about 50 days per year, primarily in the spring and summer, and can produce high winds, hail, and tornadoes. The continental U.S. has been assessed to determine a regional design-basis tornado (ANSI 1980); the tornado design wind speed for Iowa is 112 meters per second (250 miles per hour). The design criteria wind speed used at the Iowa Army Ammunition Plant for new facilities is 160 meters per second (360 miles per hour) (MHSM 1971B).



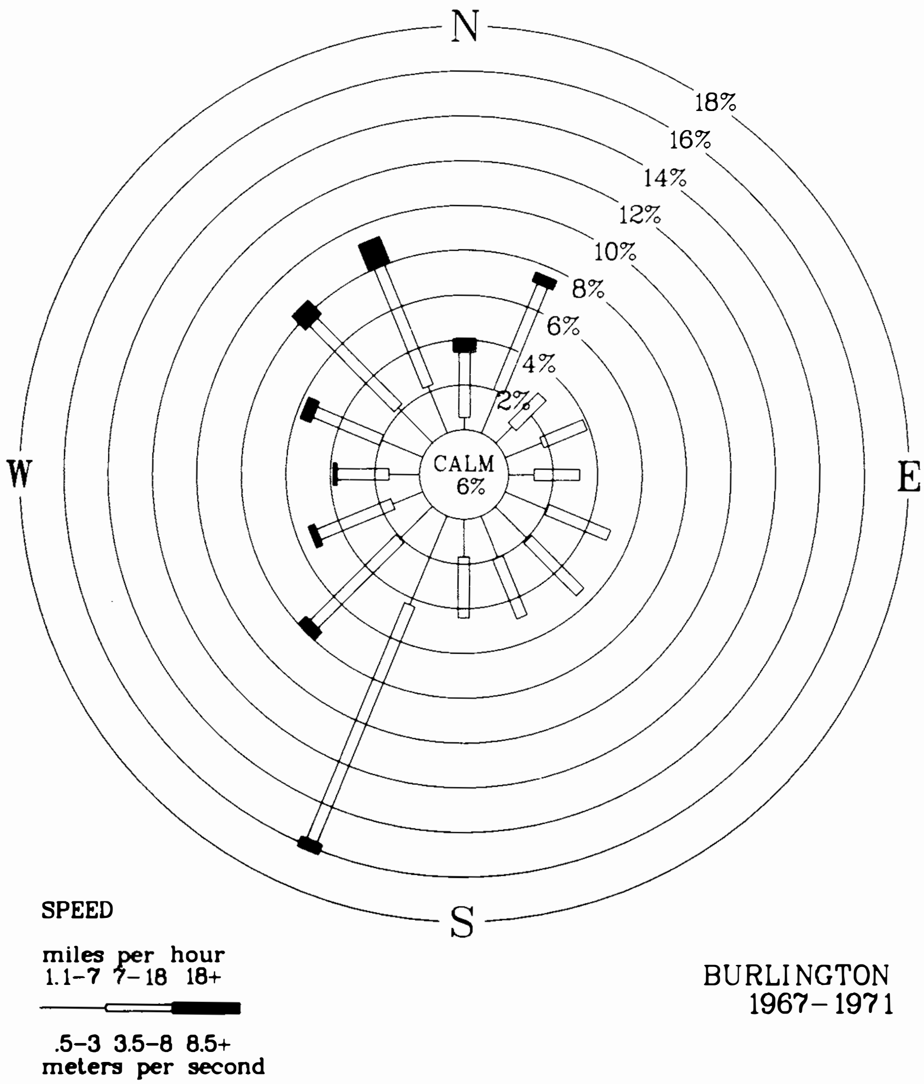
The lines and bars coming from the center of the wind rose represent the frequency of the wind speed interval coming from that particular direction. Sixteen wind directions (N, NNE, NE, ...) are presented, each covering 22.5 degrees of the circle.

Figure 3.1.1.1-A. Wind rose for Pantex Plant area.

3.1.1.3 Hanford Site--General Environs

The 147,800-hectare (360,100-acre) Hanford Site is located in semiarid southeastern Washington just north of the junction of the Yakima, Snake, and Columbia Rivers (Fig. 2.2.3-A). This area was settled in the late 1800's and early 1900's by farmers who developed local irrigation districts using the Columbia River. Average rainfall is low; however, as is typical of most desert communities, a wide variety of crops can be grown when water is supplied. A truck farm industry thrives on the irrigated fields. There is also wheat farming and forage production for a livestock industry.

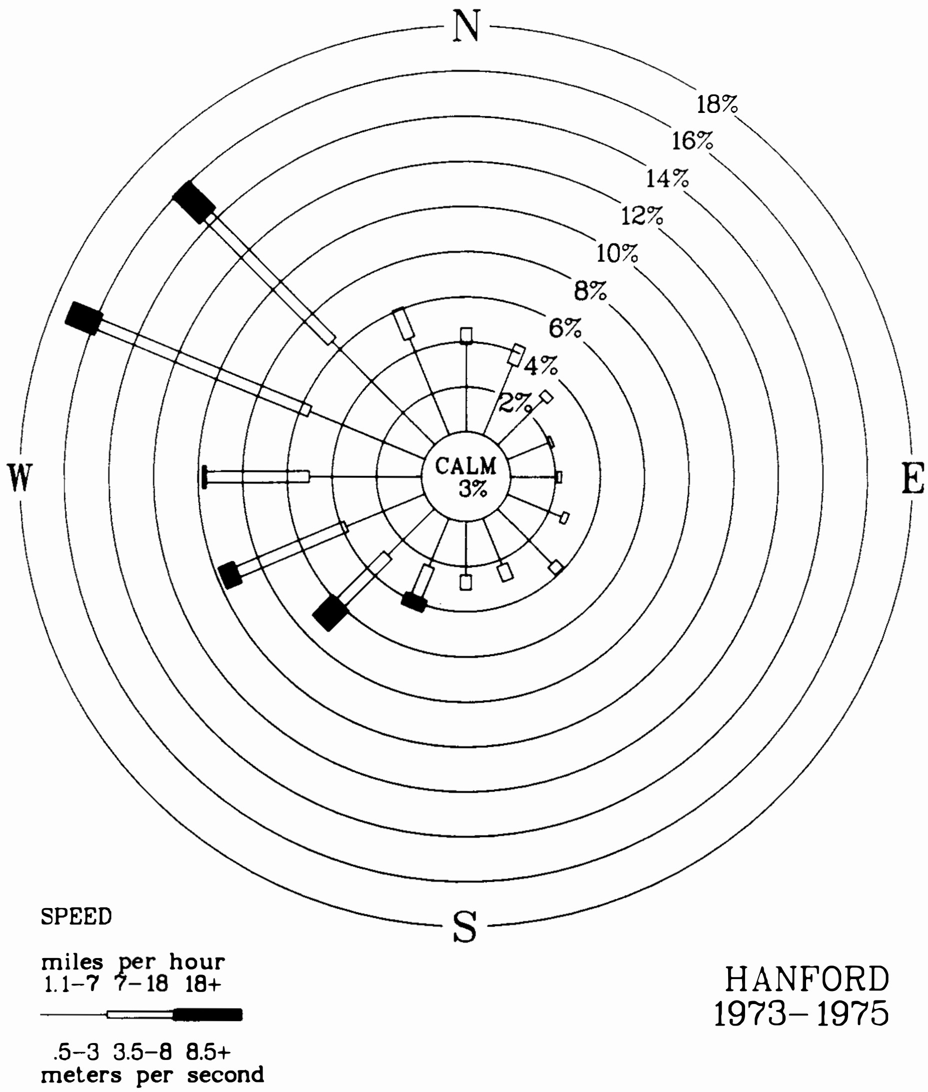
The proposed site is located in the north-central portion of the Hanford Site approximately 32 kilometers (20 miles) northwest of Richland. This area supports sagebrush and native grasses that provide wildlife habitat.



The lines and bars coming from the center of the wind rose represent the frequency of the wind speed interval coming from that particular direction. Sixteen wind directions (N, NNE, NE, ...) are presented, each covering 22.5 degrees of the circle.

Figure 3.1.1.2-A. Wind rose for Iowa Army Ammunition Plant area.

The climate is dominated by the rain shadow of the Cascade Mountain range (Stone 1972). Moisture-laden storms originating from the Pacific during winter and spring tend to rain-out as they cross the Cascades, resulting in a relatively low annual rainfall [an average total of 16 centimeters (6.3 inches)] at the Hanford Site. Winters are relatively cold, averaging 1°C (33°F); snowfall totals average only 33 centimeters (13 inches) per year. Summers are sunny, dry, and warm. The prevailing wind direction is from the west-northwest caused by air draining off the Cascade range across eastern Washington (Figure 3.1.1.3-A). Thunderstorms occur about 11 days per year, but severe thunderstorms are rare. One tornado has been observed (in 60 years) on the Hanford Site. The design criteria for nuclear reactors or structures for the storage of plutonium at the Hanford Site require the facility to withstand tornado wind speeds of 78 meters per second (175 miles per hour) (USAEC 1974).



The lines and bars coming from the center of the wind rose represent the frequency of the wind speed interval coming from that particular direction. Sixteen wind directions (N, NNE, NE, ...) are presented, each covering 22.5 degrees of the circle.

Figure 3.1.1.3-A. Wind rose for Hanford Site area.

3.1.2 Existing Facilities

3.1.2.1 Pantex Plant--Existing Facilities

General Characteristics

The facilities at the Pantex Plant include some 288 buildings totaling approximately 139.5 thousand square meters (1.5 million square feet) of floor space (USERDA 1976). The Plant was established in 1951 on a portion of the former Pantex Army Ordnance Plant constructed in 1942. The original Plant was used during World War II for loading conventional ammunition shells and bombs. Several of the original buildings [55.8 thousand square meters (600 thousand square feet)] were converted in 1951 to nuclear weapons operations facilities and are still in use. All other nuclear weapons operations facilities being used were built since 1952 and are designed specifically for nuclear weapons operations work (USERDA 1976).

The Plant is divided into several major working areas. The manufacturing area is devoted to fabrication of high-explosive components and weapon assembly/disassembly operations (Section 2.1). The high-explosives development area supports various Department of Energy nuclear weapons design agencies. The temporary holding area is a safe, secure place for high explosives and nuclear weapons that are not actively being worked on. Other important facilities include test-firing sites for testing high explosives, a landfill disposal area, a burning ground for disposal of scrap high explosives, a water treatment plant, a steam generation plant, and a sewage treatment plant.

The manufacturing area in which nuclear weapons operations are conducted covers approximately 80 hectares (200 acres) and contains more than 100 buildings. This area is surrounded by a security zone. Descriptions of the weapons operations performed in the manufacturing area are presented in Chapter 1, Section 1.4.

The high-explosive development area consists of facilities that contain several bays with heavy reinforced-concrete walls. These facilities are used for synthesizing new high explosives and fabricating these new high explosives into experimental shapes. See Chapter 1, Section 1.4.4, for a description of developmental high-explosives operations.

The test-firing site has several reinforced-concrete bunkers containing control rooms and camera areas. Experimental high-explosive configurations are detonated on firing pads surrounded by earthen bunkers. Selected samples of high explosive components also are detonated for quality assurance testing.

Support facilities at the Pantex Plant include a cafeteria, changehouse, tool and die shop, water treatment plant, sewage treatment plant, photography laboratory, central health facility, plastic shop, garage and vehicle maintenance facility, and steam generation plant.

3.1.2.2 Iowa Army Ammunition Plant--Existing Facilities

General Characteristics

The Iowa Army Ammunition Plant at Burlington, Iowa, contains 1,210 buildings with a total floor space of 407 thousand square meters (4.4 million square feet). The Plant has 11 assembly lines that have been used for production of various munitions such as artillery shells and mines (USARMY 1980).

In 1947 the Burlington Atomic Energy Commission Plant was created within the confines of the Iowa Army Ammunition Plant to fabricate chemical explosives and perform nuclear weapons operations. Some Army facilities were transferred to the Atomic Energy Commission and some new facilities were constructed at that time. The mission of the Burlington Atomic Energy Commission Plant included nuclear weapons operations and other weapons program work as directed by the Atomic Energy Commission.

Those areas of the Iowa Army Ammunition Plant used by the Burlington Atomic Energy Commission Plant included the manufacturing area, the temporary holding area, the firing site, and the explosive disposal area. The manufacturing area housed all high-explosive fabrication and nuclear weapons assembly/ disassembly operations. It contained 28 buildings [total floor area--39.9 thousand square meters (430 thousand square feet)] classified as production facilities. These included the assembly cells and bays of heavy reinforced-concrete construction. In addition, there were 83 support buildings [35.9 thousand square meters (387 thousand square feet)]. These included laboratories, shops, offices, storage, equipment rooms, control rooms, pump houses, guard stations, personnel shelters, change house, and a steam generation building.

The temporary holding area contained 43 reinforced-concrete, earth-covered buildings, all of which were accessible by railroad track and road. These structures were used for temporary holding of nuclear weapons. A test-firing site having several control rooms, camera rooms, and test-firing pads was used for testing high explosives. A waste disposal area was used for burning waste high explosives.

By 1975, all nuclear weapon operations were shifted to the Pantex Plant and all facilities at the Iowa Army Ammunition Plant were returned to the Army. Some of the buildings in the manufacturing area currently are being used for high-explosive production and conventional ammunitions assembly. These buildings are all in good condition. The remaining buildings in the manufacturing area are not in active use but are maintained for possible mobilization. They are in relatively good condition, and may require only painting and air-conditioning system (heating and ventilation) maintenance to be returned to usable condition. There is sufficient space available within the plant boundaries for the construction of new high-explosive fabrication and nuclear weapons operations facilities.

3.1.2.3 Hanford Site--Existing Facilities

General Characteristics

Current major operations on the Hanford Site include an operating plutonium production reactor, fuel reprocessing and waste management facilities, the Fast Flux Test Facility, and support facilities (Jamison 1981). Purex, a fuel reprocessing facility, was used from 1955 to 1972 and is planned to restart operations in the future (USDOE 1982C, USDOE 1983). The Washington Public Power Supply System has three commercial nuclear power plants under construction on an area of the Hanford Site leased from the Department of Energy. Work on two of them has been stopped.

The Hanford Site is used for nuclear reactor operations or nuclear-reactor-related operations. This includes the operation of the plutonium-producing reactor and generation of electricity using the byproduct steam. Other operations include the maintenance of Purex to restart reprocessing of irradiated plutonium for reactor fuels production, fission product separation, criticality research, and radioactive waste storage. In addition, there is the production of uranium oxide, plutonium purification and conversion, plutonium storage, nuclear reactor fuel fabrication, reactor fuels research and development, liquid-metal fast-breeder reactor technology development, life science research, and Fast Flux Test Reactor support activities.

3.2 EXISTING ENVIRONMENTAL CONDITIONS

3.2.1 Air

3.2.1.1 Pantex Plant--Air

Air quality at the Pantex Plant meets all Federal and Texas primary air quality standards (Texas 1981) for sulfur dioxide and particulates. The Pantex Plant has no industrial processes that are significant sources of these pollutants, or of carbon monoxide, ozone, lead, nitrogen dioxide, and hydrocarbons (MHSM 1982). The high annual average wind speed of 6 meters per second (14 miles per hour) provides one of the lowest air stagnation potentials in the U.S. (Holzworth 1972).

Texas Air Control Board measurements at Amarillo for 1981 show total suspended particulates and sulfur dioxide to be within both state and Federal limits. These values are presented in Table 3.2.1.1-1.

The major sources of pollutants from operations at the Pantex Plant are waste high-explosive burning, steam generation from an existing natural gas-fired plant, and waste organic solvent evaporation. For these sources, air concentrations were estimated by theoretical calculation for both onsite and offsite locations (Macdonell 1982). None of these estimated values exceeded applicable standards. Table 3.2.1.1-2 lists data on all pollutants emitted at the Pantex Plant that are regulated by either Federal or State Ambient Air Standards. Table 3.2.1.1-3 presents air concentrations of waste organic solvents that are regulated for worker exposure but not regulated by national or state ambient air standards. Yearly totals for all the Pantex Plant major emissions are presented in Table 3.2.1.1-4. The largest single source of primary air pollutants (those assigned a National Air Quality Standard) is from vehicles used by workers driving to and from work. These releases are about 36 times greater than emissions from the gas-fired power plant and approximately 180 times greater than emissions from burning waste high explosives.

Waste high explosives and high-explosive contaminated material are disposed of by burning. There are three methods of burning: open earth pads, open-air incinerator cages, and a burn tank. The method used depends on the form and content of the material. Permission for open-air burning activities has been granted by the Texas Air Control Board (TACB 1976). Given worst case meteorological conditions, maximum burning emissions could have levels of nitrogen oxides (NO_x) of about 46 parts per million for 3-1/2 minutes (estimated time of burn) at the nearest site boundary. This would result in an estimated annual average concentration of 0.0004 parts per million. When NO_x comes in contact with moisture, nitrous acid and nitric acid are formed, which can cause discomfort to humans standing at the nearest boundary (Macdonell 1982). These effects could include irritation to the eyes and mucous membranes. No other effects would be expected.

Gaseous emissions from high-explosive test shots are at least 100 times smaller than those from burning of waste high explosives (Macdonell 1982). Thus, air concentrations from high-explosive test shots meet all applicable standards.

Potential releases of toxic air contaminants are controlled (where deemed necessary) with air-cleaning apparatus, such as high-efficiency particulate air filters. With the exceptions of burning waste high explosives and evaporating waste organic solvents at the burn site, most nonradioactive atmospheric releases are from fume hoods and building exhaust systems. The limited quantities released and infrequent nature of these releases do not constitute an environmental, worker, or public health

TABLE 3.2.1.1-1

AMBIENT AIR MEASUREMENTS AT AMARILLO FOR 1981

Pollutant	Time Period	1981 Measured Concentration	Units	Federal Primary Standard	Secondary Standard	Texas Standard
Total suspended particulates	24 hour	112	micrograms per cubic meter	260	150	150
	Annual	60	micrograms per cubic meter	75	60	75
Sulfur dioxide	3 hour	Not measured	parts per million	No standard	0.5	0.5
	24 hour	0.008	parts per million	0.14	No standard	0.14
	Annual	0.003	parts per million	0.03	No standard	0.03

TABLE 3.2.1.1-2

CALCULATED MAXIMUM OFFSITE AIR CONCENTRATIONS FOR PRIMARY AIR POLLUTANTS*
EMITTED FROM PANTEX PLANT
(All concentrations expressed in parts per million)

Source	Pollutant	Concentration	Time Period	Environmental Protection Agency Ambient Air Standard	Texas Ambient Air Standard
High-explosive burning	CO	3.2	1 hour	35.0	35.0
		0.4	8 hours	8.75	8.75
	NO	0.0004	Annual	0.05	0.05
	HF**	0.006	3 hours	No standard	0.006
Steam generation	CO	0.0027	1 hours	35.0	35.0
		0.0027	8 hours	8.75	8.75
	NO_2	0.00053	Annual	0.05	0.05

*Primary air pollutants are those for which a National Ambient Air Standard Exists.
**Hydrogen fluoride was included because of State standards.

TABLE 3.2.1.1-3

AIR CONCENTRATIONS FOR SOLVENT EVAPORATION AT PANTEX PLANT
(all concentrations in parts per million)

Solvent	Onsite* Solvent Concentration	Occupational Exposure Limits***		Offsite** Solvent Concentration
		15 minutes	8 hours	
Ethyl acetate	0.02	NS+	400	0.21
Acetone	0.05	1000	750	0.61
Methyl ethyl ketone	0.02	300	200	0.24
Toluene	0.01	150	100	0.08
Methanol	0.05	250	200	0.59
Butyl acetate	<0.005	200	150	0.03
Methyl isobutyl ketone	<0.005	75	50	0.05
Dimethylformamide	<0.005	20	10	0.01
Tetrahydrofuran	0.03	250	200	0.34
Isobutyl acetate	<0.005	187	150	0.05

*Onsite concentrations were calculated at the closest major occupied area (approximately 4,300 meters distant).

**Offsite concentrations were calculated at the closest site boundary (approximately 800 meters distant).

***From ACGIH 1981.

+NS means no standard.

TABLE 3.2.1.1-4

ANNUAL EMISSIONS FOR PANTEX PLANT MAJOR AIR POLLUTANT SOURCES

	Estimated Annual Emissions (kilograms)
Automobile Commuter Traffic	
Hydrocarbons	51,300
NO_x	679,300
CO	57,300
Gas-Fired Power Plant*	
NO_x	14,300
CO	3,200
Waste High-Explosive Burning (69,000 kilograms)*	
NO_x	3,250
CO	1,200
Organic Solvent Evaporation*	
Toluene	16,100
Acetone	20,800
Dimethylformamide (DMF)	12,200
Others	10,200

*Information from Laseter 1982.

hazard (MHSM 1973, MHSM 1975A, MHSM 1975B, MHSM 1976, MHSM 1977A, MHSM 1977B, MHSM 1978, MHSM 1979A, MHSM 1979B, MHSM 1980A, MHSM 1980B, MHSM 1982).

The amounts of solvents evaporated at the Pantex Plant are relatively small. For comparison, a small independent paint company would have uncontrolled emissions of approximately twice the amount of hydrocarbons [145 thousand kilograms (320 thousand pounds)] per year as the waste solvent evaporation operation at the Pantex Plant [60 thousand kilograms (132 thousand pounds)] (USEPA 1976).

Electric power at the Pantex Plant is provided by Southwest Public Service Company. Air pollutant emissions from Southwest Public Service Companv Plants that resulted from Pantex Plant electricity usage were only 0.3 percent of Southwest Public Service Company's total air emissions and are a negligible contribution to regional air pollution.

3.2.1.2 Iowa Army Ammunition Plant--Air

The air quality in the Iowa Army Ammunition Plant area is generally very good, reflecting moderate annual average wind speeds and few major industrial air pollution sources. Measurements taken by the State of Iowa indicate that the Burlington area is in compliance with Federal secondary standards for particulates (Johnson 1981). Routine monitoring data for other primary air pollutants are not available.

The major sources of emissions for the Iowa Army Ammunition Plant are several small boilers, the coal-fired main heating plant, burning high-explosive wastes, and high-explosive test shots.

Fuel oil is burned in several small boilers at the Iowa Army Ammunition Plant. A limitation of 2.2 percent sulfur content was included in the purchase agreement with a supplier. This percentage prevents exceeding sulfur dioxide concentration limits, as stated in state and Federal emission regulations. The coal-fired main heating plant is currently inoperable because the existing boilers cannot function properly with a recently installed electrostatic precipitator and a new 45-meter (150-foot) stack. Rehabilitation of this plant will permit it to operate in compliance with emission standards.

Until 1982 the Iowa Army Ammunition Plant burned explosive wastes and explosive-contaminated wastes in the open air. Ambient air sampling during high-explosive burns indicated compliance with nitrogen oxide standards (Honea 1973). Two new incinerators equipped with pollution control devices to reduce particulate emissions have been installed to replace open-air burning. Successful compliance tests were conducted in 1982 by the Army Environmental Hygiene Laboratory before full-scale operations began (US Army 1982).

High-explosive test shots are performed for quality assurance and to determine detonation characteristics. Quantitative measurements have not been taken at the site boundary for air pollutants from these shots at the Iowa Army Ammunition Plant. However, test shots release smaller amounts of nitrogen oxides than waste high-explosive burns, and measurements of high-explosive burns indicate compliance with ambient air standards (Honea 1973).

An incinerator for pathological wastes is used at the Iowa Army Ammunition Plant. The material burned includes hospital wastes and some chemical wastes from the chemical laboratory. This incinerator is used for several hours about once a week.

3.2.1.3 Hanford Site--Air

The Columbia Basin has a relatively high potential for air pollution because of frequent inversions and the air-trapping effect of the topography (Stone 1972); however, the Hanford Site is in compliance with Federal ambient air quality standards (Sula 1982). Particulate emissions from the Hanford Site operations constitute less than 0.2 percent of the particulate emissions in the Tri-County (Benton, Franklin, and Walla Walla counties) Air Pollution Control District (Sula 1981B). Routine emissions from the Hanford Site operations meet Federal emissions standards (Sula 1981B). Two onsite coal-fired power plants recently installed baghouses to control particulates. Tests are now being conducted to ensure compliance with emission standards.

3.2.2 Water

3.2.2.1 Pantex Plant--Water

The major surface-water source near the Pantex Plant is the Canadian River. The Canadian River is impounded at Lake Meredith about 40 kilometers (25 miles) north of the Plant. Water from the lake is diverted, mixed with ground water pumped from the Ogallala Formation, and used for municipal and industrial supplies for cities and towns in the high plains.

All surface-water drainage at the Pantex Plant is into playa basins; major runoff is into three onsite playas. The drainage from a small southeast area is into an offsite playa and portions of drainage along the northern boundary of the Plant go into a playa beyond the Plant boundary (Becker 1982B). There is no hydrologic connection that could transport potential contaminants into the Canadian River or Lake Meredith.

The Pantex Plant is underlain in ascending order above the Precambrian Basement Rocks by sediments of the Permian, Triassic, Tertiary, and Quaternary systems. The Ogallala Formation of the Tertiary system is of major importance. Deep wells completed at depths of about 180 to 260 meters (600 to 850 feet) into the gravels of the Ogallala Formation have provided the water supply at the Pantex Plant for more than 30 years. The Ogallala Formation also furnishes municipal and industrial water to nearby towns and cities and irrigation water to nearby farms. There has been little or no development of water supply from sediments of the Permian or Triassic systems because of low yield and poor water quality (Cronin 1964; Long 1961).

The Ogallala aquifer is not recharged by surface waters in the Pantex Plant area. The soil zone [upper 15 meters (50 feet)] is composed of caliche with interbedded clay and silty clay that restrict the infiltration of water. This restricted water infiltration, the high evaporation and evapotranspiration rates, and low rainfall result in essentially no recharge to the aquifer. This lack of recharge virtually eliminates any potential for contamination, if available, of the aquifer from surface sources. It also results in the aquifer being depleted through time as more water is pumped from the aquifer than is returned to it.

Since 1942, the average annual water-level decline in the Pantex Plant Well Field has been about 0.5 meter per year (1.8 feet per year) (Purtymun 1982B). Most of the water-level decline can be attributed to heavy pumpage from the Amarillo field north of the Plant. The Amarillo municipal supply wells produced about 96 billion liters (25.5 billion gallons or 78.3 thousand acre-feet) during the period 1975 through

1980 or almost 12 times the Pantex Plant pumpage of about 8.3 billion liters (2.2 billion gallons or 6.8 thousand acre-feet) during the same period (Purtymun 1982B).

Water usage at the Pantex Plant has generally declined from about 2.08 billion liters (550 million gallons or 1.7 thousand acre-feet) in 1965 to about 1.3 billion liters (345 million gallons or 1.06 thousand acre-feet) in 1980 (Stewart 1980). The main reason for this decrease is less water usage by the Texas Tech University Research Farm for agricultural purposes. Operational processes and sanitary effluents account for about 89 percent of the water used.

The water supply at the Pantex Plant contains principally ions of calcium and bicarbonate. The quality of the water is good; the total dissolved solids are below a concentration of 400 milligrams per liter. The concentrations of chemical constituents are low, meeting Federal criteria or standards for municipal water supplies (Purtymun 1982B). The first wells for the Pantex Plant (Army Ordnance Plant) were drilled and in operation by 1942. A comparison of the water quality from one of the wells in 1942 with the chemical quality of the water from wells in 1981 indicated no significant change in water quality. Neither the withdrawal of water from the aquifer nor operations of the Pantex Plant has resulted in deterioration of the water quality (Purtymun 1982B).

Industrial and Sanitary Liquid Wastes

There are no liquid, industrial, or sanitary waste discharges from the Pantex Plant into offsite surface waters.

The Pantex Plant has a sewage treatment plant that consists of two primary clarifiers, two trickling filters, two secondary settling tanks, and an anaerobic digester. At the present time, the treatment plant operates at less than 25 percent of its design capacity. The sanitary sewage system receives primarily domestic waste. In addition, diluted plating-shop wastes and cooling-tower water are routed to the system. Effluent from the treatment plant is discharged into Playa Basin Number 1, where it can be used to irrigate experimental crops. The quality of the effluent meets permit limits issued by the Texas Department of Water Resources under provisions of Chapter 26 of the Texas Water Code (Permit Number 02296, May 19, 1980).

Several types of industrial liquid wastes are disposed of onsite. All these discharges conform to the limits in the permit (Permit Number 02296, May 19, 1980) issued by the Texas Department of Water Resources. No Environmental Protection Agency National Pollutant Discharge Elimination System permit is required because none of the discharges reach offsite surface waters.

Analysis of water and sediments from drainage ditches into Playa Basin Number 1 and from the playa itself for Environmental Protection Agency priority pollutants indicate they are at or near background levels. Based on the low levels of these pollutants and hydrologic characteristics of the playa deposits, no impact is foreseen on the aquifer in the Ogallala Formation (Purtymun 1982B).

High-explosive-contaminated wastewater is collected in troughs in each machine shop bay. This wastewater results from using water for cooling in high-explosives machining, so it contains no other pollutants besides high-explosive particles. This wastewater runs through settling and filtering equipment to remove the suspended particles of high explosives. The treated water then is routed to a playa basin.

Several types of organic solvents are used in high-explosives formulation. During the formulation, these solvents become contaminated with high explosives. Contaminated solvents are collected in drums or a portable 1,900-liter (420-gallon) tank and are removed to the burning ground for disposal by evaporation from metal tanks, followed by burning of the residue.

Boiler blowdown from the main steam boilers contains some salts of sulfuric acid and sodium hydroxide plus other various treatment chemicals. The blowdown is discharged into the sewer and conveyed to a playa.

Solvents from degreasing and wastewater from electroplating are collected in a subsurface storage tank. The waste solution is neutralized before discharge to the sanitary sewage system.

Acid wastewaters from manufacture of chemical high explosives are neutralized with ammonia and calcium carbonate, collected in a plastic-sheet-lined pond, and discharged to an open ditch. This effluent is mixed with filtered cooling water in the ditch and routed to Playa Basin No. 1. Discharges from the pond are minimal because they occur only when the wastewater level in the pond reaches the level of the discharge pipe. Because the pond has a very high evaporation rate, little wastewater from the pond is discharged to the open ditch that leads to Playa Basin No. 1 (MHSM 1980E).

Monitoring of surface runoff in the playa basins indicates the presence of only small amounts of chromates (less than 0.01 milligram per liter) and small amounts of high explosives (less than 0.4 milligram per liter) (MHSM 1982, Purtymun 1982A). The chromates are below the criteria for drinking water. High explosives are at the lower limits of detection. The water in the playa basins is not used for municipal supply and its quality is good enough to have no known detrimental effects when used for onsite irrigation.

3.2.2.2 Iowa Army Ammunition Plant--Water

The Iowa Army Ammunition Plant uses about 1.09 billion liters (288 million gallons or 884 acre-feet) of water annually. Water, which comes from the Mississippi River, is purchased from the city of Burlington. An additional 1.09 billion liters (288 million gallons or 884 acre-feet) could be acquired annually, according to an agreement with Burlington (USDOD 1975). The plant also has three standby wells that could furnish up to about 2.98 billion liters (788 million gallons or 2.4 thousand acre-feet) annually. Surface water could also be obtained from a manmade reservoir on the Plant site, if needed.

Ground water resources at the Plant are in a shallow, water-table aquifer in glacial sediments and numerous deeper water-bearing zones in a thick Paleozoic sedimentary section. Below the shallow (within 5 to 10 feet of ground surface in many places around the site) water table is a layer (aquiclude) that will yield little to no water to a well. At the Iowa Army Ammunition Plant, this aquiclude is a series of shale layers 82 to 100 meters (270 to 325 feet) thick between the shallow and deep aquifers (Day 1942). Because of the presence of these shale layers, which are expected to be relatively impermeable, the possibility of contamination of the lower Devonian and Cambrian-Ordivician aquifers from the shallow aquifer and ground surface is small. This is confirmed by permeability and potentiometric (water-level) data collected onsite in conjunction with a subsurface contamination investigation (Terracon 1981).

A potential for flooding occurs about once a year at the mouth of Long Creek (USGS 1964). This flooding is not considered a danger to Plant operations (Becker 1982B).

Recent studies indicate that past Plant operations have had an effect on surface and shallow ground water. Elevated levels of barium, nitrates, sulfates, and phosphates have been reported. In addition, there is evidence of high explosives and decomposition products of high explosives in both the surface and shallow ground waters at selected locations within the Plant boundaries (ERG 1981).

The Skunk River, a tributary to the Mississippi River, flows adjacent to the Plant's southern boundary. All drainage from the Plant discharges either directly or indirectly into the Mississippi River, which is located 10 kilometers (6 miles) to the east.

Industrial and Sanitary Liquid Waste

Industrial and sanitary waste treatment is provided by two sewage plants equipped with chlorination facilities and eight septic tank systems. The sewage treatment plants operate at about 35 percent of capacity.

Industrial wastewater includes some contaminated with metals and some contaminated with explosives. Systems for removing metals at the industrial waste treatment facilities eliminate the discharge of metal wastes to streams within the Iowa Army Ammunition Plant. Systems for removal of explosives contamination from industrial waters exist for all operating water lines flowing from high-explosive processing areas.

Treated process water and liquid sewage effluent from the Plant's sewage treatment facilities are discharged into onsite streams. These effluents flow through a tributary-river network that eventually drains into the Mississippi River. The Iowa Army Ammunitions Plant monitors water quality at the outfalls of two wastewater treatment plants and eight industrial wastewater discharge points quarterly in compliance with their National Pollutant Discharge Elimination System permits. Most discharges meet the permit conditions. Occasionally, limits are exceeded for pH, suspended solids, Biological Oxygen Demand, and iron in runoff from the coal pile of the Main Heating Plant, according to quarterly monitoring reports submitted to the Environmental Protection Agency. As of August 1982, the regulatory and enforcement responsibilities of the National Pollutant Discharge Elimination System permit were being transferred from the Environmental Protection Agency to the State of Iowa.

3.2.2.3 Hanford Site--Water

The water supply for the Hanford Site is mainly from the Columbia River. In 1980, 613 billion liters (162 billion gallons or 497 thousand acre-feet) were diverted from the Columbia River for coolant, sanitary, and irrigation water. Wells tapping shallow water-table aquifers furnish small quantities of water (about 190 liters per second or 50 gallons per minute) for sanitary and irrigation uses at outlying technical areas (USERDA 1975). A confined aquifer in the basalts could supply water but is currently unused.

Environmental studies at the Hanford Site have documented some contamination of the shallow water-table aquifer by ruthenium-106, cobalt-60, technetium-99, tritium, and nonradioactive nitrate. Some of this contamination has entered the Columbia River via the aquifer, although the dilution effect is large (Eddy 1981). There also appears to be some contamination of the river water with radioactive iodine (Sula 1981B). Onsite ponds show elevated levels of strontium, cesium, gross alpha, and gross beta (Sula 1981A).

A potential for flooding exists at the Hanford Site along the Columbia River; however, this flooding potential only exists along the river up to about 3 miles inland. Flooding would not occur at the proposed location for the nuclear weapons operations plant (Jamison 1981).

Industrial and Sanitary Liquid Waste

Wastewater is discharged at eight points along the Hanford Site reach of the Columbia River. These discharges consist of backwash water from water-intake screens, cooling water, water storage tank overflow, and the fish laboratory wastewater. Effluents from each of these outfalls are routinely monitored under the National Pollutant Discharge Elimination System permit. During 1980, effluents were within the limitations stipulated in the permit with the exception of a single discharge point that experienced random temperature excesses on several occasions. An engineering study is now underway to determine the cause(s) for the violations and develop corrective measures (Sula 1981B). There is some thermal impact resulting from industrial discharge into the Columbia River, but the effect is localized over a small area and is not apparent in the river at Richland (Houston 1980).

3.2.3 Terrestrial Resources

3.2.3.1 Pantex Plant--Terrestrial Resources

Normal operations at the Pantex Plant for the past 30 years have not adversely affected the terrestrial resources of the area. The Pantex Plant is located on a near-level plain of windblown sand broken by shallow playas or basins. The Plant site is underlain by a thick section of sediments of Permian, Triassic, and Tertiary Age. The geologic structure is simple with a general thickening of the sediments to the northeast and thinning of the sediments to the southwest. To the northeast, the lower or older sediments of Permian age contain oil and gas and are part of the large Panhandle Oil and Gas Field. Fifty kilometers (31 miles) to the west, limestone (caliche) in the upper part of rocks of Tertiary Age is used for manufacture of cement (Purtymun 1982B).

The Pantex Plant lies within Zone 1 on the Seismic Risk Map (UBC 1979). Zone 1 earthquakes may cause minor damage, that is, broken windows, falling plaster, and disturbance of tall objects (corresponds to intensity V and VI on the Modified-Mercalli Intensity Scale, 1931). Zone 2 earthquakes, by comparison, may cause moderate damage, that is, damage to buildings varies, depending on the quality of construction (corresponds to intensity VII on the Modified-Mercalli Intensity Scale, 1931).

Seismic studies specifically for the Pantex Plant defined a maximum credible earthquake as having 320 centimeters per second per second (0.33 gravity) horizontal acceleration and 220 centimeters per second per second (0.22 gravity) vertical acceleration. The probability of experiencing that magnitude of earthquake was judged to be no more than 1 chance in 10,000 a year. There are no known faults that extend through or displace the sediments of the Ogallala Formation. Thus, there is little, if any, hazard from surface rupture at or adjacent to the Pantex Plant (Blume 1976).

Industrial Wastes

A sanitary landfill covers about 3 hectares (7 acres) and receives approximately 2,300 cubic meters (3,000 cubic yards) of waste each month. No explosives, explosive-contaminated materials, or radioactive materials are included in landfill wastes. Near the sanitary landfill is a smaller [about 1.8-hectare (4.5-acre)] landfill for construction debris. About 75 cubic meters (100 cubic yards) of construction rubble is disposed of monthly; this volume varies with the level of construction activity (USERDA 1976).

Hazardous chemical disposal is based on the nature of the chemical (MHSM 1980E). Chemicals considered too hazardous to bury or burn (for example, mercury-contaminated materials) are shipped to an Environmental Protection Agency-approved offsite disposal area (USEPA 1981). About 0.3 gram (0.01 ounce) of beryllium residue from machining operations is shipped to the Nevada Test Site for disposal every 2 years.

Hazardous or toxic solid wastes currently are handled in accordance with State and Environmental Protection Agency requirements (Environmental Protection Agency permit TX4890110527 and Texas Department of Water Resources Industrial Solid Waste Registration Number 30459). They represent relatively small volumes. No hazardous waste (as defined in 40 CFR 261) is discharged into playas nor is any buried as solid wastes at the Pantex Plant.

High explosives and high-explosive-contaminated wastes are treated by burning under controlled conditions to destroy their hazardous properties (see Section 3.2.1.1). This includes waste and scrap high explosives, sludge from filtering particles of high explosive out of cooling water, high-explosive-contaminated wastes (paper, wipes, gloves, and so on), and the high-explosive-contaminated residues from evaporating solvents. The ash remaining from these burning operations has been analyzed and found to contain only trace amounts of high explosive and is not considered hazardous. The ash is buried in a landfill on the Pantex Plant site.

Past disposal operations included burning solvents containing some explosives in open pits. Now these solvents are evaporated in tanks and the remaining residues containing high explosives are burned. Analyses of cuttings from test holes adjacent to the pit formerly used to burn solvents and explosives indicated no movement of explosives into the underlying soil zone. Analyses of the soil for solvents indicated some solvents from 4 to 14 meters (13 to 48 feet) deep immediately adjacent to the pit (Purtymun 1982A). The solvents may be in the vapor phase as the solvents are highly volatile (Purtymun 1982A). Solvents in the vapor phase will not migrate to the Ogallala Aquifer.

3.2.3.2 Iowa Army Ammunition Plant--Terrestrial Resources

The Iowa Army Ammunition Plant is located on a plain of glacial sand, gravels, and clays. The topography varies from rather flat landscape on the northern sector to gently rolling terrain with steep slopes on the southern portion. Three streams flowing from north-northwest to south-southeast cross the Plant site. Beneath the glacial sediments is a thick sedimentary sequence of rocks of Paleozoic age.

Studies have indicated that Plant operations have caused elevated concentrations of heavy metals such as barium, chromium, copper, lead, zinc, and high explosives in the soil and sediment. These occur mainly in the vicinity of the landfill, the demolition area, the explosives disposal area, and at suspected former burial sites (ERG 1981).

The Iowa Army Ammunition Plant lies within Zone 1 on the Seismic Risk Map issued by the Uniform Building Code (MHSM 1971B). In Zone 1, distant earthquakes will cause minor damage to structures through the vibration (of buildings) with periods greater than 10 seconds. This damage would include broken windows, fallen plaster, and disturbance of tall objects. By comparison, in Zone 2, earthquakes may cause moderate damage, such as damage to buildings depending on the quality of construction.

Industrial Wastes

The Iowa Army Ammunition Plant has an extensive program to recover and recycle waste materials. Waste products are collected, sorted, and stockpiled for later sale. About $400 thousand was realized in calendar year 1980 from scrap sales of over 1,500 metric tons (1,650 tons).

The Iowa Army Ammunition Plant management currently controls the production, procurement, storage, handling, use, and disposal of hazardous materials. The methodology for handling hazardous materials at Iowa is detailed in a Spill Prevention, Control, and Countermeasure Plan (IAAP 1981).

All waste oil generated by the Iowa Army Ammunition Plant is collected and classified as burnable or nonburnable. The nonburnable oil is sold to a refinery; the burnable oil is used to help fire plant boilers.

A sanitary landfill is operated by the Plant and monitored by the Iowa Department of Environmental Quality. The landfill's area is approximately 10 hectares (25 acres). The depth of fill is about 7.5 meters (25 feet), as stipulated in the operating procedures (IAAP 1979).

3.2.3.3 Hanford Site--Terrestrial Resources

The Hanford Site is located on a partly eroded flood plain of the Columbia River. The land surface slopes upward from the Columbia River onto a central plateau. North of this plateau, within the site, are two ridges, Gable Mountain and Gable Butte. The Columbia and Yakima Rivers form portions of the site boundary (Fig. 2.2.3-A).

The surface at the Site is a cover of sand dunes and eolian (windblown) sands ranging up to 12 meters (40 feet) in thickness. The Site is underlain stratigraphically by semi- and unconsolidated sands and gravels with a deeper sequence of basaltic lava flows. It is estimated currently that this basalt sequence is at least 3,700 meters (12,000 feet) thick (Gephart 1979).

Environmental monitoring studies have shown that some soil on the Hanford Site is contaminated with strontium, cesium, and plutonium. Studies of onsite ponds also have shown elevated concentrations of radioactivity (Sula 1981A). There also appears to be some contamination of Columbia River water with radioactive iodine (Sula 1981B).

The Hanford Site is located in an area that is still undergoing seismic deformation and resultant earthquake activity. The largest maximum earthquake calculated in the Hanford Site regional vicinity is located on the Rattlesnake-Wallula alignment of the Cle Elum zone of deformation. This earthquake would have a magnitude of 6.5 M on the Richter scale and a probability of occurrence of 1 chance in 50,000 a year. In relation to the proposed relocation area, the closest maximum earthquake would be located on Gable Mountain on the Hanford Site. This earthquake would have a magnitude of about 5 M on the Richter scale and a probability of occurrence of about 1 chance in 17,000 a year. Although this fault on Gable

Mountain was recently found to be capable of triggering an earthquake, the area's design ground motion values of 245 and 125 centimeters per second per second (0.25 and 0.125 gravity) as the zero period limit of appropriate response spectra for the Safe Shutdown Earthquake and Operating Basis Earthquake, respectively, has remained unchanged (Knight 1982).

Industrial Wastes

Toxic nonradioactive wastes (beryllium, asbestos, mercury, and so on) are disposed of in different ways. Beryllium waste is packaged and buried in retrievable storage (USDOE 1980D). Nonburnable solid or liquid toxic materials are packaged and buried in an onsite disposal area.

Other nonradioactive, nontoxic solid waste is buried in an onsite sanitary landfill. The waste volume is reduced by a factor of 3 by compaction before being buried. The total compacted volume for the waste is about 12,000 cubic meters (15,700 cubic yards) per year.

3.2.4 Ecology

3.2.4.1 Pantex Plant--Ecology

Aquatic Ecology

No known aquatic or aquatically associated threatened or endangered species are known to exist within the boundaries of the Pantex Plant according to the United States Fish and Wildlife Service (Stephens 1981, USFWS 1981).

Lake Meredith, a manmade impoundment on the Canadian River, is the only perennial aquatic ecosystem near the Plant. This ecosystem, approximately 40 kilometers (25 miles) north of the Plant, supports a warm water sport fishery, and thus, provides a potential ecological pathway to man. However, Pantex Plant operations have not impacted this ecosystem adversely as pollutant emissions are below toxic or harmful levels and are essentially contained onsite. (See Sections 3.2.1 on Air and 3.2.2 on Water.) In addition, runoff from severe storms or melting snows is collected in playa basins on or adjacent to the site and does not enter the Lake Meredith aquatic ecosystem (Becker 1982B).

Aquatic ecosystems that exist on or immediately adjacent to the Pantex Plant are High Plains Playas (small catchment basins) that accumulate water during wet seasons and serve as stock watering ponds or as occasional water sources for irrigation. These ponds typically dry up on an annual basis; therefore, the most common macro invertebrates found are aquatic insects. These ponds also serve as resting, feeding, and nesting habitat for migratory waterfowl and shorebirds.

The most important playa onsite is Playa Lake Number 1, which receives wastewater discharges from the Pantex Plant in addition to runoff. Water from this pond is used for irrigation, and this playa has enough inflow that it does not go dry annually. The environmental monitoring reports (MHSM 1973, MHSM 1975A, MHSM 1975B, MHSM 1976, MHSM 1977A, MHSM 1977B, MHSM 1978, MHSM 1979A, MHSM 1979B, MHSM 1980A, MHSM 1980B, MHSM 1981G, MHSM 1982) show that most elements and pollutants measured are below the desired maximum levels for irrigation waters (Dawson 1974) and also are below proposed criteria for agricultural usage (USEPA). (See Chapter 10, response to Texas Parks and Wildlife Department.) Additional water and sediment sampling done specifically for this Environmental Impact Statement (Purtymun 1982A, Purtymun 1982B) also show priority pollutants to be at or near background levels. Based on the low levels of pollutants measured, no environmental impacts would be expected. Wildlife using this playa or the other playas would not ingest heavy metals or other pollutants at levels considered harmful. Therefore, further field studies of the various food chains or ecological pathways associated with these aquatic ecosystems were deemed unnecessary.

Terrestrial Ecology

Flora. According to the United States Fish and Wildlife Service, no plant species federally recognized as endangered or threatened exist at the Pantex Plant (Stephens 1981, USFWS 1981). An unofficial potential list of rare and endangered plants native to Texas was prepared by the Rare Plant Study Center of the University of Texas at Austin 1974 (RPSC 1974). This listing contains four species (Panhandle prickly pear, bracted milkweed, cylinder spikesedge, and bottle brush) having the potential to exist at the Pantex Plant; however, the chance of finding one is remote, because no identifiable prime habitat for these species is found at the Pantex Plant.

A detailed survey of plant species was prepared for the Amarillo International Airport Environmental Impact Assessment report (CBA 1981), and because of the location and habitat types, it is considered applicable to the Pantex Plant. That study did not identify any of the four mentioned species on the Rare Plant Study Center list.

The Pantex Plant is located within a treeless portion of the High Plains that is classified as mixed prairie by Allred (1956). It originally was characterized by climax stands of bluestems, wildrye, and other bunchgrasses, such as buffalo grass and grama grass. Today, extensive tracts of this native vegetation have been converted into irrigated cropland. Most of the remaining range has been overgrazed, allowing less desirable grasses, forbs, and shrubs to dominate these areas both onsite and on the surrounding rangelands.

Pesticides. Herbicides and pesticides are routinely used at Pantex to control specific target species of undesirable vegetation and insects. During 1979 the following were used: Hyvar X [1,400 kilograms (3,100 pounds)]; 2,4-D [250 liters (66 gallons)]; Malathion [45 liters (12 gallons)]; Chlordane [20 liters (5 gallons)]; and Isotox [1 liter (0.25 gallons)]. All pesticides used are registered under the Federal Insecticide, Fungicide, and Rodenticide Act and are used in accordance with labeled directions at concentrations, application rates, and frequencies that have been approved. Pesticides are stored in secured areas and application is supervised by a trained State-certified employee.

Fauna. No Federally recognized threatened or endangered species are known to live onsite. The habitat conditions are such that the black-footed ferret (a Federally recognized endangered species) might be expected. However, according to the United States Fish and Wildlife Service, this species is "assumed to be extirpated in Texas" (Stephens 1981). Two raptors, the southern bald eagle and the peregrine falcon (both Arctic and American), migrate through this area and occasionally might be found onsite (USFWS 1981). One whooping crane has been observed near the Plant in the last 15 years; however, it is thought that the bird was blown off the normal migratory path (CBA 1981).

The State of Texas has adopted lists of protected endangered species, protected nongame species, and protected game species under subtitle B of the Texas Parks and Wildlife Code. Some of these species may exist onsite or migrate across the site; however, no unique habitat that would require special attention exists onsite.

Based on the results of the threatened and endangered species evaluation, the low levels of liquid and airborne emissions and the detailed survey of wildlife done for the Amarillo International Airport (CBA 1981), further ecological studies are not needed for the Pantex Plant.

3.2.4.2 Iowa Army Ammunition Plant--Ecology

Aquatic Ecology

No known rare or endangered aquatic or aquatically associated species are known to exist within the Iowa Army Ammunition Plant's boundary (USARMY 1973A). However, there are numerous aquatic ecosystems present.

Most of the aquatic ecosystems within the Iowa Army Ammunition Plant exist as small ponds [surface area less than 0.5 hectare (1.2 acre)] or as drainage ditches. In addition, there are three streams and two manmade lakes (Carl Anderson Lake and Long Lake Reservoir) onsite that support sport fisheries or otherwise provide recreational activities (USARMY 1973A).

The shoreline vegetation of these ecosystems is typified by dense stands of hydrophytic (plants requiring moist habitat) and phreatophytic (plants whose roots penetrate the water table) species. Commonly found plants include cottonwoods, willows, red osier dogwood and buttonball bush. Most of these ecosystems support healthy populations of warm-water fish (USARMY 1973A).

Terrestrial Ecology

No known rare or endangered plant or animal species are known to reside within the Plant (USARMY 1973B). However, bald eagles have been observed nesting on the Mississippi River and could occasionally enter Plant boundaries searching for food.

Flora. What was once tall grass prairie, composed of warm-season grasses with mixed forbs, broken by woodland communities of white oak and hickory, has become some of the most productive agricultural land known anywhere in the world (Section 3.2.5, Agriculture). Today the vegetative community types are a man-influenced mosaic of rowcrops, improved pastures, woodland shrub transition zones, and mixed deciduous hardwood forests.

Current releases of air and water pollutants (Sections 3.2.1.2 and 3.2.2.2) are below levels considered to be phytotoxic (Davis 1973, Skelly 1974).

Fauna. Linked to the high productivity and diversity of habitat types is an equally diverse and abundant spectrum of animal life. Current releases of air and water pollutants (Sections 3.2.1.2 and 3.2.2.2) are below levels that would cause significant bioaccumulations of toxic elements in wildlife populations.

3.2.4.3 Hanford Site--Ecology

Much of the following information has been adapted from the document, "Standardized Input for Hanford Environmental Impact Statements" (Jamison 1981).

Aquatic Ecology

No aquatically associated rare or endangered species are known to exist within the proposed project area on the Hanford Site (Elle 1981). Robinson's Onion, an onion-like member of the lily family, occurs on gravel bars along the Columbia River but is well removed from the interior of the Site. This plant is a candidate for Federal listing as a threatened or endangered species (Rickard 1981A).

The Columbia River is the most important aquatic ecosystem on the Hanford Site, and the last free-flowing reach of the Columbia River in the United States passes through the Hanford Site (Jamison 1981).

Operations at the Hanford Site have resulted in small radioactive releases and thermal discharges to the Columbia River (USERDA 1975). The Columbia River supports a cold-water fishery, and the Hanford reach contains both fall Chinook salmon and steelhead trout spawning grounds. These spawning grounds now produce 15 to 20 percent of the total fall Chinook salmon hatch in the river. Thirty-nine species of fish are found in the Hanford site reach of the Columbia.

Terrestrial Ecology

No rare and/or endangered plant or animal species are known to exist year around within the proposed project area (Elle 1981). However, bald eagles winter along the Columbia River, and from November to February, they would be frequently found flying over or hunting on the proposed plant construction site (Fitzner 1979).

Flora. The Hanford Site is located in a region that has been variously classified as cool desert, winter-wet cool steppe, or midlatitude desert. Vegetation types are those tolerant of dry hot summers followed by cold wet winters. As a result, productivity is low. However, the region has wide diversity of habitat types and a very diverse species composition.

The proposed project site is within a sagebrush/cheatgrass vegetation type that covers approximately 75 percent of the Hanford Site. This vegetation type is conducive to rodent populations, which in turn support a wide variety of raptors (Fitzner 1980).

In addition to Robinson's Onion, three plant species (Columbia milk vetch, rosy balsamroot, and persistent sepal yellow cress) exist on the Site and are candidate species for Federal listing as threatened or endangered. None of these species are expected to be found in the interior of the Hanford Site at or near the proposed project site (Rickard 1981A).

Fauna. A wide variety of wildlife exists at the Hanford Site. Most of this wildlife has access to radioactively contaminated onsite ponds and vegetation growing in or near the ponds. The ingestion of radioactively contaminated water or vegetation by wildlife provides a transfer mechanism away from these designated waste areas. Ingestion of contaminated material by game animals provides a potential pathway for contamination to man (Sula 1981A).

The wildlife sampling program for 1980 included waterfowl, upland game birds, deer, and rabbits (Sula 1981A).

3.2.5 Land Use/Agriculture

3.2.5.1 Pantex Plant--Land Use/Agriculture

Land Use

Most land surrounding the Pantex Plant is dryland or irrigated farmland on broad, flat plains interspersed with grassland pastures and water ponds (playas) in natural drainage areas. The average-sized farm is 518 hectares (1,280 acres) or 2 square miles. These large tracts of land are interrupted only by U.S. Highway 60, a railroad, a few gravel roads, and an occasional farmstead or rural home site. Rural housing development is more dense several miles south and southwest of Pantex Plant boundaries toward Amarillo and the Amarillo International Airport.

Other major developments in the immediate vicinity of Pantex Plant are the Texas Tech University Agriculture Research Station, the Iowa Beef Packing Plant, and the industrial park adjoining Amarillo International Airport. These facilities are located about 8 kilometers (5 miles), 10 kilometers 6 miles), and 12 kilometers (7-1/2 miles) southwest of the Pantex Plant.

General Agriculture

Agricultural land within the Pantex Plant boundary [about 3,270 hectares (8,070 acres)] is managed by the Texas Tech University Research Farm through an agreement with the Department of Energy. The research farm itself consists of about 400 hectares (1 thousand acres) of farmland and a feedlot located southwest of the Pantex Plant boundary. Farmland on the site generally is planted under limited irrigation and dryland conditions in a 3-year winter wheat-fallow-grain sorghum sequence. Two sources of irrigation water are used (water from the Ogallala aquifer and surface water from the playa basins including Playa Lake Number 1) to irrigate crops depending on rainfall (Section 3.2.2.1).

The major soil type, the Pullman series, is finely textured and easily eroded. These soils require careful cropping practices (Unger 1981) to minimize wind loss and sheet erosion under fallow conditions. Because of the fine texture and low permeability of these soils, irrigation is limited to about 13 to 15 centimeters (5 to 6 inches) per application. These soils, when irrigated, have been considered as potentially prime farmland by the Soil Conservation Service (USDA 1978, USDA 1981A, USDA 1981B).

Hard red winter wheat is planted in early September after irrigating or when soil has stored sufficient rainfall. Wheat is typically irrigated once in October/November, once in March/April, and again in May/June, depending on rainfall.

Drought-resistant grain sorghum and forage canes are grown under limited irrigation or dryland conditions. Corn is not a major crop because extensive irrigation is necessary for maturation. About half the crops grown in Carson County are strictly dryland because of the high cost of pumping water from the Ogallala aquifer.

Cow/calf operations are maintained in the Panhandle area on large (several sections) ranches. Stocking rates of one animal unit per 2 to 4 hectares (5 to 10 acres) of rangeland are typical, and substantial supplemental feeding is necessary at times during the winter months. Calves also are grazed from November to March on young winter wheat. The native short-grass prairie feed is highly nutritious and is characterized by a grass mixture of blue grama and buffalo grass.

Radioactivity Measurements in Agricultural Products

A special study was undertaken for this Environmental Impact Statement to evaluate food and agricultural pathways. Foodstuffs (garden vegetables and beef cattle) from the Pantex Plant site were sampled and analyzed for several radionuclides (tritium, uranium, and plutonium). All foodstuffs sampled were found to be at background levels. There are no indications of any contamination of garden and livestock products grown on or near the Pantex Plant site (Wenzel 1982A, Buhl 1982).

3.2.5.2 Iowa Army Ammunition Plant--Land Use/Agriculture

Land Use

The Iowa Army Ammunition Plant is located on a combination of high-quality, almost flat, agricultural land (about 60 percent of the area) and hilly, rough pasture land (40 percent) traversed by three small creeks. Terrain beyond plant boundaries is characterized by an escarpment leading to Mississippi River bottomlands. The upland is generally flat to moderately rolling plains with pastures on the poorer, steeper slopes. Timber covers the rougher areas along waterways. The Skunk River valley forms the irregular southern boundary of the Plant site.

Two major cities, Burlington and West Burlington, border the Plant site on the east. Six villages and small towns are located adjacent to or within 3 miles of the Plant boundary on the north, west, and south. The surrounding rural area is composed of about 61 percent cropland, 11 percent pasture, 15 percent woodland, and 13 percent urbanized home sites. This area is interspersed with open space, state and Federal lands, waterways, or other nonagricultural land masses. Heavy rainfall in the area permits intensive farming practices on units that average about 100 hectares (250 acres) in size. As a result, it is common to observe three or more homes on a square mile of highly productive farmland.

Agriculture

This region is one of the most productive farming areas of the United States, producing upwards of 180 bushels of corn per acre. The Army leases 2,800 hectares (7,000 acres) of prime agricultural land within Plant boundaries to private farmers, which totals 40 percent of the site. Crop sequences and practices are closely supervised with assistance from the Soil Conservation Service and United States Department of Agriculture (SCS 1972). An additional 800 hectares (2,000 acres) is leased for pasture. Improved meadows carry 1-1/2 to 2 animal units per acre (IAAP 1974).

The major row crops are field corn and soybeans. Corn and soybeans are rotated with improved pastures of alfalfa/grass grown under nursery crops of winter wheat or oats. Livestock is typified by corn-fed cattle and hogs. There are some dairy operations geared to local markets.

3.2.5.3 Hanford Site--Land Use/Agriculture

Land Use

Land use within 8 kilometers (5 miles) of the proposed construction site includes portions of the Columbia River; the area managed by the U.S. Bureau of Sports, Fisheries, and Wildlife; the Washington Public Power Supply System generating plant; the meteorology station; the Near-Surface Test Facility; and a central fire station. Also included are the associated roadways, railroads, and transmission facilities and corridors. Much of the land between existing facilities is open desert range. The nearest public highway (State Highway 24) traverses the northwest corner of the Hanford Site about 12 kilometers (7-1/2 miles) from the proposed construction site. Land use surrounding the Hanford Site includes irrigated farmland near the river, dryland farms, and large tracts of grazing land. The nearest population center is Richland, approximately 32 kilometers (20 miles) southeast of the proposed construction site.

Agriculture

Agriculture is a primary industry in eastern Washington. The Columbia Basin Project north and east of the Hanford Site has opened more than 500 thousand acres to irrigated farming. The growing season is long, with 175 frost-free days.

The soils of the region are characterized by their high silt and sand content. They are loess soils with low exchange capacity. Gravel is a major component in the river flood plain area (Hagood 1970).

Benton County (to the west of the Hanford Site) includes most of the Yakima River Valley. This area is well known for apple, cherry, and peach orchards, vineyards, alfalfa, field corn, and irrigated and dryland wheat. The orchards are grown close to the Yakima River, whereas the wheat is grown on the tops of the Horseheaven Hills, which are several hundred feet higher in elevation. In Franklin County (to the east of the Hanford Site), field corn, wheat, alfalfa, potatoes, and asparagus are the major crops.

Cattle are grazed on cheatgrass and native vegetation in the winter months from January through May; then the cattle are placed on irrigated improved pastures for the rest of the year or trucked to mountain pastures. Dairy herds are numerous and are fed local silage and alfalfa. There are two large feedlots in the area that use local grain and alfalfa as major feeds.

No farming or grazing is practiced currently on the Hanford Site south of the Columbia River. Extensive farming was practiced historically, surrounding the abandoned townsites of White Bluffs and Hanford, as well as along the Columbia River, before the site was purchased by the government.

3.2.6 Environmental Radiation and Radioactivity

Environmental radiation levels in the areas surrounding the Pantex Plant site and the two alternative sites are dominated by natural background radiation and radiation resulting from worldwide fallout from nuclear weapons testing.

3.2.6.1 Pantex Plant--Environmental Radiation and Radioactivity

Radioactive Releases

Two principal radioactive materials, depleted uranium and tritium, are emitted to the atmosphere from operations at the Pantex Plant. Plutonium is handled at the Pantex Plant only in solid form. No release of plutonium results from routine plant operations.

There are no existing or expected radioactively contaminated liquid effluents at the Pantex Plant.

To evaluate the radiological effects of current and past operations on the environment at the Pantex Plant, several special studies were done. These included

- measuring external penetrating (charged-particle and photon) radiation around Pantex at 24 locations for 15 months and resolving these radiation fields into natural background and fallout components (Buhl 1982);
- monitoring air concentrations of uranium and plutonium at 14 locations for 1 year (Buhl 1982);
- measuring depleted uranium air concentrations following an explosive test shot (Buhl 1982);
- sampling and analyzing soil at five locations onsite, at five perimeter locations, and 17 regional locations (Purtymun 1982A, Buhl 1982, Wenzel 1982A);
- sampling and analyzing sediments at five locations onsite and eight locations offsite (Purtymun 1982A);
- sampling and analyzing ground and surface water both onsite and offsite including the Canadian River drainage and Lake Meredith (Purtymun 1982A); and
- sampling and analyzing foodstuffs, including produce, vegetation, and livestock produced in the Pantex area (Buhl 1982, Wenzel 1982A).

Analysis of air, soil, water, and foodstuff samples found no detectable above-background offsite concentrations of uranium, plutonium, or tritium, the radionuclides that would be associated with the Pantex Plant. Additional detail on some of these results is presented in Appendix 8.1.

In addition to the special studies, air sampling for radioactivity at the Pantex Plant is routinely accomplished through the use of continuously operating air samplers located around the Plant (MHSM 1982 and MHSM 1983). Measured ambient concentrations of tritium and uranium are very small, less than 0.01 percent of the Department of Energy's Radioactivity Concentration Guides (USDOE 1980A). Measured air concentrations of radioactivity, including plutonium, reflect no discernible impact from the Pantex Plant operations.

Radiological Doses

The results of the above studies showed that the component of 1981 radiation dose resulting from current or previous operations is so small that it cannot be detected above the background radiation dose

TABLE 3.2.6.1-1

PANTEX PLANT VICINITY ESTIMATES* OF CURRENT BACKGROUND AND FACILITY-ASSOCIATED RADIATION DOSES (millirem) PER YEAR OF EXPOSURE TO A HYPOTHETICAL INDIVIDUAL

	Whole Body	Lung	Bone
Background	106	306	291
Maximum individual dose from facility releases**	<0.01	<0.01	0.08
Radiation Protection Standards***	500	1500	1500

*Estimates include a 10 percent reduction in cosmic radiation and a 20 percent reduction in external terrestrial radiation because of shielding by buildings and an additional 20 percent reduction in external terrestrial radiation because of self-shielding by the body (NCRP 1975).

**Doses are 50-year dose commitments per year of exposure (Buhl 1982).

***Radiation Protection Standards for an individual in the general public (USDOE 1980A).

component by environmental field measurements. The inability to directly measure this Plant operation dose component is of particular importance in evaluating the environmental impacts of the proposed action because the proposed action involves essentially continuing the type of operations at the Pantex Plant that have occurred for the last 30 years and that were part of the Iowa operation for about 25 years. Nevertheless, to provide some basis for analysis of impacts, the radiation dose component in 1981 resulting from current or previous operations has been theoretically calculated from demographic, agricultural, and meteorological data and uranium and tritium release rates (Buhl 1982, MHSM 1982, and MHSM 1983). Table 3.2.6.1-1 shows the estimated doses to the maximum exposed individual living next to the Pantex Plant from exposure during 1981 to facility releases. Doses calculated for facility releases are 50-year dose commitments per year of exposure. The 50-year dose commitment to an organ is the total dose that an organ would receive from internally deposited radioactive material during the 50 years following intake. These doses are all small fractions of doses from natural background radiation and the U.S. Department of Energy's Radiation Protection Standards (USDOE 1980A). The doses are also well within the proposed Environmental Protection Agency regulations on emissions of airborne radioactivity (48FR15076; April 16, 1983.)

These calculated doses do not increase existing doses from natural background radiation by more than 0.03 percent. The highest 50-year organ dose commitment per year of exposure to the maximum exposed individual was calculated to be 0.08 millirem per year to the bone, or 0.005 percent of the Radiation Protection Standard (USDOE 1980A). The 80-kilometer (50 mile) 50-year population dose commitment is 0.012 person-rem per year of exposure (whole body), 0.05 person-rem per year of exposure (lung), and 0.16 person-rem per year of exposure (bone).

The population dose from natural background radiation within an 80-kilometer (50-mile) radius is 27,200 person-rem per year (whole body); 78,600 person-rem per year (lung); and 74,700 person-rem per year (bone). In calculating these doses, a 10 percent and 20 percent reduction was applied to the cosmic and external terrestrial radiation dose components, respectively, to account for shielding by housing, and an additional 20 percent reduction was applied to external terrestrial radiation for self-shielding by the body (NCRP 1975).

Radiological Effects

Potential somatic and genetic health effects from natural background radiation and routine Plant operations were calculated using risk factors from BEIR III (BEIR III 1980) and the computer model estimates of doses. (See Appendix 8.1 for additional discussion of calculation procedures.)

The average added risk of cancer mortality to a member of the public living within 80 kilometers of the Pantex Plant resulting from 1 year's operation is less than 1 chance in a billion. For comparison, the risk of dying from cancer as a result of exposure to natural background radiation for 1 year is 1 chance in 45,000 (Buhl 1982). These risk estimates, which predict no observable increase in cancer mortality because of Plant radioactive emissions, appear to be consistent with the conclusions of the epidemiological study (Wiggs 1982A) discussed in Section 3.2.12.1.

The average added risk of genetic disorders in offspring in all subsequent generations as a result of Pantex Plant radionuclide emissions for 1 year is less than 1 chance in a billion. This can be compared with the estimates of risk ranging from 1 disorder in 5000 to 1 in 90,000 expected annually from natural background radiation, and the risk of 1 disorder in approximately 10 offspring because of spontaneous incidence of genetic defects (Buhl 1982).

Solid Wastes with Radioactive Contamination

No radioactive waste is disposed of or permanently stored at the Pantex Plant. Approximately 6 to 7 cubic meters (200 to 250 cubic feet) of solid waste with low levels of radioactive contamination are generated annually from Pantex Plant operations and high explosives testing involving depleted uranium. The bulk of this waste is vacuum filters, paper toweling, and rubber gloves. Some is soil and other residue picked up around the test-firing sites. This waste is sealed in plastic bags, compacted in 0.5-cubic-meter (55-gallon) steel drums, and temporarily held at the Pantex Plant in an aboveground, secured igloo. The drums are shipped to the Nevada Test Site on a semiannual or annual basis for permanent disposal. (Information on routine waste transportation is included in Section 4.3.1.)

Some residue collected from military nuclear weapons accidents is still being held at the Pantex Plant pending final decisions on its disposition. Approximately 75 cubic meters (2,700 cubic feet) of material in about 40 containers were moved to the Pantex Plant for storage in 1966 when another facility in Texas was closed. These steel and fiberglass-coated-wood boxes containing the residue were retrievably stored in either underground concrete cylinders or in an earthen trench. In 1980 a project was undertaken to determine whether the contents should be permanently disposed of at the Nevada Test Site or should be considered for possible recovery of the nuclear material. In 1981 all of the containers were retrieved and moved to an aboveground igloo for radiological assaying and characterization. Approximately half of the containers were evaluated to contain material considered radioactive waste. These containers were packaged for shipment and transported to the Nevada Test Site for permanent disposal without incident.

The remaining 18 containers include kilogram quantities of fissile material. Additional evaluations are underway to determine the feasibility and desirability of recovering the fissile material. If it is determined that recovery is appropriate for some or all of these containers, they would be shipped to another Department of Energy facility. Any of the containers with nonrecoverable material would be shipped to the Nevada Test Site. The final decisions regarding the disposition of these 18 containers of accident residue still at the Pantex Plant will include appropriate consideration of environmental aspects, economics, security and safeguards considerations, and transportation requirements. (Some of the transportation precautions are discussed in Section 4.3.3.1.) It is expected that these decisions will be made and all containers removed from the Pantex Plant by early 1984.

Soil removed from the trench where part of the nuclear weapons accident residue was stored is being sent to the Nevada Test Site for disposal. A small portion of the soil near one of the residue containers had low levels of fissile material contamination from a container leak. A larger amount of soil removed from the trench included low levels of depleted uranium contamination from the Pantex Plant test firing sites. At the time of publication of the Draft Environmental Impact Statement, it was believed that no contamination remained in the trench based on a limited number of samples from the trench including some taken by the Texas Department of Health. Subsequently, more extensive documentation (a more intensive sampling of the trench) located additional traces of contamination. Accordingly, additional soil is being removed from the trench until no measurable contamination remains.

Some of the soil removed from the trench has already been sent to the Nevada Test Site for final disposal. All potentially contaminated soil removed from the trench is being packed and transported to the Nevada Test Site for disposal as low level radioactive waste. Approximately 1,500 cubic meters (40,000 cubic feet) of this soil will be shipped in about 55 shipments by common carrier truck. (Additional information on transportation is included in Section 4.3.3.1.)

3.2.6.2 Iowa Army Ammunition Plant--Environmental Radiation and Radioactivity

Radioactive Releases

There are no radiological releases from current operations at the Iowa Army Ammunition Plant.

A limited area of onsite contamination, identified as depleted uranium, was found at the firing site where test firing similar to that now being conducted at the Pantex Plant was conducted by the Atomic Energy Commission from 1965 to 1974. Resuspension and transport of dust from this area were considered in evaluating the radiological impact of past operations. However, offsite soil surveys for uranium, plutonium, and tritium and field gamma-ray spectroscopic measurements (field studies undertaken for this Environmental Impact Statement) detected no manmade radionuclides other than those associated with worldwide fallout (Buhl 1982).

Radiological Doses

Table 3.2.6.2-1 shows the estimated doses (50-year dose commitments) to the maximum exposed individual resulting from exposure in 1981 to past releases from the Iowa Army Ammunition Plant. Both background doses and the Department of Energy's Radiation Protection Standards also are shown. Doses from Plant operations were estimated using the computer code AIRDOS-EPA (Moore 1979) and site-specific parameters. The 50-year population dose commitments resulting from past operations at the Iowa Army Ammunitions Plant are 0.00012 person-rem (whole body), 0.0015 person-rem (lung), and 0.0011 person-rem (bone).

Population doses resulting from exposure to natural background radiation are 31.6 thousand person-rem per year (whole body), 106 thousand person-rem per year (lung), and 100 thousand person-rem per year (bone). In calculating the population and individual doses, reductions of the 10 and 20 percent were applied to the cosmic and external terrestrial radiation to compensate for shielding by housing. An

TABLE 3.2.6.2-1

IOWA ARMY AMMUNITION PLANT VICINITY ESTIMATES*
OF CURRENT BACKGROUND AND FACILITY-ASSOCIATED RADIATION
DOSES (millirem) PER YEAR OF EXPOSURE TO A HYPOTHETICAL INDIVIDUAL

	Whole Body	Lung	Bone
Background	85	285	270
Maximum individual dose from facility releases**	<0.01	<0.01	<0.01
Radiation Protection Standards***	500	1500	1500

*Estimates include a 10 percent reduction in cosmic radiation and a 20 percent reduction in external terrestrial radiation because of shielding by buildings and an additional 20 percent reduction in external terrestrial radiation because of self-shielding by the body (NCRP 1975).
**Doses are 50-year dose commitments per year of exposure (Buhl 1982).
***Radiation Protection Standards for an individual in the general public (USDOE 1980A).

additional 20 percent reduction in terrestrial radiation was applied to account for self-shielding by the body.

Radiological Effects

The lifetime risk of cancer mortality from natural background radiation is 1 chance in 53,000 per year of exposure. Estimates of the risk of genetic disorder in offspring from annual exposure to background radiation ranges from 1 disorder in 6,200 offspring to 1 disorder in 110,000 offspring, whereas the total risk of spontaneous incidence of genetic disorder resulting from all causes is 1 disorder in 10 offspring.

Residual contamination resulting from previous explosive testing involving depleted uranium is found in a limited area around a firing site at the Iowa Army Ammunition Plant. The added lifetime risk of cancer mortality that results from this contamination to the average individual living within 80 kilometers (50 miles) of this site is less than 1 chance in 1 billion per year of exposure. The added risk of generic disorder in offspring is also less than 1 chance in a billion per year of exposure.

3.2.6.3 Hanford Site--Environmental Radiation and Radioactivity

Radioactive Releases

The radioactive materials discharged to the atmosphere at the Hanford site are detailed annually in their Environmental Surveillance Report (Sula 1982). Radioisotopes released to the atmosphere consist of fission and activation products normally associated with the uranium fuel cycle. In 1981, about 78 thousand curies were released, with argon-41 (65 thousand curies, 1.8-hour half-life), cesium-138 (11 thousand curies, 32-minute half-life), and xenon-135 (490 curies, 76-minute half-life) representing the bulk of this total.

Radiological Doses

Table 3.2.6.3-1 shows the estimated doses incurred in 1981 by a member of the public living next to the Hanford Site from both background and site operations. These dose were taken from the 1981 Environmental Surveillance Report for the Hanford Site (Sula 1982).

TABLE 3.2.6.3-1

HANFORD SITE VICINITY ESTIMATES*
OF CURRENT BACKGROUND AND FACILITY-ASSOCIATED RADIATION
DOSES (millirem) PER YEAR OF EXPOSURE TO A HYPOTHETICAL INDIVIDUAL

	Whole Body	Lung	Bone
Background	82	282	267
Maximum individual dose from facility releases**	0.4	0.02	1.3
Radiation Protection Standards***	500	1500	1500

*Estimates include a 10 percent reduction in cosmic radiation and a 20 percent reduction in external terrestrial radiation because of shielding by buildings and an additional 20 percent reduction in external terrestrial radiation because of self-shielding by the body (NCRP 1975).
**Doses are 50-year dose commitments per year of exposure (Sula 1982)
***Radiation Protection Standards for an individual in the general public (USDOE 1980A).

Radiation doses to the public caused by the current operations of the Hanford Site in 1981 were estimated by computer modeling and, where possible, from field measurement. A 50-year dose commitment of 1.3 millirem to bone of a hypothetical maximum exposed individual was the highest dose calculated for 1981 operations. This dose represents 0.09 percent of the Radiation Protection Standard (USDOE 1980A). All other calculated organ doses were less than 0.09 percent of their respective Radiation Protection Standard. The 50-year population dose commitments are 4 person-rem (whole body), 3 person-rem (lung), and 6 person-rem (bone) (Sula 1982).

Exposures to natural background radiation results in estimated population doses of 27,000 person-rem per year (whole body); 93,200 person-rem per year (lung); and 88,200 person-rem per year (bone). Components of these doses from cosmic and external terrestrial radiation have been reduced by 10 percent and 20 percent, respectively, because of shielding by housing. The external terrestrial radiation dose was reduced an additional 20 percent because of self-shielding by the body.

Radiological Effects

Exposure to background radiation levels would result in a risk of dying from cancer of 1 chance in 53,000 per year of exposure. The risk of genetic disorder in offspring ranges from 1 disorder in 6,700 to 1 disorder in 120,000 per year of exposure. The risk of spontaneous genetic disorder from all causes is about 1 disorder in 10 offspring. Risk of cancer mortality resulting from facility operations in 1981 is calculated to be 1 chance in 500,000,000. Corresponding estimates of the risk of genetic disorder in all subsequent offspring are from 1 chance in 50,000,000 to 1 chance in 800,000,000.

Radioactive Wastes

Locations within the Hanford Site are used for radioactive waste disposal by the Department of Energy. Support facilities include complexes of underground storage tanks for high-level liquid radioactive waste, as well as cribs, ditches, and ponds used for discharge of liquid radioactive wastes, and solid radioactive waste burial grounds. Detailed accounts of these disposal operations may be found in USERDA 1975. Contamination of the shallow ground water and the Columbia River has resulted from the liquid radioactive disposal. Onsite soil contamination by strontium, cesium, and plutonium also has been measured (Sula 1981B).

3.2.7 Energy Resources

3.2.7.1 Pantex Plant--Energy Resources

In 1981, the Pantex Plant used 39.8 million kilowatt hours (136 billion British thermal units) of electricity and 10.5 million cubic meters (370 billion British thermal units) of natural gas (MHSM 1981C). The natural gas is used primarily for generating steam for space heating of buildings. The electricity is used mostly for space cooling and lighting. The Pantex Plant electricity consumption represents about 0.3 percent of the generating capacity of Southwest Public Service Company of Amarillo, Texas (SPSC 1981). The natural gas consumption is equivalent to the usage of 3 to 5 thousand single-family dwellings.

The consumption of electricity at the Pantex Plant increased at an average rate of 1.8 percent per year for the period of 1975 to 1980. Natural gas usage declined at a rate of 7 percent per year. The total energy usage has decreased 5.4 percent per year during that 5-year period. Approximately 10 percent of the total energy is used in the various production and assembly processes.

3.2.7.2 Iowa Army Ammunition Plant--Energy Resources

Electrical energy for the Iowa Army Ammunition Plant is purchased from the Union Electric Company of St. Louis, Missouri. The Plant is serviced by two separate lines from the utility company. The total annual electrical energy consumption at the Iowa Army Ammunition Plant is approximately 17 million kilowatt-hours. This is less than 0.03 percent of the total generating capacity of Union Electric (UEC 1981).

The facilities at the Iowa Army Ammunition Plant are steam heated. The primary fuel of the steam plant is natural gas supplied by Iowa Southern Utilities on an interruptable basis; however, 1000 British thermal units of natural gas are available in industrial quantities on a firm demand basis. The Iowa Army Ammunition Plant is currently converting a standby electric generation facility from fuel oil to coal, which may in time become the principal power source at the Iowa Army Ammunition Plant (Rapp 1982).

3.2.7.3 Hanford Site--Energy Resources

The Hanford Site receives electricity from the Bonneville Power Administration system, which has a total generating capacity of 17 million kilowatts. Power plants (nuclear and coal fired) on the Hanford Site have a capacity of 860 thousand kilowatts. A system for delivering coal to the Plant site is operational and is now delivering coal to steam-generating plants on the site.

3.2.8 Employment and Population

3.2.8.1 Pantex Plant--Employment and Population

Employment

The Pantex Plant is the largest employer in the Amarillo area employing nearly 2400 workers. The composition of the current work force is approximately 80 percent male and 20 percent female. Pantex Plant employment represents approximately 2.7 percent of the total 1980 labor force (about 87.6 thousand) reported by the Texas Employment Commission. Approximately 87 percent of Pantex Plant employees reside in the Amarillo metropolitan area. The remainder reside in small rural communities or on farms.

Employment Forecast

The employment forecast for the Pantex Plant study area [the 80-kilometer (50-mile) radius around the Pantex Plant] was based on 1981 employment data for counties and on discussions with the Texas Employment Commission concerning future economic and employment growth in the Amarillo area (TEC 1981).

A conservative estimate of growth (1.35 percent) in annual employment was used to forecast 1990 employment in the Amarillo Standard Metropolitan Statistical Area. This is an increase of 9,900 workers from July 1981 to 1990. July 1981 employment in the portion of the counties within the Pantex Plant study area excluding the Amarillo Standard Metropolitan Statistical Area is approximately 34,700. A much lower annual growth rate in these counties is assumed because of the probable decline in agriculture-related employment resulting from higher water costs. Using an annual growth rate of 0.4 percent, employment in the non-Standard Metropolitan Statistical area portion of the Pantex Plant study area is estimated to increase between 1981 and 1990 by 1,300 jobs to a total of 36,000. In summary, the total labor force in the study area is expected to increase from 113,200 to 124,400 between 1981 and 1990 (LATA 1982).

Population

A study of the 1980 residential population surrounding the Pantex Plant shows that the majority of the population is located west-southwest of the Pantex Plant in the Amarillo metropolitan area. The 1980 residential population surrounding the Pantex Plant is somewhat evenly distributed at a density of about 1 person per square kilometer (3 people per square mile) except for concentrations within and near larger cities and towns. The total population within an 80-kilometer (50-mile) radius of the Pantex Plant was 259,300 in 1980 (LATA 1982).

Population Forecasts

The predicted 1980 to 1990 change in residential population indicates that the greatest change will occur west and southwest of the Pantex Plant in the Amarillo metropolitan area. Very little residential growth is expected within 16 kilometers (10 miles) of the Pantex Plant site (LATA 1982).

Figure 3.2.8.1-A summarizes the 1990 total population of 288,900 for the 80-kilometer (50-mile) radius around Pantex Plant. This figure indicates that the largest population center will continue to be the Amarillo metropolitan area. Smaller but still significant population concentrations are shown for the Dumas, Borger, and Pampa sectors. The only substantially populated area within 16 kilometers (10 miles) of the Pantex site is the 8- to 16-kilometer (5- to 10-mile) southwest sector with a population of approximately 5,700 persons (LATA 1982).

3.2.8.2 Iowa Army Ammunition Plant--Employment and Population

Employment

In 1981 Mason and Hanger-Silas Mason Company, Inc., employed about 1,030 workers at the Iowa Army Ammunition Plant. The Plant is the second largest employer in the area. The work force composition is about 80 percent male, 20 percent female. The Plant work force represents about 1.6 percent of the total employment in the four surrounding counties (Des Moines, Henry, Lee, and Louisa). Plant records indicate

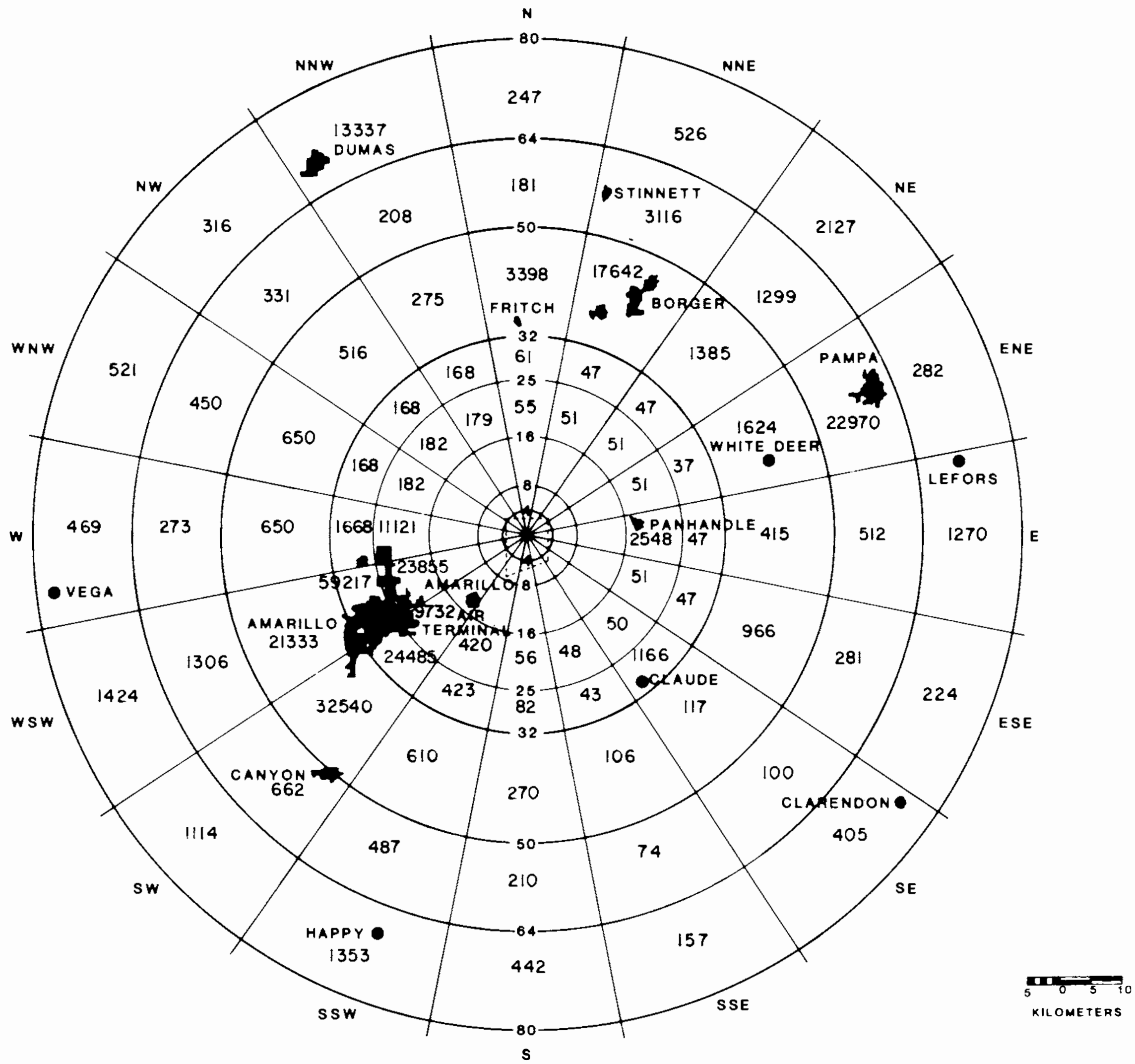


Figure 3.2.8.1-A. Projected 1990 population for Pantex Plant study area.

that over 86 percent of the work force lives in these four counties; the remainder reside in Illinois and commute across the Mississippi River.

Employment Forecast

The Iowa Army Ammunition Plant study area [80-kilometer (50-mile) area around the Plant] includes portions of three bordering states. Economic and employment data from all three states were analyzed. This analysis indicates that no significant change will occur and that the 1990 employment levels will be similar to 1980 employment levels within the study area (LATA 1982).

Population

The 1980 residential population between 16 kilometers (10 miles) and 80 kilometers (50 miles) of the Iowa Army Ammunition Plant is quite evenly distributed (LATA 1982). Population densities in rural areas are about 10 people per square kilometer (26 people per square mile). Rural populations within 16 kilometers (10 miles) of the Iowa Army Ammunition Plant are slightly higher with about 12 people per square kilometer (31 people per square mile). The sectors with the largest concentrations of population are east and east-northeast of the Iowa Army Ammunition Plant. These sectors include most of the residential population in the cities of Burlington and West Burlington. The total population within an 80-kilometer (50-mile) radius of the Iowa Army Ammunition Plant was 378,800 in 1980 (LATA 1982).

Population Forecast

The net inmigration for the Iowa Army Ammunition Plant study area between 1980 and 1990 is estimated to be 2,849 persons (LATA 1982).

The 1990 total population forecast of 383,600 for the 80-kilometer (50-mile) radius around the Iowa Army Ammunition Plant is shown in Figure 3.2.8.2-A. The largest concentrations of people are found in the Burlington, Fort Madison, and Mount Pleasant areas. Rural population densities remain about the same with densities of 10 to 12 people per square kilometer (26 to 31 people per square mile).

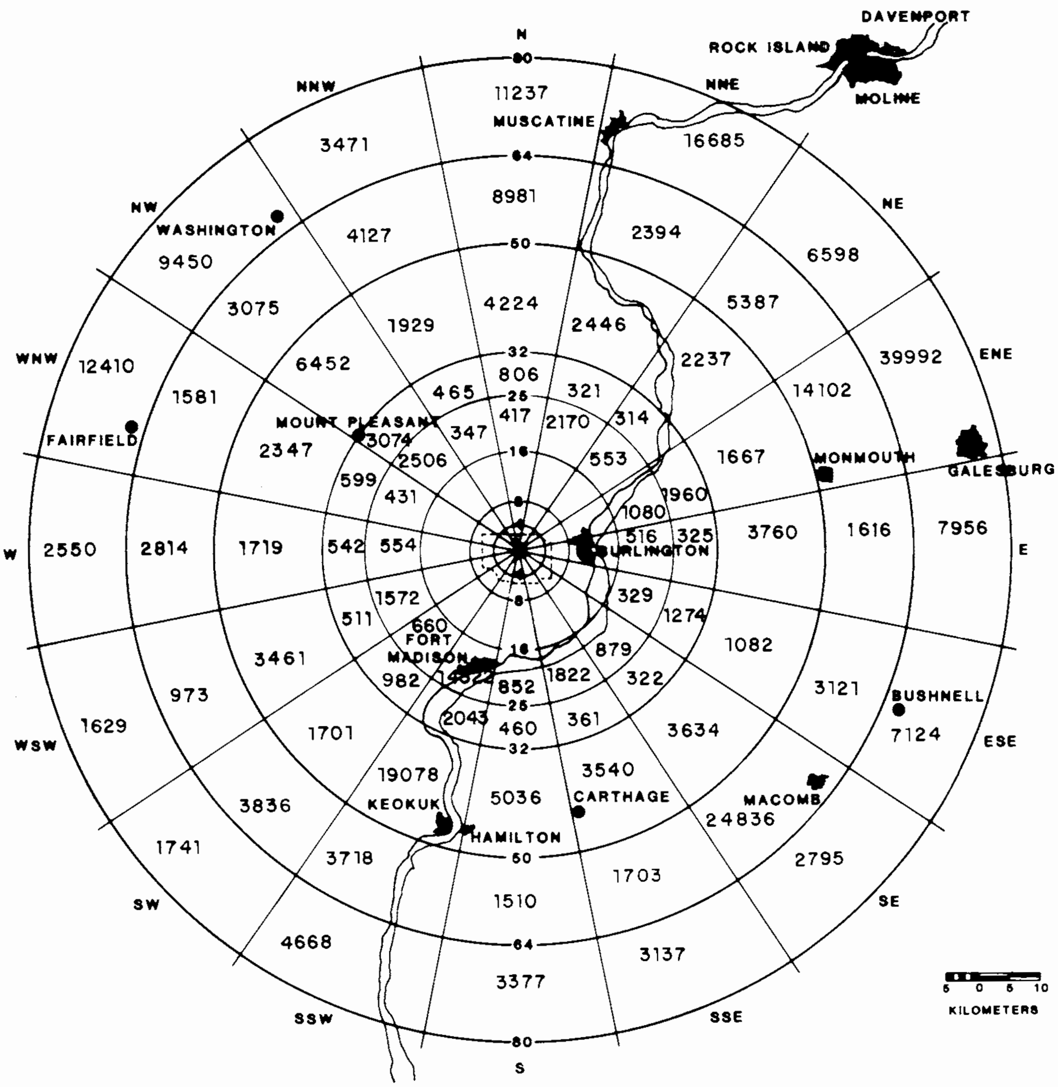


Figure 3.2.8.2-A. Projected 1990 population for Iowa Army Ammunition Plant study area.

3.2.8.3 Hanford Site--Employment and Population

Employment

As of January 1981, the Hanford Site and related Department of Energy operations in Franklin and Benton Counties employed approximately 12,000 workers. In addition, 10,500 workers currently are employed by the Washington Public Power Supply System to construct three nuclear power generation plants on the Hanford Site. The total employment on the Hanford Site represents about 30 percent of the total resident labor force (77,200) in 1981 (USDOE 1981C, WJS 1981A, WES 1982).

Employment Forecast

Employment data and growth information for counties in the Hanford Site area were obtained from the Pasco office of the Washington State Employment Security Department. The Employment Security Department believes that the Tri-Cities (Richland, Kennewick, and Pasco) area will experience substantial employment growth in the 1980 to 1990 decade, but this growth will not be as spectacular as that seen in the recent past. An employment growth rate of 30 percent is anticipated during the 1980 to 1990 period. This compares with the 1970 to 1979 period during which nonagricultural wage and salary employment in the Tri-Cities area more than doubled. This 1980 to 1990 employment forecast is also consistent with a 1980 Tri-Cities transportation study that predicted a 36 percent increase in employment in the area (LATA 1982). However, large portions of the Hanford Site study area [80 kilometers (50 miles) around the proposed construction site] are predominantly agricultural with few people and little potential for growth. Employment growth rates between 0 percent and 5 percent were assigned to each of these agricultural counties; 5 percent growth rates were used for those counties with urbanized areas where growth might occur (LATA 1982).

Population

The largest residential population concentration occurs southeast and south-southeast of the Hanford Site in the Tri-Cities area (Richland, Kennewick, and Pasco). Lesser concentrations are found south-southwest of the Hanford Site in Prosser, west-southwest in Toppenish, west in Yakima, and north-northeast in the Moses Lake area (LATA 1982). The rural population between 16 kilometers (10 miles) and 80 kilometers (50 miles) of the proposed construction site has a density of about 5 people per square kilometer (13 people per square mile). There are essentially no people within 16 kilometers (10 miles) of the proposed construction site because over 95 percent of this land belongs to the Hanford Site. The total population within an 80-kilometer (50-mile) radius of the Hanford Site was 323,900 in 1980 (LATA 1982).

Population Forecast

Approximately 62,600 persons are expected to migrate into the Hanford study area between 1980 and 1990. Of these, over 54,000 are forecast to migrate to the Tri-Cities area, and 6,200 will go to Yakima County. Almost 2,000 new migrants are expected to settle in Grant County during the decade (LATA 1982).

1990 Total Population

Figure 3.2.8.3-A shows the 1990 total population forecast of 388,600 for the 80-kilometer (50-mile) radius around the Hanford Site. The largest concentration of population still exists in the Tri-Cities

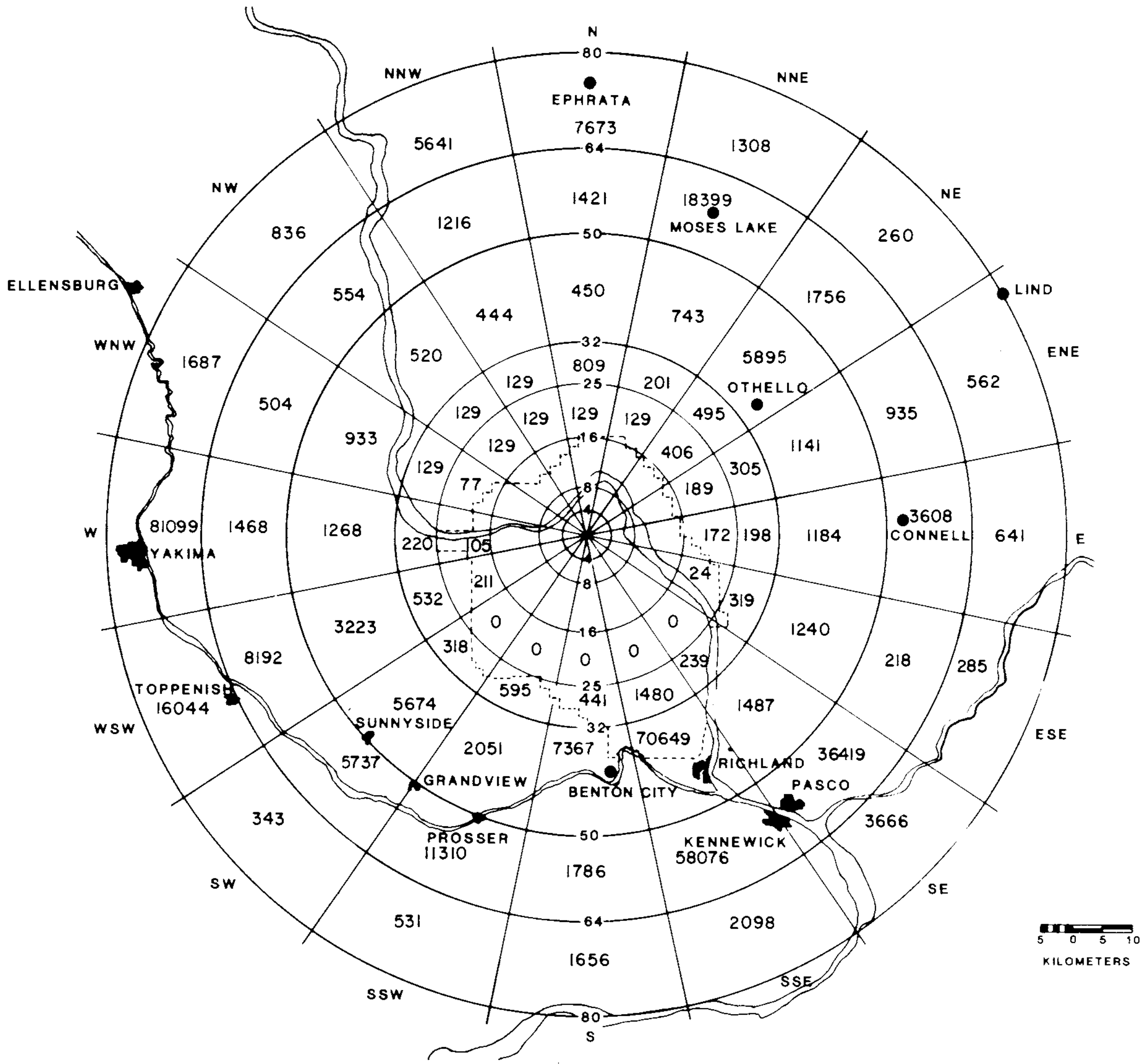


Figure 3.2.8-3-A. Projected 1990 population for Hanford Site study area.

area. The second largest concentration is found in the Yakima sector; other areas with significant populations are found to the north-northeast, south-southeast, and west-southwest of the Hanford Site (LATA 1982).

3.2.9 Economics

3.2.9.1 Pantex Plant--Economics

The combined payroll and purchases associated with the Pantex Plant operation are estimated to contribute about 3 percent of the 1981 retail sales in Amarillo trade areas. The total payroll at the Pantex Plant (reported at $54.4 million in 1981) plus local purchases for materials and services ($3.5 million) totals $57.9 million. Nonbasic or induced employment is estimated to increase this total by $48.5 million.

In 1981 Amarillo schools received about $56,500 in Federal impact funds because of the Pantex Plant operation. Other school systems serving students of Pantex Plant employees received an estimated $8,500 for a total expenditure of $65,000 in Federal impact funds in 1981 (Rapp 1982).

3.2.9.2 Iowa Army Ammunition Plant--Economics

The 1980 payroll at the Iowa Army Ammunition Plant was about $20.2 million. In addition, estimated purchases of materials and services from local suppliers totaled $1 million. Total wages for nonbasic employment were estimated at $18 million. Using current marketing data, the combined payroll and purchases attributed to the Iowa Army Ammunition Plant are estimated at $18.4 million in 1981 retail sales in the four-county Southeast Iowa trade area (Des Moines, Henry, Lee, and Louisa). This is about 3 percent of the 1981 retail sales in the Southeast Iowa trade area (Rapp 1982).

In 1981 the Burlington Community School District received an estimated $38 thousand in Federal impact funds for children of employees at the Iowa Army Ammunition Plant. A district official estimates that 98 percent of the children of employees are enrolled in area schools within the District.

3.2.9.3 Hanford Site--Economics

Payroll directly attributed to Hanford Site operations varies because of various work force fluctuations. A conservative estimate of the 1980 to 1981 basic payroll totals $545 million. Nonbasic employment was estimated to add an additional $485 million (Rapp 1982).

Total retail sales for the Tri-Cities area in 1981 were $924 million. The combined payrolls for basic and nonbasic employment at the Hanford Site generated about $613 million or about 66 percent of the 1981 retail sales (Rapp 1982).

In 1981 the three independent school districts in the Tri-Cities area received an estimated $782 thousand in Federal impact funds for children of Federal workers employed at the Hanford Site. This represents approximately 97 percent of all Federal impact funds paid to area school districts (Rapp 1982).

3.2.10 Community Resources

3.2.10.1 Pantex Plant--Community Resources

Housing

Housing in the Amarillo area has kept up with demand since the closing of the Amarillo Air Force Base in the late 1960's. However, major expansion of the population over a short period of time may result in temporary shortages of housing (Amarillo 1980).

Utilities

The Southwestern Bell Telephone Company serves the Amarillo area. Natural gas is supplied to the Pantex Plant by the Pioneer Corporation, which is headquartered in Amarillo. There is no shortage of natural gas foreseen in the region with assured reserves of 11.7 years, which is considerably higher than most companies in the nation (Rapp 1982). Electrical power is supplied by the Southwestern Public Service Company. Their service area covers 45,000 square miles with a 3,660-megawatt interconnected system. In June 1980 a third 350-megawatt coal-fired generating unit was added to the Amarillo service area. In July 1982 the first of two 561-megawatt coal-fired units at the Harrington Station came on line. The Southwestern Public Service Company is exporting power through the Southwest Power Pool, and users are assured of adequate power supplies in the foreseeable future (Rapp 1982).

Education

Total enrollment (1981 to 1982) for the Amarillo Independent School District was 26.4 thousand. Of that number, 898 students (3.4 percent) were children of Pantex Plant employees. In addition, school systems in surrounding counties provide services to an estimated 180 children of Pantex Plant employees.

Health Services

Amarillo provides a full range of health and medical care. Hospitals in the metro area now provide about 5 beds per 1,000 residents, compared with Federal guidelines that recommend 4 beds per 1,000. The 25-county health planning region has a total of 300 medical doctors serving a population of 234 thousand people. The Amarillo Standard Metropolitan Statistical Area has 210 physicians. Thus, the doctor-to-patient ratio in the service area ranges from about 1 per 750 to 1 per 780 persons. When compared with the Federal guidelines, which recommend one primary care physician per 2,500 population, the ratio is considered adequate within the commuting area of Pantex Plant (Rapp 1982, PRPC 1981).

Public Safety

The Amarillo metropolitan area is protected with the full range of public safety services. In 1980 there was 1 sworn officer per 645 residents and 1 fireman per 730 residents. The Amarillo Police Department advised us that the authorized strength of the department was 234 sworn officers. However, in 1981, the corps was 12 officers below full strength. Actual street patrol was about 1 per 1,000 population; however, this ratio was deemed adequate for the current needs of the population. The sheriffs' offices in both Potter and Randall Counties reported their authorized strength for road patrol was adequate for the needs of their respective jurisdictions (Rapp 1982).

Transportation

Transportation services in and around Amarillo are very good. The area is served by Interstate Highway 40, Interstate Highway 27, and several major United States highways. There are 18 motor freight companies, 4 intercity bus lines, and 3 railroad companies. In addition, 7 airlines operate at the Amarillo International Airport. The airport can handle all large military aircraft (Rapp 1982).

3.2.10.2 Iowa Army Ammunition Plant--Community Resources

Housing

A housing surplus currently exists in the city of Burlington. Vacant hotels could be reopened for bachelor housing, and space is available in mobile home parks. In some cases, the surrounding rural communities have a shortage of housing because younger families, willing to commute longer distances, have acquired many of the older homes. However, most communities allow placing of mobile homes in fringe areas (Burlington 1981B, IJS 1980A).

Utilities

The Burlington area is supplied with natural gas via the Michigan Wisconsin Pipeline and the Iowa Southern Utility Company. The Iowa Army Ammunition Plant currently is converting a standby electric generation plant from oil to coal, which may in time become the principal power source there. However, the Union Electric Power Company has ample capacity for the power requirements. The Iowa Army Ammunition Plant is supplied by two independent, 69-kilovolt supply lines with interconnects to the Mid-America Interpool Network and with principal transmission lines through Illinois and Missouri. Other supplies are assured through Iowa Southern Utility Company. Therefore, electrical power seems assured for the foreseeable future (Rapp 1982).

Education System

Iowa enjoys a reputation for quality schools and facilities. Burlington, in particular, has several surplus school buildings (Rapp 1982).

Health Services

The Iowa Army Ammunition Plant has access to very good health services. The area is serviced with hospitals in Burlington, Fort Madison, Keokuk, and Mount Pleasant. There are a total of 714 beds or an average of nearly 6 beds per 1,000 population compared with Federal guidelines that recommend 4 beds per 1,000 population.

The ratio of primary care physicians to population is approximately 1 per 1,000. Although distribution of doctors in the area is a problem, the ratio compared favorably with Federal guidelines that recommend a ratio of 1 per 2,500. Therefore, the health services within commuting distance of the Iowa Army Ammunition Plant are considered adequate (Rapp 1982, SIRPC 1981).

Public Safety

The communities surrounding the Iowa Army Ammunition Plant have adequate public safety services. At present, the Burlington police and fire departments employ about 1 person per 580 population. The Des Moines County Sheriff's Department employs about 1 per 1,000 population (Burlington 1981A). The Burlington Police Department advised us that they had an authorized strength of 36 sworn officers supported by 13 sworn reserve officers. The authorized strength was deemed adequate for the current needs in Burlington (Rapp 1982).

Transportation

The transportation facilities serving the Burlington area are adequate. Medium-sized jet aircraft flown by commercial airlines serve the area (for example, DC-9). However, the Burlington Airport cannot handle large commercial (for example, DC-10) or military aircraft.

Rail freight service and rail passenger service is available at Burlington. Ozark Airlines also serves the region. Trucking service is provided by 31 common carriers and passenger bus service is provided by Continental Trailways. Two United States highways cross the area north-south and a third crosses east-west. Water transportation is available on the Mississippi River about 10-1/2 months of the year (Burlington 1981B).

3.2.10.3 Hanford Site--Community Resources

Housing

No significant housing shortage is anticipated in the Tri-Cities area because of the recent construction activities at the Hanford Site. A recent real estate report indicates no shortage of housing units in the Tri-Cities area. The study noted a 16.7 percent vacancy rate among some 6,000 apartment units. Many construction workers provide their own mobile housing as may be seen by numerous mobile home parks in the area (TCRERC 1981).

Utilities

The natural gas and electrical power facilities serving the Tri-cities area are adequate. The Tri-Cities area provides municipally owned water and sewer services. Natural gas is supplied to the area by Cascade Natural Gas Company. Cascade Natural Gas Company obtains its supply from the Northwest Pipeline Company of Salt Lake City, which has the highest assured supply (21.3 years) of any gas company in the nation. The relatively new high-pressure distribution system is expected to assure adequate service for the foreseeable future (Rapp 1982).

Electric power is supplied in the area by the Franklin County and Benton County Public Utility Districts and by Richland Energy Services. Telephone service is provided by General Telephone Company of the Northwest, Inc. in Kennewick and Richland and by the Pacific Northwest Bell Telephone Company in Pasco (WSDCED 1980).

Education

School facilities in the Tri-Cities area are very adequate with an average teacher ratio of 1 teacher for 19 students.

Health Services

The Tri-Cities are served by three hospitals with a total of 276 beds or about 1.9 beds per 1,000 population, as compared with Federal guidelines that recommend 4 beds per 1,000 residents. However, hospitals reported occupancy rates of 63 percent, 69 percent, and 80 percent in the past year. The Kadlec Hospital in Richland currently is seeking certification of need for 64 additional beds in 1982. Further, they plan to add 80 beds in 1983, 80 more in 1986, and still another 80 about 1991 (Rapp 1982).

The Tri-Cities area supports over 100 physicians and surgeons and over 50 dentists. The ratio of primary care physicians in the service area is about 1 per 1,500 population, which compares favorably with Federal guidelines that recommend 1 per 2,500 population. Therefore, the health services in the Tri-Cities area are considered adequate (Rapp 1982).

Public Safety

Continued construction activities on the Hanford Site over a long period of time will very likely require the enlargement of the public safety forces serving the Tri-Cities area. At present, the three cities support their own police and fire departments, averaging about 1 police officer per 715 residents and 1 fireman per 752 residents. Senior police officers in Pasco, Kennewick, and Richland reported the ratio of sworn officers to population ranged from 1.3 to 1.5 officers per 1,000 residents. All considered the authorized strength was adequate to deal with the public safety needs of their community. However, the sheriffs of Franklin and Benton Counties reported their departments were undermanned at this time. Franklin County, with 17 sworn sheriffs' officers, reported the need for 7 more deputies (41 percent) in order to meet national averages for counties of similar classification (Rapp 1982).

Transportation

The Tri-Cities are connected by U.S. Highway 12. Other major roads serving the region are U.S. 395 and State Highways 14, 24, and 240. Interstate Highways I-82 and I-182 are still in the planning stages. In September 1981, Amtrak service was restored to the area. Rail service includes the Burlington Northern and the Union Pacific Railroad companies. Air service is provided at the Tri-Cities Airport at Pasco by Republic Airlines and a commuter airline, Cascade Airways. However, the airports cannot handle very large aircraft. The commuter airline also serves the Richland Airport. The Kennewick Airport serves only general aviation traffic. Motor freight service is provided by over 20 interstate and intrastate trucklines. Passenger service is provided by Greyhound Bus Lines. Barge service on the Columbia River and Snake River is provided by three companies. The Tri-Cities area supports three functioning river port facilities (Rapp 1982).

3.2.11 Cultural Resources and Native Americans

3.2.11.1 Pantex Plant--Cultural Resources and Native Americans

Cultural Resources

A detailed archaeological survey was conducted at Pantex Plant in 1981 (Hughes 1981). This survey located remains of 42 prehistoric Indian camps and three pre-World War II farmsteads. One historic site is on the uplands, and all other sites are in or near four playa basins located on Plant property.

Although these sites do not appear to be historically or archaeologically significant enough to qualify for the National Register of Historic Places (Hughes 1981), all prehistoric sites are cultural resources worthy of protective measures. However, none of these sites are located in areas that would be impacted by construction activities.

In addition to the archaeological survey, the Texas Historic Commission was contacted to determine if any National Register sites existed within the area. In February 1982 the Acting State Historic Preservation officer sent notification that no sites were recorded (Herrington 1982A).

Native Americans

Today, there are no Indians that identify Carson County, Texas, as homeland or as religiously significant (Herrington 1982B). During the 1800's the Panhandle of Texas was occupied by Kiowas, Kiowa

Apaches, and Comanche Indians (Newcomb 1961). These Indians were removed in the late 1800's, when the military established reservations for tribes of the Comanche and Apache Nations in Oklahoma, New Mexico, and Arizona.

3.2.11.2 Iowa Army Ammunition Plant--Cultural Resources and Native Americans

Cultural Resources

No known archaeological resources exist; however, a detailed archaeological survey of the Iowa Army Ammunition Plant has not been performed. The State Historic Preservation officer (Iowa State Historical Department, Division of Historic Preservation) sent notification in March 1982 that over 60 prehistoric sites have been recorded in surrounding townships (Anderson 1982). Based on this information and site topography, the State Historic Preservation officer determined that a cultural resource survey should be conducted before any construction activities begin (Anderson 1982).

Native Americans

No Indians currently exist that claim the Iowa Army Ammunition Plant or surrounding area as homeland or as religiously significant. The western Illinois-eastern Iowa region was occupied by the Fox and Sauk Indians in the early 1800's. The Black Hawk War ended in 1832, and the surviving Fox and Sauk Indians were placed on a reservation in Iowa. Most of these Indian populations have ceased to exist; however, remnants of the Fox are still found in central Iowa (Oswalt 1978).

3.2.11.3 Hanford Site--Cultural Resources and Native Americans

Cultural Resources

There are 17 historic sites listed on the Washington State Register of Historic Places, the National Register of Historic Places, or the National Register of Historic Landmarks that are within about 80 kilometers (50 miles) of the Hanford Site (Jamison 1981). Of these, 10 are archaeological sites or archaeological districts. Within the Hanford Site itself, there are 9 cultural resource areas listed with the National Register of Historic Places. Many less interesting sites are in the area. Most of these sites are found on the Columbia River shoreline and are campsites associated with fishing grounds (Jamison 1981).

The considered project site is over 3 kilometers (2 miles) from the river, and no archaeological sites are expected. However, because of the abundance of archaeological sites in the general area and a known cultural resource (the Hanford Ditch), the State Historic Preservation officer determined that a detailed cultural survey should be performed before construction (Stump 1982).

Native Americans

No known shrines or places of Native American worship exist at the considered project site; however, existing tribes may consider this area to be homeland or as having religious significance.

Indians used some places on the Hanford Site as traditional wintering grounds from prehistoric times till 1943 when the area was evacuated by the United States Government (Jamison 1981). Four major tribes (the Yakima, Cayuse, Walla Walla, and Umatilla) live near the Hanford Site (Elle 1982).

3.2.12 Existing Health and Safety Conditions

Worker and public health and safety is addressed for current operations at the Pantex Plant. The other two sites are not addressed because nuclear weapons operations are not performed currently at either of these two sites.

Past operating experience at the Pantex Plant has shown that public health and safety is ensured by controlling effluents to appropriate standards (MHSM 1973, MHSM 1975A, MHSM 1975B, MHSM 1976, MHSM 1977A, MHSM 1977B, MHSM 1978, MHSM 1979A, MHSM 1979B, MHSM 1980A, MHSM 1980B, MHSM 1982). Public access to those areas where inadvertent exposure to radioactive materials, explosives, toxic materials, and/or physically dangerous situations could occur is restricted. Control of public access is accomplished by means of security measures.

The processes involved in nuclear weapons operations bring the work force into potential contact with a broad variety of hazards. In addition to hazards common to any light industrial activity, there are hazards associated with handling high explosives and radioactive materials. To meet health and safety concerns and to comply with applicable Department of Energy regulations, the Pantex Plant has a well-developed health and safety program.

Operations with conventional chemical high explosives carry an implied risk of accidental detonation. This is true for chemical high explosives in components for nuclear weapons as well as in other common uses such as conventional munitions (including ammunition for rifles or handguns), explosives for mining and construction, and fireworks displays. Therefore, plants handling chemical high explosives are usually designed with protective physical features to minimize consequences of accidental explosions. The consequences of most concern are physical blast effects such as overpressures (high-pressure pulse) or flying fragments. These consequences could injure workers or induce additional explosions in adjacent or nearby work areas. Common protective features are separation of facilities, barriers such as berms, blowout panels or walls to direct blast effects, and high-strength structures. All of these are used at the existing Pantex Plant.

3.2.12.1 Epidemiologic Investigations

Regional Study

Regional epidemiological studies around the Pantex Plant do not show unusual trends or patterns of cancer-related mortalities that could be attributed to the cumulative effect of Plant operations (Wiggs 198A).

Mortality for 18 cancer categories that have either been associated with radiation or chemical exposures or that have been the focus of public concern were investigated. Meteorological data (Bowen 1981) was used to define the study region, which included the two counties (Carson and Potter) adjacent to the Plant and the three "downwind" counties (Hutchinson, Gray, and Roberts) to the north and east of the Plant. Because of public interest, Randall County, southwest of the plant, also was included.

Mortality rate ratios (county rates divided by state rates) were used to compare age-adjusted cancer mortality rates for these counties with rates for Texas over three time periods: 1950 to 1959, 1960 to 1969, and 1970 to 1978. A standard statistical technique was used to determine if rates differed significantly between the counties and the state. Cancer mortality was not unusual in any of the three time periods examined.

Work Force Study

An epidemiologic study of past and present Pantex Plant workers was done (Acquavella 1982). This study compared total and cause-specific mortality for Pantex Plant workers employed between 1951 and December 31, 1978, with expected cause-specific mortalities based on U.S. death rates. Significantly fewer deaths were observed in the work force than would be expected from projections based on United States death rates for the following causes of death: all cancers, arteriosclerotic heart disease, and digestive diseases. Furthermore, no specific causes of death occurred significantly more frequently than expected. Analyses of worker mortality by duration of employment, time since first employment, and cumulative occupational radiation exposure greater than 1.00 rem produced similar results. The results of this investigation provide no evidence that mortality from major causes of death is measurably affected by low-level occupational radiation exposure. Even considering the "healthy worker effect," the results of this study indicate that Pantex Plant workers experience no increased risk of dying as a result of employment at the Pantex Plant.

3.2.12.2 Health and Safety Evaluations

The Pantex Plant has a well-defined health and safety program for protecting worker health. There is no evidence of chronic overexposures of workers to radiation (Elder 1982A). A detailed review of Pantex medical and industrial hygiene records also indicates no overexposures to other toxic materials. Safety- and health-related activities are actively directed at compliance with applicable regulations (USDOE 1980A). All purchase requests for toxic chemicals are reviewed to assure that appropriate control measures will be taken before purchase is approved.

The health and safety program at Pantex Plant provides the essential elements of worker protection: routine inspections and monitoring of workplaces, employee health and safety training, preemployment and routine medical examinations, accident investigation and reporting, plans and procedure review, employee complaint review, and active enforcement of regulations. The Department of Energy routinely audits the Pantex Plant program to assure compliance with applicable standards and regulations. Written standards and procedures prescribe the acceptable methods of accomplishing potentially dangerous activities. Strict adherence to these safety instructions limits contact with toxic materials and minimizes the probability of an accident.

Progress toward improved worker health and safety has been significant in the last 10 years. Recently, high-explosive materials with a much lower sensitivity to initiating events have been introduced in some weapons systems. Special control measures, such as local exhaust ventilation (with exhaust air cleaners where deemed necessary to protect the environment), have been provided to prevent worker exposure to toxic and radioactive materials. Solvent storage and pumping stations have been installed outside of buildings to reduce personnel contact with solvent vapor. Shielding, tools, fixtures, reduction of time spent near radiation sources, and design features to reduce penetrating radiation from nuclear components have served to reduce worker doses (Elder 1982A).

Records of radiation doses during routine operations show that doses are maintained well within limits established by the Department of Energy. Details of the review of Pantex Plant radiation dose records are provided separately (Elder 1982A). Table 3.2.12.2-1 summarizes the dose distribution of all Pantex Plant workers since 1966, when uniform compilation of doses at Department of Energy (or Atomic Energy Commission or Energy Research and Development Administration) facilities was initiated. The 5-rem-per-year limit (set by the Department of Energy for radiation workers) on whole-body dose was exceeded only once at the Pantex Plant in this period.

Over the period 1979 to 1981, a major workload increase caused integrated doses among workers to increase into the range of 150 to 204 person-rem. This was substantially above the 50 to 72 person-rem range of previous years. Over this same period, efforts were accelerated to reduce worker doses to "as low as reasonably achievable." These efforts included improved shielding, procedures, and worker training. A recently established administrative limit of 2.5 rem per year (50 percent of the Department of Energy limit) has produced a favorable trend of lower doses distributed among a higher number of workers (MHSM 1981B).

Doses that are kept below the 5-rem-per-year limit for ionizing radiation should not cause any effects exceeding an average risk of eventual cancer mortality of 1 chance in 10,000 per rem (ICRP 1977).

TABLE 3.2.12.2-1

PANTEX PLANT ANNUAL WHOLE-BODY DOSES FOR 1966 TO 1981*

	Number of Workers with Dose in Each Range of Measurement							Total Number of Workers	Integrated Dose***
Year	<Meas**	<1 rem	1-2 rem	2-3 rem	3-4 rem	4-5 rem	5-6 rem	Monitored	(person-rem)
1966		526	15	3				544	
1967		496	17	4	1			518	
1968		393	6					399	
1969		397	2	1				400	
1970		352	15	7	1			375	
1971		426	21	8	2			457	
1972		407	10	6				423	
1973		296	7					303	
1974		472	9					481	72
1975	45	457	6					508	56
1976	31	406	3	1				441	50
1977	20	419	4	1				444	62
1978	68	426	2	1				497	57
1979	27	610	28	10	1	4	1+	681	185
1980	106	641	27	10	2			786	153
1981	355	512	49	8				924	204

*Compiled from "Annual Report of Radiation Exposure for DOE and DOE Contractor Employees," USDOE Office of Nuclear Safety.

**Dose was below the measurement limit of dosimeters (approximately 0.01 rem). Uniform reporting not begun until 1975.

***Summed doses of all workers receiving a measurable dose. Data not reported from 1966 to 1973.

+The 5-rem per year limit was exceeded in this one case. Underestimation of the rate of dose received by a male worker resulted in a dose of 5.14 rem in 1979. An incident report was prepared and corrective measures taken.

For toxic chemicals, exposures kept below the threshold limits specified by the American Conference of Government Industrial Hygienists (ACGIH 1981) and the Occupational Safety and Health Administration should not cause "adverse effects," although a small percentage of workers may experience some discomfort or even develop an occupational disease (OSHA 1978).

3.2.12.3 Historic Safety Record

The Systems Safety Division of EG&G-Idaho analyzed accident and injury statistics for the Pantex Plant. This analysis indicates that the Pantex Plant is extremely safe (Briscoe 1981). This section presents the major conclusions of the safety analysis study.

There have been four fatalities from accidents at the Pantex Plant since the start of operations in 1951 by the Atomic Energy Commission. An accidental electrocution occurred on February 13, 1971, resulting in the loss of one life. An accidental explosion occurred in the high-explosives research and development area (not part of the nuclear weapons operations) on March 30, 1977, resulting in the loss of three lives (Poole 1982).

In spite of these two accidents, historical records show that both Plant injury rate and time lost from injury are below those seen in other Department of Energy installations, the explosives industry, and most private industry. In addition to this good record, the data show a steady decline in both worker injuries and damaged property from 1975 through 1980, except for the 1977 accidental explosion.

Table 3.2.12.3-1 shows a comparison between the Pantex Plant and other industries. The Pantex Plant loss rates are lower in every category than rates for all Department of Energy operations. The Pantex Plant injury rate for 1981 is 68 percent less than the average total United States explosives industry and 43 percent less than the rest of the Department of Energy operations.

Pantex Plant property loss rates for 1980 are one-seventh the property loss rates for all Department of Energy operations and their contractors. The average loss rates from 1975 to 1980 show Pantex Plant higher; however, the single accident in high-explosive development (loss of 3 lives and 1 building) accounts for 82 percent of all the Pantex Plant losses over the 6-year period.

TABLE 3.2.12.3-1

INJURY LOSS RATES--OSHA INCIDENCE RATES
(based on 200,000 man-hours)

		Total Recorded Cases	Lost Work Cases
1981	Pantex Plant	1.3	0.6
	All Department of Energy	2.3	1.0
	DuPont (S.R.) Production	0.5	0.1
	Hercules Powder (to June 1981)	--	1.4
1977-1979* Average	U.S. Explosives Industry**	4.1	1.7
	All U.S. Industry**	7.9	3.5
	DuPont Corporation***	1.1	0.1

*This timeframe was chosen because data were available from Accident Facts (NSC 1981).
**Accident facts (NSC 1981).
***DuPont Corporation (Petrochemical Division about the same).

3.2.12.4 Noise

Test firing high explosives creates high impulse noise levels (pressure waves) that can potentially result in adverse health effects in humans (damage to pressure-sensitive organs). These high impulse noise levels have the same potential for inflicting serious damage to wildlife a short distance from the pressure wave source. However, beyond a relatively short distance from the source, the intensity of the blast wave has diminished sufficiently that the potential for adverse effects ceases to exist Hirsch 1968).

The effects of blast waves have been studied and are taken into account by regulations that establish personnel and building safety zones for high-explosive detonations (USDOE 1982D, USDOD 1978). The Pantex Plant Explosives Test Sites are located at distances that exceed the prescribed safe quantity-distance limits (quantity of high explosives versus distance to inhabited buildings and/or public traffic routes). In addition, audible and visual alarms warn personnel to remain out of the area during tests. No damage to human health or hearing would be expected under the high-explosive testing operations conducted at the Pantex Plant.

The effects of high impulse noise levels on wildlife are probably more adverse than in humans because of the difference in body size and sensitivity. In addition, impairment of auditory systems in wildlife can have adverse effects on courtship and mating behavior, prey location, predator detection, and homing capabilities (USEPA 1971). However, because of the relatively small area involved in test-firing activities, the native species have been able to adjust their living habits around these locations. The pressure waves from current testing would not seriously affect the bird population flying farther than about 30 meters (32 yards), or animals on the ground beyond 75 meters (85 yards), of testing operations. Based on this evaluation, very little impact on animal life would be expected from Pantex Plant high-explosive testing.

4.0 ENVIRONMENTAL IMPACTS

This chapter summarizes the potential environmental impacts of possible future actions at each of the three alternative siting locations. The emphasis is on changes in environmental impacts from existing conditions (described in Chapter 3) that would be expected in the future. The results of technical analyses are summarized. Assumptions and analytic procedures are briefly described. The reader is referred to supporting documents or an appendix for additional details.

The first section of Chapter 4 presents the impacts for all three alternatives (Pantex Plant, Iowa Army Ammunition Plant, and Hanford Site) assuming normal operations (Section 4.1). The second section of Chapter 4 considers potential plant accidents (Section 4.2), and the last section considers related transportation operations (Section 4.3).

4.1 ENVIRONMENTAL IMPACTS OF PLANT FACILITIES, CONSTRUCTION, AND NORMAL OPERATIONS

The impacts are discussed under the same 12 environmental topical areas used in Section 2.3. Each topical subsection presents information for each site in the same sequence.

4.1.1 Air

4.1.1.1 Pantex Plant--Air

Table 4.1.1.1-1 presents the estimated changes between 1981 and 1985 in annual emissions for future major routine releases at Pantex Plant. This table shows that all existing source terms will remain about the same or decrease in the future. Thus, future emissions from existing sources will meet all applicable Federal and state ambient air emission standards.

The largest potential change that would affect air quality is construction of a new coal-fired cogeneration plant. The coal-fired plant will be designed to comply with the National Ambient Air Quality Standards. Fugitive dust from coal and ash storage will be minimized through handling procedures such as windbreaks and water sprays. As presented in Table 4.1.1.1-2, preliminary air quality impact analysis indicates that downwind air concentrations would not exceed Environmental Protection Agency Ambient Air Quality Standards or Prevention of Significant Deterioration increments (UNENG 1979). This coal-fired plant would release several naturally occurring radionuclides normally present in all coal (see Section 4.1.6.1).

In the future, plastic-bonded high explosives will be burned that contain significant quantities of fluorine. When burned, hydrogen fluoride gas will be emitted. New administrative controls on quantities burned or possibly a new location for burning are being implemented to ensure continued compliance with the Texas State hydrogen fluoride standard at the site boundary (Macdonell 1982).

Some fugitive dust would result from earthwork during construction of new facilities. Various control strategies (such as watering) would be employed to minimize emissions during the construction period.

TABLE 4.1.1.1-1

FUTURE ANNUAL EMISSIONS FOR PANTEX PLANT
MAJOR AIR POLLUTANT SOURCES FOR ALL OPTIONS

Source	Estimated Change (Percent) Between 1981 and 1985	Estimated Emissions (kilograms)
Automobile Commuter Traffic		
Hydrocarbons	-58	21,600
NO_x	-52	334,700
CO	-48	29,800
Gas-Fired Power Plant*		
NO_x	0	14,300
CO	0	3,200
Coal-Fired Cogeneration Power Plant**		
Hydrocarbons	New source	4,200
NO_x	New source	141,700
CO	New source	13,900
SO_2	New source	83,400
Particulates	New source	22,250
Burning of Waste High Explosives*		
NO_x	-30 to -50	2,280 - 1630
CO	-30 to -50	840 - 600
Solvent Evaporation*		
Toluene	0	16,100
Acetone	0	20,800
Dimethylformamide (DMF)	0	12,200
Others	0	10,200

*Information from Laseter 1982.
**This plant would not be operational until 1988 but is included for comparison (USDOE 1981E).

4.1.1.2 Iowa Army Ammunition Plant--Air

Neither partial relocation nor total relocation of nuclear weapons operations to the Iowa Army Ammunition Plant would have a significant effect on air quality. Iowa State ambient air quality standards are identical to Texas State ambient air quality standards except for hydrogen fluoride, which is not regulated by the State of Iowa.

If all emissions shown for the Pantex Plant (Section 4.1.1.1) were moved to the Iowa Army Ammunition Plant, offsite concentrations from these emissions would be lower because of greater distance to the site boundary. As these emissions have been shown to be a negligible fraction of the ambient air standards (Section 3.2.1.1), their incremental addition to current ambient air concentrations would not result in a violation of either the Federal or state standards.

TABLE 4.1.1.1-2

COMPARISON OF PREDICTED MAXIMUM AMBIENT AIR CONCENTRATIONS AND APPLICABLE STANDARDS FOR THE COAL-FIRED COGENERATION POWERPLANT

Pollutant	Predicted Concentration	Units	Time Period	National Ambient Air Quality Standards	Prevention of Significant Deterioration Increments
SO_2	0.10	parts per million	3 hours	0.5	0.2
	0.03	parts per million	24 hours	0.14	0.035
	<0.03*	parts per million	Annual	0.03	0.008
Total suspended particulates	<1.0*	micrograms per cubic meter	24 hours	150	37
	<1.0*	micrograms per cubic meter	Annual	75	19
NO_2	0.06*	parts per million	1 hour	No standard	No increments
	<0.05**		Annual	0.05	No increments

*Based on comparison with 24-hour value.
**Based on comparison with 1-hour value.

Excess and waste high explosives are burned in incinerators at the Iowa Army Ammunition Plant to reduce particulate emissions. These incinerators have the capacity to handle the increased amounts of waste high explosive; however, their use may not be compatible with the large pieces of high explosives generated by nuclear weapons operations. A safe way to reduce these large pieces of explosives into smaller sizes would have to be developed.

The largest impact on air quality would be the addition of the coal-fired power plant. Emissions from this Plant would be similar to those discussed for the Pantex Plant (Section 4.1.1.1). Nevertheless, this coal-fired power plant would be in compliance with both Federal and state ambient air standards.

Some fugitive dust would result from earthwork during construction of new facilities. Various control strategies would be employed to minimize emissions during the construction period.

Effects in the vicinity of the Pantex Plant expected after relocating operations at the Iowa Army Ammunition Plant are in Section 4.1.1.4.

4.1.1.3 Hanford Site--Air

Relocation of nuclear weapons operations to the Hanford Site would not significantly affect air quality. Washington State ambient air quality standards are identical to Texas State ambient air quality standards except for particulates and sulfur dioxide. The differences are that Washington has adopted more stringent standards of 60 micrograms per cubic meter for particulates, and 0.02 parts per million annual average and 0.10 parts per million in a 24-hour average for sulfur dioxide.

If all emissions shown for the Pantex Plant (Section 4.1.1.1) were moved to the Hanford Site, offsite concentrations from these emissions would be lower because of greater distance to the site boundary. Because these emissions have been shown to be a negligible fraction of the ambient air standards (Section 3.2.1.1), their incremental addition to current ambient air concentrations would not result in violations of either the Federal or state standards.

The largest impact on air quality would be the addition of the coal-fired power plant. Emissions from this plant are shown in Table 4.1.1.1-2 and would be similar in type to those emissions from each of the two existing coal-fired steam plants at Hanford Site. This plant would meet all state ambient air quality standards.

Effects in the vicinity of the Pantex Plant expected after relocating operations at the Hanford Site are discussed in Section 4.1.1.4.

4.1.1.4 Termination--Air

Terminating nuclear weapons operations at the Pantex Plant would eliminate its emissions from open-air testing of high explosives, from burning excess and waste explosives, and from evaporation of waste solvents. Decontamination and decommissioning activities would produce some fugitive dust. After decommissioning, air quality in the vicinity of the Pantex Plant would depend on the use of the land. As the whole operation at Pantex Plant emits few air pollutants, shutting down operations would improve air quality imperceptibly.

4.1.2 Water

4.1.2.1 Pantex Plant--Water

An adequate water supply for the Pantex Plant is available for any of the proposed options. The projected annual water use for operations of the Pantex Plant during 1981 to 1990, regardless of option, is about 1.45 billion liters (383 million gallons or 1,180 acre-feet). This is slightly less than the average annual water use in the period 1971 to 1980 of 1.46 billion liters (387 million gallons or 1,190 acre-feet) (MHSM 1980C).

By comparison, the annual amount of water pumped from the Ogallala aquifer, as computed by the State of Texas, for irrigation, municipal, and industrial supply for the next 10 years is estimated at 182.2 billion liters (48.2 billion gallons or 148 thousand acre-feet) in Carson County (Bell 1979). Of this pumpage, about 71 percent or 127.6 billion liters (23.8 billion gallons or 103.6 thousand acre-feet) will be used for irrigation, 15 percent or 27.3 billion liters (7.2 billion gallons or 22.2 thousand acre-feet) for municipal supply, mainly for Amarillo, and 27.3 billion liters (7.2 billion gallons or 22.2 thousand acre-feet) for industrial supply. The projected annual use of about 1.45 billion liters (383 million gallons or 1,180 acre-feet) at the Pantex Plant is about 1 percent of the total projected amount of water pumped in Carson County or about 6 percent of the projected annual amount of water pumped for industrial supply.

The water-level decline in the Ogallala aquifer projected by Texas Department of Water Resources for the next 40 years ranges from 0.6 to 0.9 meter (2 to 3 feet) per year (Bell 1979). In the year 2020, the saturated thickness of the aquifer will still be more than 30 meters (100 feet) permitting wells to produce about 50 to 63 liters per second (800 to 1000 gallons per minute) (Bell 1979). Based on hydrologic characteristics of the aquifer projected by the Texas Department of Water Resources, the water supply at the Pantex Plant from the Ogallala Formation still should be adequate in the year 2020 (the practical limit of projections for this environmental impact statement).

Pantex Lake [a large dry playa of about 436 hectares (1,077 acres)] is retained by the Pantex Plant as a potential area for drilling additional water wells into the Ogallala aquifer if needed for future operations. Pantex Lake is adjacent to the Amarillo water-well field and is located at one of the better geologic locations for drilling wells into the aquifer (Purtymun 1982B).

There are no additional ground water sources that can be developed at the Plant (Purtymun 1982B). The formations underlying Ogallala at the site contain water of a poor quality. Hydrologic characteristics of these formations indicate that the yield from wells in the formations would be low (Cronin 1964, Long 1961).

None of the proposed projects (see Section 2.2.1.1) would significantly affect the quantity, quality, or points of discharge of the liquid effluents. These projects are mechanical assembly facilities or replacements of existing facilities, except for the proposed Alternative Energy Source Project. (This project will be designed and operated to comply with local, state, and Federal effluent regulations.) In addition, if any new wastes, not previously registered, are generated as a result of Plant expansion, the appropriate Texas State agencies will be contacted.

4.1.2.2 Iowa Army Ammunition Plant--Water

Adequate water is available to the Iowa Army Ammunition Plant if either option is implemented. This will be true even if the Iowa Army Ammunition Plant increases its conventional munitions workload to levels similar to those in the late 1960's and early 1970's. In addition, onsite ground and surface water is available (Section 3.2.2.2).

No major changes in surface or ground water quality will occur from nuclear weapons operations provided adequate measures are taken in operation, treatment, and disposal of effluent wastes such as those currently used at Pantex Plant. The additional volume of sewage effluents could overload the current sewage treatment facilities. Therefore, a new sewage treatment plant would have to be constructed (Becker 1982A).

Buildings constructed by the Atomic Energy Commission were fitted with waterproof foundations and drainage tile systems to drain shallow ground water away from the buildings. Buildings constructed by the U.S. Army were not. Buildings not fitted with drains and waterproofing may need to be outfitted with a drainage system to lower the water table and alleviate possible flooding. New buildings constructed in this area may need to be fitted with waterproof foundations and drain systems.

Under Option 2, total relocation, new facilities located above elevation 650 near the shoreline of Long Lake would probably not be flooded by the 100-year flood (Becker 1982C). This and smaller floods would be passed through the spillway.

Shallow ground water is present on the Iowa Army Ammunition Plant site, and it is advisable that exploratory holes to locate these areas be drilled within the proposed construction site before construction begins.

Effects in the vicinity of the Pantex Plant expected after relocating operations at the Iowa Army Ammunition Plant are discussed in Section 4.1.2.4.

4.1.2.3 Hanford Site--Water

There is ample water available from the Columbia River to implement the Hanford Site alternative. At present, about 613 billion liters (162 billion gallons or 497 thousand acre-feet) of water is removed annually from the Columbia River for Hanford Site operations, 93 percent of which is used for coolant water. The additional 1.5 billion liters (400 million gallons or 1200 acre-feet) required for relocation of nuclear weapons operations to the Hanford Site is less than 1 percent of the current Hanford Site water usage requirement. The basalt (confined) aquifers are not being used currently as a water supply source and could be tapped for additional water supply if needed.

No further changes in surface or ground water quality will occur with implementation of any of the Hanford Site options provided adequate measures are taken in operation, treatment, and disposal of effluent wastes such as those currently used at Pantex Plant. A complete sewage treatment plant capable of handling about 757 million liters (200 million gallons) of waste water annually will need to be built to accommodate the associated wastes. Industrial waste water treatment of high-explosives waste should be handled exactly as at the Pantex Plant; infiltration ponds or other environmentally acceptable waste treatment process will need to be constructed for disposal of the sanitary and industrial effluents.

The risk of flooding is small in the area designated for proposed construction on the Hanford Site. Flooding by the Columbia and Yakima Rivers is nearly eliminated by dams. Neither the highest flood on record nor the probable maximum flood (magnitude determined by a meteorological estimate of the physical limit of precipitation over the drainage basin) would flood the proposed area.

Effects in the vicinity of the Pantex Plant expected after relocating operations at the Hanford Site are discussed in Section 4.1.2.4.

4.1.2.4 Termination--Water

In the case of termination of operations at the Pantex Plant, the pumpage from the Ogallala Aquifer for industrial use at the Pantex Plant would cease. This would have very little effect in the general overall water-level decline. The Plant uses only an estimated 1 percent of total pumpage from the Ogallala Aquifer in Carson County. The projected annual use at the Plant is about 1.45 billion liters (383 million gallons or 1,180 acre-feet). If the entire Plant were taken over for irrigated farming, the water production from the Ogallala Aquifer could reach 11.2 billion liters (3 billion gallons or 9,100 acre-feet) assuming a 30-centimeter (12-inch) application to the 3,680 hectares (9,100 acres). This would be nearly eight times more pumpage of water from the aquifer to support irrigated farm land when compared to pumpage for use at the Pantex Plant.

Plant operation does not affect the water quality in the Ogallala Aquifer (MHSM 1982). Thus, if operation of the Plant were to end, there would be no change in water quality of the aquifer. However, with Plant operations terminated and release of sanitary effluents ended, the playas would be dry part of the year. Water that has been used for irrigation or to support waterfowl or wildlife would not be available.

4.1.3 Terrestrial Resources

4.1.3.1 Pantex Plant Terrestrial Resources

There are no unique terrestrial resources at Pantex Plant that would be impacted by any of the options considered.

With continued operations at Pantex Plant, there will be contamination of the soil with depleted uranium at the firing site, and soil contamination with high explosives in the ditch system leading to and into Playa Basin Number 1. However, the level of contamination is expected to remain unchanged. Monitoring of the soil and ground water at the Pantex Plant has shown no apparent movement of high explosives into the environment (Purtymun 1982A). Only minute quantities of high explosives have been detected in the ground water (RDX, cyclotrimethylene trinitramine, less than 0.01 milligram per liter; HMX, cyclotetramethylene tetranitramine, less than 0.05 milligram per liter) (MHSM 1982). This is due in part to the insolubility of high explosives in water (Dobratz 1981). Similarly, depleted uranium has not leached into the ground water nor is it found in the site's perimeter soil (Purtymun 1982A, Buhl 1982).

The site of the coal pile (low- or high-sulfur coal) for the proposed cogeneration power plant will be planned before coal is used. The area beneath the coal pile will require a compacted clay or other type of impermeable blanket and will be equipped with a drainage system to channel all runoff from the coal pile into a leachate pond. The runoff will require little or no treatment if the coal has a low sulfur content.

If the coal has a high sulfur content, a limewater treatment will increase the alkalinity of the runoff allowing noxious elements and chemicals to precipitate out. Then, the precipitate will be packaged and disposed of with other chemical wastes produced at the Pantex Plant. The treated effluents will be released into the playas along with other treated waste waters.

4.1.3.2 Iowa Army Ammunition Plant--Terrestrial Resources

There are no unique terrestrial resources at the Iowa Army Ammunition Plant that would be impacted by any of the options considered.

Monitoring of the soil, sediment, surface, and ground water has shown some contamination with high explosives and heavy metals. If the control and treatment of effluents currently maintained at the Pantex Plant were followed at the Iowa Army Ammunition Plant, no further deterioration of the environment from nuclear weapons operations would result.

Industrial solid wastes, such as building and construction materials, will be disposed of in trenches. Other waste, such as cafeteria refuse, will be disposed of in a landfill. Combustible solid waste contaminated with explosives will be burned. These buried or burned wastes would not affect the environment outside of the Iowa Army Ammunition Plant.

The coal pile would be placed on a compacted clay or other type of impervious blanket. Drainage off the coal pile would be channeled into a leachate pond, so that the runoff could be treated before release into the environment. Treatment has been described in Section 4.1.3.1.

4.1.3.3 Hanford Site--Terrestrial Resources

There are no unique terrestrial resources at the Hanford Site that would be impacted.

As shown by studies at the Pantex Plant and Iowa Army Ammunition Plant, depleted uranium associated with dynamic testing would be localized in the firing site area (Purtymun 1982B, Buhl 1982). It is expected that relocation of all nuclear weapons operations to Hanford Site would not affect the offsite or onsite environment if waste management practices now used at the Pantex Plant were followed at the Hanford Site.

Solid wastes, such as building material or paper waste, would be disposed of in a sanitary landfill. Solid waste contaminated with explosives would be burned.

The coal pile associated with the proposed cogeneration plant would require placement on a compacted clay or other type of impervious blanket. Drainage off the coal pile would be channeled into a leachate pond so that this runoff could be treated before release into the environment. Treatment has been described in Section 4.1.3.1.

4.1.4 Ecology

4.1.4.1 Pantex Plant--Ecology

The only measurable impacts will be those associated with construction activities and minor changes in land-use patterns.

Future burning of high explosives that release hydrogen fluoride may result in a limited measurable impact. Hydrogen fluoride is highly toxic to plants. Part per billion concentrations at the burning pads could potentially cause limited damage to plants adjacent to burning operations under worst case meteorological conditions (Lacasse 1969, Jacobsen 1970). However, this situation is highly unlikely because of the short burn times and length of exposure needed to produce damage.

None of the other operations would release pollutants at levels considered biologically harmful (Sections 3.2.2 and 3.2.6). Any of these releases could be increased by several times and they still would not cause noticeable environmental effects.

The addition of a coal-fired power plant would represent the largest impact to the local environs. Long-term environmental effects from such facilities (such as creation of acid rain) are just now being scientifically examined. The implications of incremental pollutant releases of this power plant for long-term environmental regional effects (either positive or negative) are essentially unknown but would be a small fraction of those attributable to commercial power plants in the region.

4.1.4.2 Iowa Army Ammunition Plant--Ecology

Implementation of either option at the Iowa Army Ammunition Plant would not result in significant environmental impacts other than some minor changes in land use. Releases of harmful pollutants would be very low and similar to those seen at Pantex Plant (Sections 3.2.1, 3.2.2, 3.2.6).

Effects in the vicinity of the Pantex Plant expected after relocating operations at the Iowa Army Ammunition Plant are discussed in Section 4.1.4.4.

4.1.4.3 Hanford Site--Ecology

Implementation of the Hanford Site alternative would not result in significant impacts on the local environs other than those associated with construction and noise from high-explosive test firing. Here, as at the other siting alternatives, the coal-fired cogeneration power plant would represent the largest project-related impact on the local environs.

The addition of test firing high explosives at the proposed location within the Hanford Site might disrupt current patterns of winter use by bald eagles along the Columbia River (Rickard 1981B). Past experience with eagles indicates that they may be disturbed enough to move to more isolated (quieter) locations up or down river. There are ample locations nearby for the eagles to relocate.

Effects in the vicinity of the Pantex Plant expected after relocating operations at the Hanford Site are discussed in Section 4.1.4.4.

4.1.4.4 Termination--Ecology

Termination of operations at the Pantex Plant could result in negative impacts to local wildlife populations. Currently, the Pantex Plant serves as an effective wildlife sanctuary because of restricted access and the prohibition of hunting. If this land were converted into agricultural production, some extensive tracts of natural habitat could be lost.

4.1.5 Land Use/Agriculture

4.1.5.1 Pantex Plant--Land Use/Agriculture

Land Use

Overall land use at the Pantex Plant will not be changed significantly with any construction option. Even with total replacement, the use of new land areas within the Pantex Plant site could be offset with restoration of currently used land areas to agriculture uses.

Termination of operations at the Pantex Plant would only alter current land uses in the event of total demolition and removal of all facilities. Mothballing or similar shutdown procedures would result in very little if any net changes in land use at the Pantex Plant.

Agriculture

New construction would have very little effect on agriculture. Plant expansion would remove approximately 2 hectares (5 acres) from agricultural production. Completely rebuilding the Plant would remove a greater amount--about 20 hectares (50 acres). These acreages are negligible and represent 0.1 percent and 1.0 percent, respectively, of land currently used on the Pantex Plant site for agricultural production.

Consumption of agricultural products grown on or adjacent to Pantex Plant will not impact human health. Anticipated future releases of radioactive and nonradioactive pollutants will remain at such small levels (Sections 4.1.1.1, 4.1.2.1, 4.1.6.1) that no agricultural problems are expected.

4.1.5.2 Iowa Army Ammunition Plant--Land Use/Agriculture

Land Use

Construction of a totally new facility at the Iowa Army Ammunition Plant would convert some farmland, brushland, and deciduous forest into an industrial park. However, the total change would be insignificant in terms of current land use patterns.

Agriculture

Reuse of existing facilities at the Iowa Army Ammunition Plant (Option 1) for nuclear weapons operations would not affect any of the existing leased agricultural land. Detonation of devices containing some depleted uranium would be expected to resume at the firing site; however, deciduous forest exists between the firing site and the farmland. This forest provides a natural barrier to contain releases.

Relocating all operations to the Iowa Army Ammunition Plant and closing the Pantex Plant would remove some leased land from agricultural use. The amount of land removed is less than 15 percent of the leased farmland and does not present a significant impact.

Consumption of agricultural products grown on or adjacent to the site will not impact human health. Computer simulation of crops and livestock at Iowa Army Ammunition Plant indicates no expected uptake of radionuclides above normal background levels (Wenzel 1982D).

Effects in the vicinity of the Pantex Plant expected after relocating operations at the Iowa Army Ammunition Plant are discussed in Section 4.1.5.4.

4.1.5.3 Hanford Site Alternatiave--Land Use/Agriculture

Land Use

Construction of a nuclear weapons operations facility at the Hanford Site will change a portion of the desert into roads, parking lots, and buildings. This action will not change current land-use patterns because other facilities currently dot the landscape at widely separated intervals. The proposed construction would be similar in size and be separated by about the same distance (several miles) as current facilities on the Hanford Site.

Agriculture

Based on the low level of potential emissions and the remote location of the proposed site with respect to current offsite agriculture, no agricultural impacts are expected.

Effects in the vicinity of the Pantex Plant expected after relocating operations at the Hanford Site are discussed in Section 4.1.5.4.

4.1.5.4 Termination--Land Use/Agriculture

Land Use

Land-use impacts upon termination of operations at the Pantex Plant would depend on ultimate use. The facility could be shut down and maintained in a readiness condition for remobilization. This would result in essentially no change from current conditions. The Plant could be decommissioned and used by private interests. Land-use impacts then could vary from total agricultural usage to total industrial park, depending on the user.

Agriculture

Terminating the Pantex Plant operations would not change current agricultural land-use patterns in the surrounding area. After decontamination and demolition of some of the existing facilities, additional onsite land could be released to the public. As most of the site is used already for agriculture, the site would probably revert to private farms and ranches.

Because the acreage is small compared to the 65 thousand hectares (160 thousand acres) already under cultivation in Carson County, no noticeable changes in agricultural economics would be seen in the area (USDA 1980).

4.1.6 Environmental Radiation and Radioactivity

4.1.6.1 Pantex Plant--Environmental Radiation and Radioactivity

Radioactive Releases

Emissions of radionuclides from normal operations at the Pantex Plant would continue to be negligible and indistinguishable from background radiation.

Depleted Uranium. Dynamic testing involving depleted uranium is expected to include no more than 10 kilograms a year of depleted uranium in the future. Releases of depleted uranium in test shots would be less than 232 microcuries per year of the uranium radionuclides.

Tritium. Tritium releases are expected to remain constant at about 0.1 curie per year.

Plutonium. No releases have occurred, and no releases are expected to occur.

Coal-Fired Power Plant

The proposed coal-fired power plant would release several naturally occurring radionuclides. These radionuclides are principally members of the thorium and uranium decay chains and include over 25 different radionuclides (Buhl 1982).

Some of the major emissions are listed below.

Radionuclides	Microcuries Released per Year
Uranium-238	80
Uranium-234	80
Thorium-232	33
Thorium-228	33
Thorium-230	40
Radium-228	50
Radium-224	50
Radium-226	60
Radon-222	16,000
Polonium-210	200
Lead-210	200

Radiological Doses

All Options. Radiation doses from depleted uranium releases will be approximately the same as those from current operations. The dose estimates presented here were calculated using the computer model AIRDOS-EPA (Moore 1979). These dose estimates are higher than those given in Section 3.2.6.1 because of additional conservative assumptions made in these calculations to maximize the potential future dose. The maximum 50-year dose commitment is 3.1 millirem to bone per year of exposure for the maximum exposed individual. This dose is 0.2 percent of the Radiation Protection Standard (USDOE 1980A), and 1.1 percent of the natural background dose. The maximum theoretical 50-year population dose commitment to bone is 2.5 person-rem per year (Buhl 1982).

The continued constant release rate for tritium of 0.1 curie a year would result in a 50-year dose commitment of less than 0.01 millirem to the whole body per year of exposure to the maximum exposed individual, which is less than 0.001 percent of the Radiation Protection Standard, and a 50-year population dose commitment to whole body of 0.00005 person-rem per year from all tritium releases (Buhl 1982).

Coal-Fired Power Plant

The organ whose dose is the largest fraction of its Radiation Protection Standard is bone. The maximum exposed individual would receive a 50-year dose commitment to bone of 0.02 millirem for each year of exposure, or 0.001 percent of the Radiation Protection Standard (USDOE 1980A). The annual 50-year population dose commitment to bone would be 0.19 person-rem per year (Buhl 1982).

Radiological Effects

All Options. An average member of the public within an 80-kilometer (50-mile) radius of the Pantex Plant would incur an added lifetime risk of cancer of less than 1 chance in a billion per year from Pantex Plant operations because of the routine release of depleted uranium and tritium. The added risk of genetic disorder in all subsequent generations is less than 1 disorder in a billion offspring per year of exposure. These risks are less than 0.001 percent of natural background radiation rates. These conclusions are based on the field studies undertaken in support of this impact statement, as well as estimates of future effects using projected release rates and computer modeling (Buhl 1982).

Coal-Fired Power Plant

Emissions of naturally occurring radioactivity from the coal-fired power plant would result in an added risk of cancer mortality of less than 1 chance in a billion per year of exposure. The added risk of genetic disorders in offspring in all subsequent generations is less than 1 disorder in a billion offspring per year of exposure. These risks are less than 0.001 percent of those estimated to occur from one year's exposure to natural background radiation (Buhl 1982).

Solid Radioactive Wastes

Solid radioactive wastes will continue to be packaged and shipped to the Nevada Test Site for disposal.

4.1.6.2 Iowa Army Ammunition Plant--Environmental Radiation and Radioactivity

Radioactive Releases

Relocating part or all of the nuclear weapons operations to the Iowa Army Ammunition Plant would result in three sources of radioactive emissions. These sources are small atmospheric releases of depleted uranium from dynamic testing, tritium releases from facility operations, and naturally occurring radioactivity from the coal-fired power plant (Buhl 1982).

If all nuclear weapons operations were relocated to the Iowa Army Ammunition Plant, the maximum 50-year dose commitment of the maximum exposed individual and the maximum 50-year population dose commitment would be 2.5 millirem (to bone) and 0.94 person-rem (to bone), respectively, for each year of exposure. The maximum individual bone dose is 0.2 percent of the Radiation Protection Standard (USDOE 1980A) and 0.9 percent of natural background bone dose. The 50-year dose commitments to all other organs are less than 0.2 percent of the Radiation Protection Standard.

These doses would be accompanied by a reduction at the Pantex Plant of maximum individual and population 50-year dose commitments. The doses at the Pantex Plant after relocating operations to the Iowa Army Ammunition Plant are discussed in Section 4.1.6.4.

Radiological Effects

If all nuclear weapons operations were performed at the Iowa Army Ammunition Plant, there would be an average added lifetime risk of cancer mortality of less than 1 chance in a billion per year of exposure and added average risk of genetic disorder in offspring of less than 1 disorder in a billion offspring per year of exposure. The added risks would be caused principally by the release of depleted uranium in explosive testing and from the release of naturally occurring radionuclides in coal. This would be accompanied by a reduction in the Amarillo area of the added risk of cancer mortality and of genetic disorder in offspring. These risks are given in Section 4.1.6.4.

The added risks of cancer and genetic disorder in offspring to the 80-kilometer (50-mile) population around the Iowa Army Ammunition Plant would be less than 0.001 percent of those from one year's exposure to natural background radiation (Buhl 1982).

Solid Radioactive Wastes

A program for handling solid radioactive wastes would be established similar to the existing program at the Pantex Plant. All solid radioactive wastes would be packaged and sent to an approved radioactive waste disposal site or the Nevada Test Site.

4.1.6.3 Hanford Site--Environmental Radiation and Radioactivity

Radioactive Releases

Relocating all nuclear weapons operations to the Hanford Site would result in three new sources of radioactive emissions. These would be small atmospheric releases of depleted uranium from dynamic testing, tritium releases from operations, and naturally occurring radioactivity from the coal-fired power plant.

Radiological Doses

The Hanford Site alternative would result in small projected doses from operational releases of radioactive materials. The maximum individual and population 50-year dose commitments are 0.35 millirem to bone and 0.4 person-rem to bone, respectively, for each year of exposure. This maximum individual bone dose is 0.02 percent of the Radiation Protection Standard (USDOE 1980A). All other organ 50-year dose commitments, including whole body, are smaller percentages of their respective Radiation Protection Standard (Buhl 1982). Radiation dose at the Pantex Plant after relocation of operations is discussed in Section 4.1.6.4.

Radiological Effects

Relocation of nuclear weapons operations to the Hanford Site would result in an added lifetime risk of cancer mortality to an average member of the public living within 80 kilometers (50 miles) of the proposed facility of less than 1 chance in a billion for each year of exposure. The corresponding added risk of genetic disorder in offspring in the Hanford Site area is estimated to be less than 1 disorder in a billion offspring. Over 99 percent of the added risks would result from releases of depleted uranium in explosives testing and the release of naturally occurring radionuclides in coal. The risks of cancer mortality and genetic disorder in offspring are less than 0.001 percent of those from a 1-year exposure to natural background radiation. This would be accompanied by a reduction of risks in the Amarillo area as discussed in Section 4.1.6.4.

Solid Radioactive Wastes

A program for handling these additional solid radioactive wastes at Hanford Site would be established. These wastes would be packaged and disposed of at Hanford Site or some other approved radioactive waste disposal area.

4.1.6.4 Termination--Environmental Radiation and Radioactivity.

There would be essentially no radioactive releases from the Pantex Plant after relocation of operations to alternative sites. It is assumed that the firing sites and burning ground would be decontaminated to background levels. Decontamination of these areas would eliminate a source of depleted uranium that could be resuspended from the soil and transported offsite.

Minute radioactive material releases may occur from resuspension of soil during excavation of the firing sites and burning ground, but these releases would be negligible because of procedures for controlling dust.

Radiological Doses

Since radioactive releases from the Pantex Plant would be negligible, the only possible radiation doses would result from depleted uranium, and to a lesser extent from tritium, assumed to have been deposited offsite during past operations. Even though measurements cannot detect any offsite increments of uranium or tritium above natural background (Section 3.2.6.1), this evaluation assumed some must have been deposited and computer modeling was used to estimate the amounts. Based on these theoretical calculations, the organ receiving the highest fraction of the Radiation Protection Standard is bone. The 50-year dose commitment to bone for the maximum exposed individual was estimated to be less than 0.01 millirem per year of exposure. This bone dose is less than 0.001 percent of the Radiation Protection Standard and is approximately 0.001 percent of the dose to bone from natural background radiation.

The 50-year population dose commitment to bone is 0.05 person-rem per year of exposure for the population living within an 80-kilometer (50-mile) radius of the Pantex Plant. This dose is less than 0.001 percent of the natural background radiation dose to bone received by this population.

Radiological Effects

The average added risk of both cancer mortality and of genetic disorder in offspring for the population living within 80 kilometers (50 miles) of the Pantex Plant would be less than 1 chance in a billion per year of exposure. The cancer and genetic risks are less than 0.001 percent of the cancer and genetic risks incurred by this population from one year's exposure to background radiation.

4.1.7 Energy Resources

4.1.7.1 Pantex Plant--Energy Resources

Table 4.1.7.1-1 shows the total energy requirements predicted for the various options (Schnurr 1982A). Any construction option will result in an energy savings for operations because new facilities

TABLE 4.1.7.1-1

TOTAL ENERGY CONSUMPTION FOR PANTEX PLANT OPTIONS*
(expressed as million kilowatt hours)

Option	Natural Gas	Electricity	Total
1. New construction	75	37	112
2. Major upgrade	83	44	127
3. Major replacement	61	36	97
4. Existing facilities	112	41	153

*Based on the heating and cooling requirements for all facilities plus process energy consumption.

would be built to meet Department of Energy Building Energy Performance Standards (USDOE 1978). It is assumed that ceiling insulation and an automated energy management system will be added to the remaining old buildings. Predicted total annual energy use for the Pantex Plant options were obtained by adding the annual lighting and process energy consumption to the heating and cooling energy requirements.

The peak demand for electricity in 1980 was 7,800 kilowatts. The coal-fired cogeneration plant would produce 2,900 kilowatts of electricity. The addition of that plant along with proposed energy conservation measures would reduce demand for electricity generated offsite by more than 50 percent.

4.1.7.2 Iowa Army Ammunition Plant--Energy Resources

For Option 1 (partial relocation) the assumption is made that energy conservation measures are applied to old buildings at both the Pantex Plant and the Iowa Army Ammunition Plant and that the new construction meets building energy performance standards. For Option 2, the totally new plant is similar to Pantex Plant Alternative, Option 3. Based on these assumptions, the results of the energy utilization analysis are presented in Table 4.1.7.2-1.

TABLE 4.1.7.2-1

TOTAL ENERGY CONSUMPTION* FOR IOWA ARMY AMMUNITION PLANT OPTIONS
(expressed as million kilowatt hours)

Option	Natural Gas	Electricity	Total
Partial relocation**	99	46	145
Total relocation	82	43	125

*Based on the heating and cooling requirements for all facilities plus process energy consumption.
**This includes usage at both the Iowa Army Ammunition Plant and the Pantex Plant.

The peak demand for electricity generated offsite would be in the range of 5,000 to 8,000 kilowatts for Option 1 and less than 2,500 kilowatts for Option 2. This could be supplied by the Union Electric Company of St. Louis without additional generating capacity. The demand at the Iowa Army Ammunition Plant would be about 0.1 percent of Union Electric's total generating capacity of 6.967 million kilowatts.

For Option 2, the addition of the coal-fired cogeneration plant would replace natural gas as an energy source with coal. The cogeneration plant would provide steam for heating and process use, as well as electrical energy at a rate of 2,900 kilowatts.

Effects in the vicinity of the Pantex Plant expected after relocating operations at the Iowa Army Ammunition Plant are discussed in Section 4.1.7.4.

4.1.7.3 Hanford Site--Energy Resources

The Hanford Site Alternative (total relocation) requires the construction of all new facilities. The total energy requirements for this alternative are given in Table 4.1.7.3-1.

The addition of a coal-fired cogeneration plant would provide all steam requirements and 2,900 kilowatts of electrical energy. The peak demand for offsite electricity would be approximately 1,000 kilowatts. This could be supplied by the Bonneville Power Administration system (total 1981 generating capacity, 17 million kilowatts) without additional generating capacity.

Effects in the vicinity of the Pantex Plant expected after relocating operations at the Hanford Site are discussed in Section 4.1.7.4.

4.1.7.4 Termination--Energy Resources

No energy for heating and cooling at the Pantex Plant would be required. The net annual energy saving compared to the "no action" alternative would be 153 million kilowatt hours.

TABLE 4.1.7.3-1

TOTAL ENERGY CONSUMPTION FOR HANFORD SITE ALTERNATIVE*
(expressed as million kilowatt hours)

Option	Natural Gas	Electricity	Total
Total relocation	69	35	104

*Based on the heating and cooling requirements for all facilities plus process energy consumption.

4.1.8 Employment and Population

4.1.8.1 Pantex Plant--Employment and Population

Option 1 (New Construction)

The combined construction and operating employment levels at the Pantex Plant will increase by approximately 8 percent above current levels. In view of the relatively small increase in the entire Amarillo trade area (11 counties: Hartley, Moore, Hutchinson, Oldham, Potter, Carson, Deaf Smith, Randall, Armstrong, Castro, and Swisher), no negative population impacts are projected from construction or operation activities. In all probability, work force requirements can be met by the local resident labor supply (Rapp 1982).

Option 2 (Major Upgrade)

All labor force requirements could be met by local workers; thus, no negative population impacts are projected. If the project is constructed over a 5-year period, the basic employment is projected to peak at 1,000 jobs in the third year construction. Nonbasic employment would add 680 service-related jobs. However, if the same tasks are completed in 8 years, employment would be about 858 basic workers and 583 nonbasic workers. The operating work force would rise from the persent 2,400 workers to approximately 2,600 employees (TEC 1982).

Option 3 (Major Replacement)

There would be few, if any, significant population changes in the Amarillo trade area from either the 5- or 8-year construction scenarios evaluated for this option. Several local officials believe an ample supply of workers can be found within commuting distance (Rapp 1982). However, an extreme case scenario projects the inmigration of about 2,110 basic and nonbasic workers, adding a total of 5,800 workers and their families to the area. The construction could result in a temporary increase of about 2 percent in the population of the Amarillo trade area under extreme conditions. As with Options 1 and 2, the permanent operating work force would increase by 200 jobs (TEC 1981, TEC 1982).

Option 4 (No Action)

No new population and employment impacts would occur.

4.1.8.2 Iowa Army Ammunition Plant--Employment and Population

Option 1 (Partial Relocation)

No negative employment or population impacts are expected. To complete the project in 2 years, the construction work force would employ an estimated 100 basic workers and 68 nonbasic workers during peak construction periods. If the same project were completed in 3 years, peak employment would level off at 85 basic and 58 nonbasic workers. The permanent operating work force is projected to add 1,000 new jobs at Burlington and 100 new jobs at Amarillo. The resident labor supply is adequate to meet all needs without inmigration of new population (Rapp 1982).

Option 2 (Total Relocation)

No negative population changes are projected even under the hypothetical extreme case scenario. During the peak construction period, the population could be expected to rise less than 5 percent above the 1980 census count in the southeast Iowa trade area. This evaluation considered the implication of completing the construction in either 5 or 8 years. The fairly large construction work force required to complete the project in 5 years would employ approximately 1,800 basic workers and 1,224 nonbasic workers during peak periods. In contrast, an 8-year period would employ an estimated 1,526 basic and 1,038 nonbasic workers. The extreme case scenario projects inmigration of 740 single workers and about 1,400 families totaling about 5,100 persons, including 960 school-age children. The expected distribution of inmigrant workers and families projects a one-time growth in population of less than 8 percent in Burlington and West Burlington and a 4.6 percent increase in school enrollments. The balance of the new growth is projected in settlement patterns similar to the present Iowa Army Ammunition Plant work force. This growth is within acceptable annual growth guidelines, as discussed in detail in Rapp 1982 (IJS 1980A, IJS 1981B).

Upon completion, the new plant would employ a permanent work force of 2,600 workers. The labor force (except for special skills) would be filled by local residents presently found within commuting distance of the plant site (IJS 1981A).

Effects in the vicinity of the Pantex Plant expected after relocating operations at the Iowa Army Ammunition Plant are discussed in Section 4.1.8.4.

4.1.8.3 Hanford Site--Employment and Population

The Tri-Cities trade area (Franklin and Benton Counties) could supply the construction work force required for construction activities. This is particularly true in view of the cancellation of proposed construction activities of the Washington Public Power Supply System.

In the summer of 1980, Washington Public Power Supply System employed a temporary construction work force that was nearly three times the size of the largest requirement projected to construct a new plant. A decision to relocate nuclear weapons operations at Hanford Site would permit an orderly transition of needed workers with little or no inmigration of construction workers to the Tri-Cities trade area (WES 1982).

This evaluation considered 5- and 8-year scenarios. The shorter period is projected to employ 1,800 basic workers and 1,224 nonbasic workers during peak construction periods. The 8-year scenario would employ about 460 fewer workers. The extreme case scenario would represent about a 3.9 percent net growth in the total population of the Tri-Cities trade area over the 1980 census count (Rapp 1982).

Upon completion of the construction, the new plant would employ a permanent work force of 2,600. The job requirements are expected to be filled by local workers (WES 1982).

Effects in the vicinity of the Pantex Plant expected after relocating operations at the Hanford Site are discussed in Section 4.1.8.4.

4.1.8.4 Termination--Employment and Population

Termination of nuclear weapons operations at the Pantex Plant would result in the direct loss of 2,400 jobs at the Pantex Plant. As each Pantex Plant job generates about 1 additional job, the termination would also impact another 2,400 workers in the Amarillo trade area. Therefore, this alternative would affect 4,800 workers or about 5.5 percent of the labor force in the Amarillo trade area and about 4.7 percent of the labor force residing within commuting distance of the Pantex Plant (Rapp 1982).

4.1.9 Economics

4.1.9.1 Pantex Plant--Economic Assessment

Option 1 (New Construction)

No negative economic impacts are projected. Employment of an estimated 459 basic construction workers and 312 nonbasic workers would add a total of $18.4 million in annual payrolls during the peak construction period. The new payrolls would add approximately 0.5 percent to the total retail sales reported for the Amarillo trade area in 1981. The local share of supplies and construction material purchases has not been determined (Rapp 1982).

This Option would add about 200 new permanent jobs at the Pantex Plant. The 8.3 percent increase over present Pantex Plant levels in both basic and nonbasic annual payrolls totals nearly $8.7 million. The economic benefit in terms of retain sales could add about 0.3 percent to retail sales of the area (Rapp 1982).

Option 2 (Major Upgrade)

No negative economic impacts are projected. Total annual payroll and related economic benefits would range from $34 million to $40 million, depending upon length of the construction period (5 years or 8 years). Similarly, retail sales in the Amarillo trade area could increase approximately 1.0 percent to 1.2 percent above the 1981 total sales (Rapp 1982).

This option also would add 200 new permanent jobs, resulting in combined basic and nonbasic annual payrolls estimated to total $8.68 million. The increase would add only 0.3 percent to the total retail sales in the trade area (Rapp 1982).

Option 3 (Major Replacement)

No negative economic impacts are projected. The annual payroll for the peak construction activity varies with the length of the construction period (5 to 8 years). Thus, peak annual payrolls could range from $49 million to $64 million. Retail sales are projected to range between 1.4 percent to 1.9 percent above the 1981 totals in the Amarillo trade area (Rapp 1982).

As with Pantex Plant Options 1 and 2, this option would add only 200 new permanent jobs resulting in an increase in basic and nonbasic annual payrolls totalling $8.7 million. The increase would add only 0.3 percent to the total retail sales in the Amarillo trade area (Rapp 1982).

Option 4 (No Action)

No negative economic impacts are projected. The peak annual payroll for construction already underway would be about $8.7 million. Retail sales would be about 0.3 percent above the 1981 level in the Amarillo trade area.

4.1.9.2 Iowa Army Ammunition Plant--Economic Assessment

Option 1 (Partial Relocation)

No negative economic impacts are projected.

A 2-year construction scenario generates $4.4 million in annual payrolls during peak construction years versus a $3.7-million peak year payroll in a 3-year scenario. Increases in retail sales would be about 0.3 percent in the Southeast Iowa trade area (Rapp 1982).

Partial relocation would add approximately 1,000 permanent new jobs at the Iowa Army Ammunition Plant. The increase almost exactly doubles the current Iowa Army Ammunition Plant work force and would result in an economic benefit of $37 million in basic and nonbasic annual payrolls. The economic benefit in retail sales would add about 2.8 percent to the 1981 retail sales of the Southeast Iowa trade area (Rapp 1982).

Option 2 (Total Relocation)

No negative economic impacts are projected for the area.

The evaluation considered completion of the project in two time frames, either 5 years or 8 years. The longer time period would permit smaller work force levels in peak construction years. Payrolls would vary from $67 million to $79 million in peak construction years and related retail sales would vary from 5.1 percent to 6.0 percent above the 1981 level reported for the Southeast Iowa trade area (Rapp 1982).

Upon completion, the new plant would employ about 2,600 permanent workers. The new payroll generated by these permanent jobs at the plant and nearly 2,600 nonbasic jobs is estimated to total $96 million annually (Rapp 1982). Retail sales in the Southeast Iowa trade area would increase an estimated 7.6 percent above the 1981 levels.

In Amarillo, the effects of closing the Pantex Plant would be as described in Section 4.1.9.4.

4.1.9.3 Hanford Site--Economic Assessment

No negative economic impacts are projected.

The evaluation considered completion of construction in either 5 or 8 years. Total annual payrolls are projected to range between $70 million to $83 million. Similarly, retail sales in the trade area are projected to rise from 3.6 percent to 4.3 percent above 1981 levels. Implementation of this option cannot ignore the reality of declining construction at the Hanford Site, which recently employed a work force three times the size of that projected in the extreme case scenario. Current construction activities provide the potential for an economic "bust cycle" by 1983. However, relocation of nuclear weapons operations at Hanford Site could reduce the potential bust by slowing the population decline with new construction opportunities in the Tri-Cities trade area (Rapp 1982).

The new payroll generated by 2,600 permanent jobs at the Plant and nearly 2,600 nonbasic jobs is estimated to total over $114 million annually. The new payrolls would increase the retail sales in the area by about 6.0 percent above the 1981 level (Rapp 1982).

Effects in the vicinity of the Pantex Plant after relocating at the Hanford Site are discussed in Section 4.1.9.4.

4.1.9.4 Termination--Economic Assessment

Significant negative economic impacts are projected in the Amarillo area if the Pantex Plant operations were terminated. Based upon a ratio of buying income to retail sales (64.5 percent), closing the Pantex Plant would cost $54.9 million to annual retail sales (3 percent of the 1981 total) in the Amarillo trade area. Other losses would include approximately $65 thousand per year in Federal impact funds paid to the local school districts (Rapp 1982).

The Pantex Plant provides important economic stability to the entire Panhandle Region of Texas. Although it is difficult to measure the full economic implications of termination, especially in view of the current economic changes taking place in the nation, the action would negatively impact the economy of the area for at least 5 years under any foreseeable circumstances (Rapp 1982).

4.1.10 Community Resources

4.1.10.1 Pantex Plant--Community Resources

Option 1 (New Construction)

No additional demands on community resources are projected.

Option 2 (Major Upgrade)

All jobs will be filled by local labor; this avoids negative impacts upon community resources.

Option 3 (Major Replacement)

Housing. In early 1982, there were many homes on the market in Amarillo. However, high prices and costly apartment rentals also were noted. Therefore, housing shortages may occur in Amarillo until mobile home park construction catches up to new demand. In an extreme case scenario during the peak construction period, the Amarillo trade area would gain approximately 5,800 new residents (an estimated 740 single workers and about 1,400 families). Typically, about 50 percent of migrant construction workers bring their mobile homes; the balance rent or buy housing. Approximately 90 percent of the migrant work force and family members (about 5,200 total) are expected to locate in the Amarillo Standard Metropolitan Statistical area (Potter and Randall Counties). This will increase the population 2.9 percent above the 1980 United States census count. The balance of the work force and families would probably locate in rural areas or in Borger, Canyon, Panhandle, or perhaps White Deer. At Panhandle, the lack of new housing will require that virtually all new growth be accommodated in worker-owned mobile homes (TEC 1982).

Utilities. Utility services in the Amarillo trade area are adequate for all proposed actions (Amarillo 1979, Amarillo 1980).

Educational System. No adverse impacts are expected within the educational systems serving Pantex Plant employees (Rapp 1982). Approximately 900 additional students are projected for the Amarillo Independent School District (an increase of 3.4 percent over the 1981 to 1982 enrollment). At Panhandle, younger families with few children of school age are expected if mobile home space can be found. The extreme case scenario places an estimated 25 to 30 additional students of school age in the community. This represents a 4.4 percent increase over the current enrollment of 687 in the Panhandle Independent District (Rapp 1982).

During the peak construction period, another 65 to 70 students of construction worker families are expected to be enrolled in still other school districts within commuting distance of Pantex Plant.

Health Services. Health services in the Amarillo area are considered adequate to meet any projected growth associated with alternative actions at the Pantex Plant (PRPC 1981).

Public Safety Services. During the construction period, the Amarillo Police and Fire Departments will need to add at least six additional police officers and five firefighters in order to maintain the current ratio of public safety officers per capita. During peak construction, commuter traffic to the Pantex Plant may increase 100 percent and, therefore, would require additional law enforcement because of increased congestion at intersections and railroad crossings near the Plant. Required car pooling and bussing by the general contractor may be justified especially during the peak construction period (Rapp 1982).

Transportation. No significant impacts on transportation facilities are projected.

Option 4 (No Action)

No community resources are affected.

4.1.10.2 Iowa Army Ammunition Plant--Community Resources

Option 1 (Partial Relocation)

No negative impacts are expected on any community resources.

Option 2 (Total Relocation)

Housing. Only Burlington, West Burlington, and Middletown are expected to experience temporary housing shortages in an extreme case Iowa Army Ammunition Plant scenario. Surrounding counties will be impacted less than 5 percent. Housing needs will be met largely by existing surplus housing and mobile home sites. Many single workers may rent rooms at several hotels in Burlington or in the large homes in older residential areas of the city (Burlington 1981B).

Utilities. No negative impacts are expected (Burlington 1981B).

Educational Systems. Few problems would occur as surplus capacity in existing school buildings will permit timely renovation as needed. Under the extreme case Iowa Army Ammunition Plant scenario, an estimated 350 additional school-age children will attend Burlington schools through the peak construction period. This represents about 4.6 percent increase over 1981 enrollment counts in Burlington area public and private schools (Burlington 1981B). The remainder of the school children of workers (610) would be expected to be distributed in school districts surrounding Burlington in about the same proportions as for the present Iowa Army Ammunition Plant work force.

Health Services. No negative impacts are projected (Burlington 1981B).

Public Safety. Under the extreme case scenario, the Burlington city government may need to add two police officers and three firefighters in order to maintain the present ratio per capita. No other jurisdiction is expected to be significantly impacted (Burlington 1981A).

Transportation. The potential for an additional 2,100 commuters in the Burlington area would create temporary new traffic problems. Required car pooling and bussing may be justified, especially during the peak construction period.

Effects in the vicinity of the Pantex Plant expected after relocating operations at the Iowa Army Ammunition Plant are discussed in Section 4.1.10.4.

4.1.10.3 Hanford Site--Community Resources

Until recently, the Tri-Cities area supported a construction work force three times the size of that anticipated for the Hanford Site alternative. Impacts upon community resources are expected to be negligible (TCCC 1981, TCRERC 1981, USDOE 1980A, USDOE 1980B, WJS 1980, WJS 1981A, WJS 1981B).

Effects in the vicinity of the Pantex Plant expected after relocating operations at the Hanford Site are discussed in Section 4.1.10.4.

4.1.10.4 Termination--Community Resources

Termination of the Pantex Plant would have a direct effect on community resources, as evidenced by employment and economic repercussions discussed in Sections 4.1.8.4 and 4.1.9.4. The public schools would lose nearly $65 thousand per year in Federal impact fund payments. The loss in tax revenue could exceed $21.2 million annually (Rapp 1982).

4.1.11 Cultural Resources and Native Americans

4.1.11.1 Pantex Plant--Cultural Resources and Native Americans

No known archaeological or historical resources or shrines or places of Native American religious significance would be impacted. All sites located in the Pantex Plant archaeological survey were outside of potential construction areas (Hughes 1981). Further archaeological work at this site is currently unwarranted.

4.1.11.2 Iowa Army Ammunition Plant--Cultural Resources and Native Americans

No known historical or archaeological resources or shrines or other places of Native American religious significance would be impacted. However, this area has never had a detailed cultural resource survey. The State Historic Preservation Officer determined that such a survey of the proposed construction sites would be required before construction activities (Anderson 1982).

4.1.11.3 Hanford Site--Historic and Archaeological Resources/Native Americans

No known historical or archaeological resources or shrines or other places of Native American religious significance would be impacted. Native Americans living in the vicinity of the Hanford Site may consider portions of the Site as homeland or as having religious significance.

The Hanford Ditch (a potentially eligible candidate for the National Register of Historic Places) crosses the proposed firing site area, and a large number of archaeological sites exist adjacent to the Columbia River. Therefore, the State Historic Preservation Officer determined that a detailed cultural resources survey would be required before any construction activities (Stump 1982). A formal request for a National Register Determination of Eligibility for the Hanford Ditch would have to be made, and measures would have to be taken to avoid impacting this resource.

4.1.12 Future Health and Safety Considerations

Based on the studies done for this Environmental Impact Statement, no significant public or worker health and safety impacts are expected from normal operations. No releases of any material were found that would be expected to cause measurable effects on the general public. This finding is supported by the epidemiological study of the public, which found no observable effects on county cancer mortality patterns from Plant operations.

The Department of Energy is constantly striving to achieve improved operational reliability and better working conditions for all its operations. For any alternative, a primary concern would be preventing the accidental detonation of high explosives or mitigating possible consequences to facilities, workers, and the general public.

Another principal concern for protecting the health and safety of workers is limiting radiation exposures. The amount of radioactive materials handled in all types of operations was used as an approximate indicator of potential occupational exposures. Doses are expected to remain about the same as the 1979 to 1981 levels over the next 5 or 6 years. Thus, no significant changes in health and safety impacts from occupational exposures would be expected from routine Plant operations. A work force epidemiological study is underway and results are expected to be available for the Final Environmental Impact Statement.

The other health and safety concerns of nuclear weapons operations are common to all site alternatives and are similar to those health and safety concerns found in many light industries. A similar work force health and safety program, as currently implemented at the Pantex Plant, would meet or exceed existing and foreseeable standards given any of the alternatives. However, as technology advances, health and safety programs must continue to evaluate chemicals and operations used in the advanced technologies. As warranted, new health and safety procedures would be established. Future changes in weapon systems and high-explosive technology may result in changes in different toxic releases and will require continued attention from a Health and Safety standpoint.

If complete relocation to the Iowa Army Ammunition Plant or the Hanford Site were to occur, potential health and safety impacts from operations would be eliminated in the Amarillo area upon Pantex Plant termination. Routine releases would cease. All equipment would be examined for toxic materials before public release; areas with toxic materials such as the solvent evaporation tanks would be cleaned to acceptable environmental standards before Plant decommissioning.

4.2 IMPACTS OF POTENTIAL PLANT ACCIDENTS

Identifying potential accidents and then estimating the probabilities and consequences of postulated accidents required the application of several disciplines. Figure 4.2-A indicates the major interactions between the steps in the analysis.

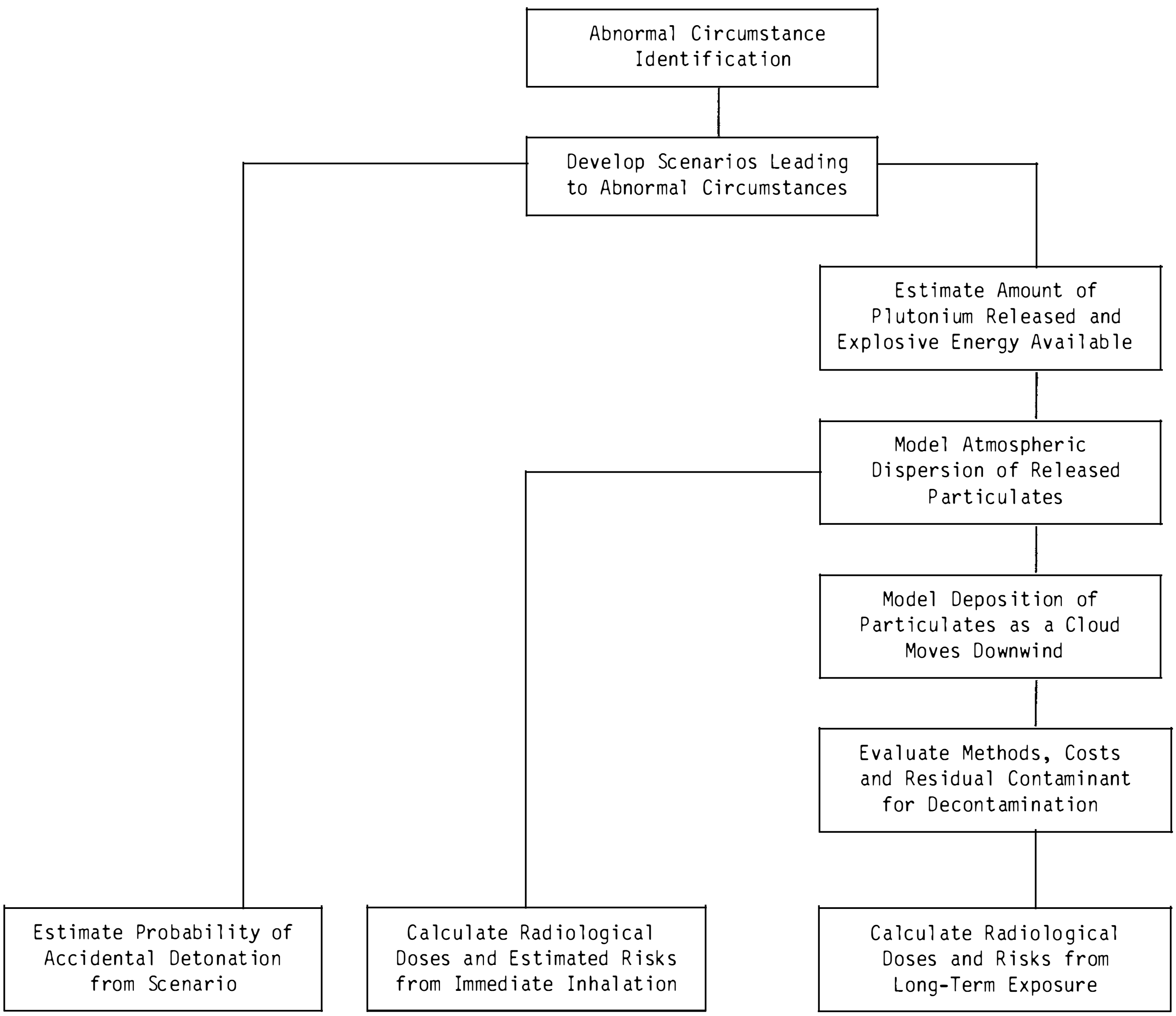


Figure 4.2-A. Accident analysis procedures showing interactions of analyses.

Identification of possible accidents to be studied was based on previous studies of the safety of nuclear weapons operations and new evaluations conducted for this Environmental Impact Statement (Section 4.2.1). Accident scenarios were devised to represent each abnormal circumstance (Section 4.2.2). These scenarios provided a basis for computing estimated probabilities of occurrence of each accident (Section 4.2.3) and the potential radioactive release (Section 4.2.4) if the accident should happen. The estimated releases for those accidents that had both credibility and significant environmental impact were combined with site-specific statistics for atmospheric dispersion conditions to estimate the dispersion and deposition of radioactive materials (Section 4.2.5). The dispersion estimates were used to estimate potential health effects to the public from the inhalation of the airborne radioactive particles as a debris cloud passes (Section 4.2.6). The cost of decontaminating the exposed area to selected cleanup objectives was determined (Section 4.2.7). The potential health effects, ranging from long-term public exposure to residual contamination, were determined (Section 4.2.8).

Results of the analysis of accident probabilities are given in Section 2.4.3 for the three site alternatives. Results of the consequence analysis are presented for selected accident scenarios in Plant Sections 4.2.6, 4.2.7, and 4.2.8. In those sections, three sets of results are presented for the Pantex Plant Alternative and the Iowa Army Ammunition Plant Alternative. The results are based on the analysis of accidents with low, intermediate, and maximum releases to illustrate the ranges of possible effects. For the Hanford Site Alternative, results are presented for the single type of accident found credible.

4.2.1 Abnormal Circumstances

The safety of nuclear weapons operations has been and continues to be under exceptional, continuous scrutiny. The safety of new facilities and major modifications to existing facilities is evaluated before construction. Existing facilities are also evaluated by the safety analysis process (USDOE 1981A). Studies of the safety of nuclear weapons operations are conducted by multidisciplinary committees composed of safety experts from the weapons design laboratories, the Department of Energy, and the plant operating contractor. These committees review the written procedures, other documentation, training of personnel, the personnel assurance program, electrical testers, tooling, and all operations that involve nuclear weapons. Operations proceed only when all safety aspects are approved. Special safety studies also are conducted. One important example is a detailed study of the safety history of nuclear weapons operations and the Pantex Plant in which a panel of experts summarized and formalized a list of the abnormal circumstances that might occur during nuclear weapons operations (Johnson 1978). These potentially serious accident situations were sorted into three types: (1) those that were physically plausible, (2) those that were physically impossible, and (3) those the panel was uncertain about.

The accident analysis for this impact statement started with the list of circumstances that the committee found physically possible (though not necessarily credible) or uncertain. These circumstances and some others added during the evaluation are listed in Table 4.2.1-1. Although the definition of these potential circumstances came from a study of the Pantex Plant, they apply equally well to nuclear weapons operations at the other two locations (Chamberlin 1982).

4.2.2 Potential Accident Scenarios

Each of the circumstances given in Table 4.2.1-1 were investigated during the accident analysis. Existing information permitted determination that some of these circumstances were considered not credible or having no potential significant environmental impact (Section 2.4.1).

TABLE 4.2.1-1

ABNORMAL CIRCUMSTANCES CONSIDERED

Natural Phenomena	External Events (Manmade)	Operational Accidents
1. Tornado	1. Aircraft crash	1. Impact
2. Hurricane	2. Discharge of firearms	2. Puncture
3. Windstorm	3. Electromagnetic radiation	3. Pressure
4. Earthquake	4. Electromagnetic pulse	4. ac/dc power
5. Grass fire		5. Electromagnetic radiation
6. Lightning		6. Static charge
7. Flood		7. Fire
8. Hail		8. Heat
9. Ice and snow		9. Cold
10. Meteorites		10. Water
		11. Processing chemicals
		12. Criticality

Evaluation of remaining circumstances began by constructing an accident scenario or scenarios that would cover possible ways that the conditions could occur. For example, a number of scenarios were developed to address mechanical impacts to explosive components. These included dropping explosives onto various surfaces and projectiles striking explosives. Potential causes included such things as equipment failures, human error, and projectiles generated by explosions in adjacent work areas or by a tornado or aircraft crash. The probability of each of these scenarios was estimated.

4.2.3 Accident Probabilities

Probabilities were calculated for scenarios that could produce an accidental detonation of conventional high explosives and thereby release radioactive material to the atmosphere.

There have been no plutonium-dispersing detonation accidents during nuclear weapons operations at the Pantex Plant or the Iowa Army Ammunition Plant. (No nuclear weapons operations have been conducted previously at the Hanford Site.) Because of this absence of actual accident data, theoretical methods of estimation were required.

The method employed was to estimate the frequency of postulated detonation accidents in a two-step process. First, statistical analysis was applied to historic records of similar events that might have caused a detonation. Then, the likelihood of a detonation occurring, given that an initiating event had occurred, was estimated. This second step was accomplished by using the known characteristics of explosives, various mitigating factors, and well-known natural laws. Multiplying these two terms gave the estimated likelihood of a detonation accident.

Tornado

Tornado frequencies were estimated from regional tornado data of the tornado history of each of the three alternative sites (McDonald 1979, Fujita 1979, ANSI 1980). The probability of inducing a detonation by a tornado was based on the wind speeds, the availability of wind-blown projectiles, and the construction of the buildings in which the explosive resides (Chamberlin 1982).

Aircraft Crash

The likelihood of aircraft crashes into structures that could result in an accident releasing radioactivity was estimated by a detailed computer-modeling methodology that accounted for precisely defined flight paths, size and weight characteristics of various classes of aircraft, different modes of aircraft operation, and the dynamics of crashes including effective skid distances and target areas of structures (Krivokapich 1976). Estimates of structural damage and releases considered the sizes and speeds of aircraft and the structural characteristics of buildings (Chamberlin 1982). Calculations for the Pantex Plant Options were refined after the publication of the Draft Environmental Impact Statement. These new calculations were based on the most recent and complete data from actual flight records for aircraft operating in the Amarillo area provided by the Federal Aviation Administration for periods through April 1983. This resulted in reductions of the estimated probabilities for the various Pantex Plant Options by factors of as much as one-half (Butler 1983). Estimates for the Iowa Army Ammunition Plant and the Hanford Site Alternatives were based on aircraft operations data from 1981 (Biringer 1982). The calculations for these two sites were not revised because qualitative review of the pertinent parameters indicated changes would be no more than found for the Pantex Plant Site. Changes of that magnitude would not change either the relative ranking of the various alternatives or the overall conclusions on risk from aircraft crash.

Operational Accidents

Historical records were used to identify possible initiating events and estimate the frequency of those that might produce a detonation in the future. The records were the reports on unusual occurrences. Such reports are aimed at reducing as much as possible the probability of an accidental detonation of any explosive component. Whenever a situation is found that could be hazardous, steps are taken immediately to rectify the situation. Therefore, there is a continually changing set of procedures in force aimed at providing maximum safety for these operations.

The effect of these changing regulations and procedures should be to improve the safety of nuclear weapons operations, that is, to reduce the frequency of abnormal occurrence and accidents. Incident reports for the 5-year period between May 1976 to May 1981 were used as representative of what can be expected in the near future. (This period includes the 1977 detonation accident at the Pantex Plant and the resulting procedure changes.) The annual frequency of initiating events was estimated from the number of similar abnormal occurrences during the 5-year period. The second factor, the probability that a detonation will be produced if a certain initiating event occurs, was obtained from a combination of experimental data or by analysis of physical phenomena where data were unavailable.

Application of these methods found only one type of operational accident that had a statistical chance of more than 1 in a million a year of producing an explosive detonation that could disperse radioactive material. The accident was the dropping of a piece of high explosive during a particular operation (Chamberlin 1982). This accident is referred to in the remainder of this report as the operational accident. The probability that the explosive might be dropped was obtained by combining the probabilities that the explosive might be dropped from different heights. The probability that a detonation would result from such a drop was obtained from analysis of sensitivity experiments in which pieces of explosive are dropped on metal from various heights. Analytically combining these probabilities led to an estimate of the overall likelihood that a drop might result in a detonation in any one year.

The value obtained was adjusted for the changes in both the explosive types and the workload to be expected in the near future. The resulting probability was found to be essentially constant in the near future (Chamberlin 1982).

4.2.4 Potential Releases

The potential release of radioactive materials from detonation accidents was based on the amount and type of explosive, the quantity of radioactive materials, and the structure in which the detonation takes place. This section discusses the amounts of plutonium and high explosive. Plutonium associated with high-explosives accidents would be dispersed as finely divided particles by the hot, high-pressure gases created by a detonation. The ability of a particular structure to contain the explosion determines how much of the plutonium and gas can escape. Other radioactive materials, including enriched uranium and tritium, which could be dispersed by potential accidents, were found to contribute no more than 1 percent of the radiological effects attributable to plutonium (Elder 1982B).

Available experimental data were used to estimate the amount of plutonium that could be released from facilities (Chamberlin 1982). Data from tests with a prototype Gravel Gertie structure were used to estimate potential releases from existing, refurbished, and new-design Gravel Gerties (Cowan 1964). A full-scale test of a Gravel Gertie was conducted at the Nevada Test Site in late 1982. This test confirmed the acceptability of the Gravel Gertie roof design under accident conditions. More than 99 percent of respirable plutonium particulate generated by an accidental detonation of high explosives within a Gravel Gertie would be filtered and removed by the gravel roof. These data confirm that the estimated releases from such an accident used for calculations of consequences in this impact statement are valid upper limits.

Results from the Roller Coaster Tests conducted in 1963 were used to estimate releases from temporary holding facilities and the various types of assembly bays (Friend 1965, USERDA 1976, Luna 1969). Even though weapons designs have changed since those tests were performed, they are believed to represent a worst case limit on the way plutonium is dispersed by high-explosive detonation. Experimental work is now underway to develop more precise information. There are strictly enforced limits to the amounts of plutonium and high explosives that are allowed at any time in each work space. For the purpose of estimating releases, work spaces involved in postulated accidents were assumed to contain the maximum amounts of high explosives and plutonium.

These assumptions lead to overestimating the releases because work spaces are seldom loaded to their operational limits of material (Chamberlin 1982) and not all the explosive in a space may be detonated. The values used were for operations as they are conducted currently at the Pantex Plant. They were assumed to apply to all Alternatives and Options.

The basic results of the release estimates for each credible accident were (1) the mass of plutonium released from the structure and (2) the amount of explosive energy vented outside the structure to characterize the initial conditions for dispersion. The amounts of plutonium that could be released from credible accidents ranged up to 120 kilograms for the Pantex Plant Alternative and the Iowa Army Ammunition Plant Alternative, and up to 0.6 kilogram for the Hanford Site Alternative (Chamberlin 1982).

4.2.5 Atmospheric Dispersion and Deposition

The spread of plutonium particles by detonation of high explosives was evaluated as a puff-type cloud using a computer model (Luna 1969). This model was based on experimental results from the Roller Coaster series of full-scale detonation tests involving weaponlike assemblies (Shreve 1965). The analytical procedure involved estimating the formation of a vertical debris cloud determined by the explosive energy released from a particular structure. The plutonium dispersed by the explosive was assumed to be initially distributed within the cloud and to have particle size distribution based on the measured experimental results (Shreve 1965). Subsequent dispersion of the cloud was calculated by the computer model that estimates Gaussian diffusion for each layer of the cloud. Deposition is calculated based on particle fall velocities as a function of particle size and wind speed. Actual meteorological data for each site was used in the computations of dispersion and deposition.

Two sets of meteorological conditions were used for each site for the nontornado accidents to evaluate the dispersion and deposition of plutonium. The conditions provide a range of possible consequences from an accidental release. These two sets of meteorological parameters represent an "unfavorable" and a "median" (most-likely) dispersion condition. (A single set of conditions selected for tornados is discussed below.) The unfavorable dispersion case assumes that the cloud passes over the largest nearby population center with only limited dilution of the cloud. This represents an "extreme case" that would result in the largest number of people being exposed and would result in the largest population dose. It does not necessarily result in the largest individual dose offsite because the maximum individual may be at different distances for the different wind direction cases. The unfavorable dispersion case also does not necessarily result in the largest decontamination costs because contamination may be dispersed over a greater land area by the median dispersion case. The median case is representative of what would be expected most of the time. The prevailing wind direction for each location (most frequently observed direction) was used for analysis along with meteorological parameters representing typically observed dispersion. The other commonly observed wind directions would give similar results. Depending upon the accident under consideration, the median case meteorological parameters are 10 to 30 times more likely to occur than those for the unfavorable case (Dewart 1982).

The frequencies of occurrence of the meteorological stability categories used for calculating dispersion at each site and the frequency of wind direction alone are presented in Figure 4.2.5-A. The frequencies of other wind directions at each site are presented in Chapter 3, Section 3.2.1, in Figures 3.2.1.1-A, 3.2.1.2-A, and 3.2.1.3-A.

A different approach was taken to select the meteorological dispersion parameters for tornado-induced accidents. The probability of a tornado-induced accident was determined by a statistical analysis of historic records as noted earlier in Section 4.2.3. Given that a tornado-induced accident has occurred, the dispersion parameters were assumed to be those typical of the winds behind the funnel cloud. (Although the debris could be taken up in the funnel cloud, the resulting consequences are expected to be much lower than for winds behind the funnel cloud because of greater dispersion and dilution.) It is very unlikely that plutonium would be dispersed toward Amarillo (to the west-southwest) following a tornado-induced detonation at the Pantex Plant, because of the much lower probability of a tornado path in that direction (Dewart 1982).

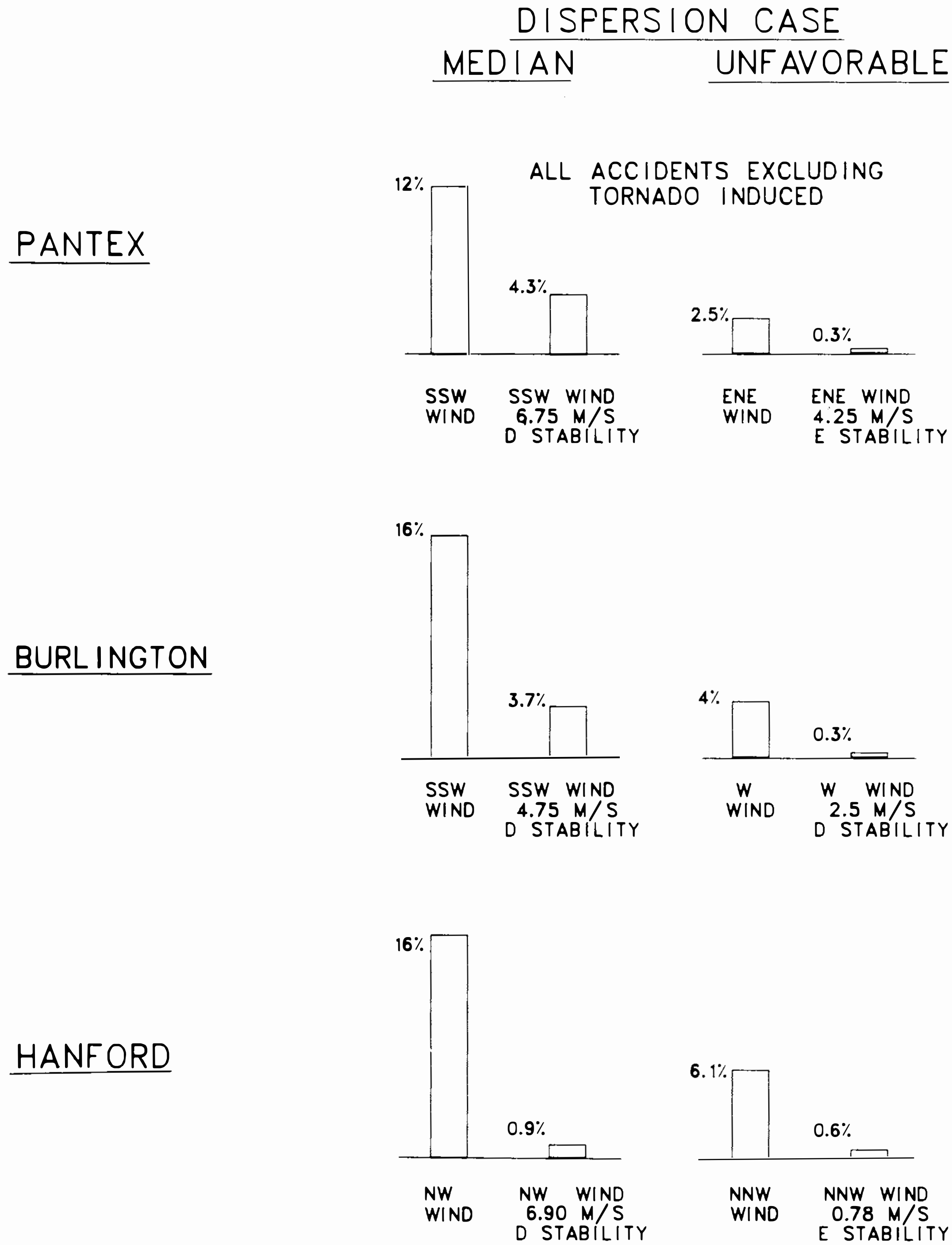


Figure 4.2.5-A. Frequency of occurrence of meteorological conditions for unfavorable and median dispersion cases.

Calculations for estimated dispersion and deposition were carried out to 80 kilometers with the assumption of constant wind speed, direction, and stability conditions. It is likely that these factors would change somewhat with time and distance but there is no way to predict the exact conditions.

4.2.6 Immediate Exposure Health Consequences

Immediate exposure, for the purposes of this document, means the inhalation of plutonium directly from the debris cloud resulting from a postulated accident. Health consequences were evaluated as the increased chance of death from radiation-induced cancers caused by the immediate inhalation of plutonium. Such cancers would occur only after latency periods of several years. No short-term effects would be expected in any offsite person even for the maximum doses calculated (Elder 1982B).

Plutonium delivers a radiation dose to an organ by alpha particles emitted during radioactive decay. Depending on the extent of the damage to the organ, observable health effects in an individual may result. The principal effect in the body of an exposed person is increased possibility of cancer. Such cancers would appear only after a latency period: approximately 10 to 20 years for lung cancer, 4 to 26 years for bone cancer, and 10 to 20 years for liver cancer (BEIR III 1980). For this analysis, all cases were assumed to be fatal because of relatively low cure rates for these forms of cancer.

An upper limit estimate of the amount of plutonium inhaled was made by assuming that all potentially exposed people would be outdoors for the entire time of passage of the cloud and taking no credit for the mitigating effects that could be provided by being inside buildings (see Section 4.2.9). Doses to individuals at specific distances were calculated by multiplying the mass of respirable particles inhaled at that location by an organ dose factor.

The dose factors for the important organs (liver, bone, and lungs) were calculated using a computer dose model (Houston 1974). The model parameters were revised to include recently accepted changes in standard organ masses and the biological effectiveness of alpha particles from plutonium (Elder 1982B). The model employs a particle deposition and clearance model adopted by the International Commission on Radiation Protection Task Group on Lung Dynamics (ICRP 1966, ICRP 1972). Retention of any component of weapons-grade plutonium in appropriate organs of the body was taken into account. The model is based on the organ masses, breathing rates, and clearance times of ICRP reference man (ICRP 1974). The reference man doses were found to not vary from mixed population doses by more than 15 percent for any important organ (Elder 1982B). A breathing rate corresponding to a moderate work level (0.00035 cubic meter per second) was selected for the analysis. This rate is an overestimate because the actual average breathing rate would probably be between this rate and the resting rate (0.00012 cubic meter per second).

Estimation of the summed dose to the exposed population required data on the number of people at various distances and directions. Population data were projected to the year 1990 for each of the alternative sites from preliminary 1980 census data (LATA 1981). (See Sections 3.2.8.1, 3.2.8.2, and 3.2.8.3 for population discussions.)

Potential radiation-induced health effects in various organs have been evaluated by several radiation protection organizations. The findings of the BEIR Committee (BEIR III 1980), the International Commission on Radiation Protection (ICRP 1977), and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSC 1977) all were considered (Elder 1982B). The quantitative relationships between radiation dose and expected cases of cancer used in this analysis were primarily based on the BEIR data: 0.000015 case per person-rem to the liver; 0.0000014 case per person-rem to the bone; and 0.000043 case per person-rem to the lungs.

The results of the analyses are presented in Tables 4.2.6-1 through 4.2.6-7 for representative accident scenarios that illustrate the full range of possible consequences for each Alternative as indicated below.

Pantex Alternative

Table 4.2.6-1 Maximum Release (120 kilograms)
Table 4.2.6-2 Intermediate Release (30 kilograms)
Table 4.2.6-3 Low Release (0.6 kilogram)

Iowa Army Ammunition Plant Alternative

Table 4.2.6-4 Maximum Release (120 kilograms)
Table 4.2.6-5 Intermediate Release (30 kilograms)
Table 4.2.6-6 Low Release (0.6 kilogram)

Hanford Site Alternative

Table 4.2.6-7 Maximum Release (0.6 kilogram)

The doses and potential health effects from plutonium estimated as described above are believed to be overestimations and represent the upper limit of a range of conceivable consequences. The results of these calculations include major uncertainties that may overstate consequences by factors of as much as 10 to 100. Furthermore, simple mitigating measures, as described in Section 4.2.9 Emergency Preparedness, could be taken by the public and would be expected to limit inhalation doses.

The significance of health effects that could occur also may be evaluated by comparing the estimated number of potential accident-related health effects with the normal incidence of the same cancer types in the same population. The normal incidence of cancer death in the United States is approximately as follows (NCI 1975).

	Average Annual Number of Deaths per 100,000 Persons	Total Deaths in Average 70-Year Lifetime per 100,000 Persons	
		Total	Percent of Deaths
Lung cancer	42	3,120	3.1
Liver cancer	2.4	256	0.26
Bone cancer	0.8	50	0.05

Comparisons with these values are presented in Tables 4.2.6-1 through 4.2.6-7, where the estimates of accident-caused health effects are expressed as total numbers and as percent of the normal incidence (Elder 1982B).

Genetic effects were also considered even though cancer induction is expected to be the overriding health concern following plutonium exposure. The dose to reproductive organs is relatively low because plutonium does not concentrate as it does in liver and bone. The number of genetic effects, including those disorders and traits that cause serious handicap at some time during lifetimes, was estimated by using the range of values given by the BEIR Committee (BEIR III 1980). The total numbers of genetic effects in all subsequent generations could range from about 2 percent to 40 percent of the number of cases of cancers estimated to occur in the exposed population as a result of any particular accident (Elder 1982B).

One perspective on the estimates of potential risk summarized can be gained by comparing them with other risks common in day-to-day living. For example, daily cigarette smoking (one pack or more per day) carries an increase in the chance of death from lung cancer more than 25 times as much as highest estimate of dose to the lungs of the maximum-exposed person for the worst case accident at the Pantex Plant. This example and others are shown in Table 4.2.6-8 in terms of increase in chance of death from common risks (Wilson 1979).

TABLE 4.2.6-1

SUMMARY OF RADIOLOGICAL RISKS TO INDIVIDUALS
FROM IMMEDIATE INHALATION OF RADIOACTIVITY DURING CLOUD PASSAGE

PANTEX PLANT ALTERNATIVE, MAXIMUM RELEASE (120 kilograms)

Location of Individual	Organ	Incremental Risk of Eventual Cancer Death (chances/100,000 for an individual)		Radiological Dose Used in Estimate (50-year commitment, rem)	
		Median Dispersion; Wind to NNE	Unfavorable Dispersion; Wind to WSW	Median Dispersion; Wind to NNE	Unfavorable Dispersion; Wind to WSW
Site Boundary	Lung Liver Bone	740 230 51	590 190 39	170 160 360	140 120 280
(distance, km)		(2.2)	(4.0)	(2.2)	(4.0)
Nearest Residence	Lung Liver Bone	690 220 47	460 150 30	160 140 340	110 97 220
(distance, km)		(2.4)	(5.0)	(2.4)	(5.0)
Major Population Center	Lung Liver Bone	42 14 3	94 28 6	10 9.1 20	22 19 45
(name, distance)		(Borger, 42 km)	(Amarillo, 25 km)	(Borger, 42 km)	(Amarillo, 25 km)
"Average Individual"	Lung Liver Bone	3 1 <.5	35 11 2	0.76 0.68 1.6	8.2 7.4 17
Total Population Exposed		13,540	142,000	13,540	142,000
Potential Cases of Cancer Deaths in Exposed Population	Lung Liver Bone	<.5 (--)* <.5 (--) <.5 (--)	49 (1.1)* 16 (4.3) 3 (4.7)		

*Value in ( ) is number of cases as a percentage of normally expected mortality from the same types of cancer in the given population.

TABLE 4.2.6-2

SUMMARY OF HEALTH RISKS TO INDIVIDUALS
FROM IMMEDIATE INHALATION OF RADIOACTIVE MATERIAL DURING CLOUD PASSAGE

PANTEX PLANT ALTERNATIVE, INTERMEDIATE RELEASE (30 kilograms)

Location of Individual	Organ	Incremental Risk of Eventual Cancer Death (chances/100,000 for an individual)		Radiological Dose Used in Estimate (50-year commitment, rem)	
		Median Dispersion; Wind to NNE	Unfavorable Dispersion; Wind to WSW	Median Dispersion; Wind to NNE	Unfavorable Dispersion; Wind to WSW
Site Boundary	Lung Liver Bone	110 34 7	82 26 5	26 23 50	19 17 39
(distance, km)		(2.2)	(4.0)	(2.2)	(4.0)
Nearest Residence	Lung Liver Bone	94 28 6	74 23 5	22 19 45	17 16 36
(distance, km)		(2.4)	(5.0)	(2.4)	(5.0)
Major Population Center	Lung Liver Bone	5 2 <.5	19 6 1	1.2 1.0 2.4	4.4 4.0 9.0
(name, distance)		(Borger, 42 km)	(Amarillo, 25 km)	(Borger, 42 km)	(Amarillo, 25 km)
"Average Individual"	Lung Liver Bone	1 <.5 <.5	5 2 <.5	0.13 0.12 0.27	1.2 1.2 2.5
Total Population Exposed		13,540	142,000	13,540	142,000
Potential Cases of Cancer Deaths in Exposed Population	Lung Liver Bone	<.5 (--)* <.5 (--) <.5 (--)	7 (0.16)* 3 (0.70) <.5 (--)		

*Value in ( ) is number of cases as a percentage of normally expected mortality from the same types of cancer in the given population.

TABLE 4.2.6-3

SUMMARY OF RADIOLOGICAL RISKS TO INDIVIDUALS
FROM IMMEDIATE INHALATION OF RADIOACTIVITY DURING CLOUD PASSAGE

PANTEX PLANT ALTERNATIVE, LOW RELEASE (0.6 kilogram)

Location of Individual	Organ	Incremental Risk of Eventual Cancer Death (chances/100,000 for an individual)		Radiological Dose Used in Estimate (50-year commitment, rem)	
		Median Dispersion; Wind to NNE	Unfavorable Dispersion; Wind to WSW	Median Dispersion; Wind to NNE	Unfavorable Dispersion; Wind to WSW
Site Boundary	Lung Liver Bone	8 2 1	19 6 1	1.8 1.6 3.6	4.4 4.0 9.0
(distance, km)		(5.0)	(5.4)	(5.0)	(5.4)
Nearest Residence	Lung Liver Bone	7 2 <.5	17 5 1	1.6 1.4 3.4	4.0 3.6 8.1
(distance, km)		(5.2)	(5.6)	(5.2)	(5.6)
Major Population Center	Lung Liver Bone	<.5 <.5 <.5	1 <.5 <.5	0.024 0.022 0.047	0.20 0.19 0.42
(name, distance)		(Borger, 42 km)	(Amarillo, 25 km)	(Borger, 42 km)	(Amarillo, 25 km)
"Average Individual"	Lung Liver Bone	<.5 <.5 <.5	<.5 <.5 <.5	0.0092 0.0082 0.018	0.042 0.038 0.084
Total Population Exposed		13,540	142,000	13,540	142,000
Potential Cases of Cancer Deaths in Exposed Population	Lung Liver Bone	<.5 (--)* <.5 (--) <.5 (--)	<.5 (---)* <.5 (---) <.5 (---)		

*Value in ( ) is number of cases as a percentage of normally expected mortality from the same types of cancer in the given population.

TABLE 4.2.6-4

SUMMARY OF RADIOLOGICAL RISKS TO INDIVIDUALS
FROM IMMEDIATE INHALATION OF RADIOACTIVITY DURING CLOUD PASSAGE

IOWA ARMY AMMUNITION PLANT ALTERNATIVE, MAXIMUM RELEASE (120 kilograms)

Location of Individual	Organ	Incremental Risk of Eventual Cancer Death (chances/100,000 for an individual		Radiological Dose Used in Estimate (50-year commitment, rem)	
		Median Dispersion; Wind to NE	Unfavorable Dispersion; Wind to E	Median Dispersion; Wind to NE	Unfavorable Dispersion; Wind to E
Site Boundary	Lung Liver Bone	1100 340 74	2000 660 130	260 230 530	480 440 950
(distance, km)		(2.45)	(1.8)	(2.45)	(1.8)
Nearest Residence	Lung Liver Bone	1100 340 74	2000 660 130	260 230 530	480 440 950
(distance, km)		(2.5)	(1.8)	(2.5)	(1.8)
Major Population Center	Lung Liver Bone	--- --- ---	850 270 59	--- --- ---	200 180 420
(name, distance)		(none)	(Burlington, 6.6 km)	(none)	(Burlington, 6.6 km)
"Average Individual"	Lung Liver Bone	68 22 5	140 46 10	16 14 34	34 30 70
Total Population Exposed		3,340	34,360	3,360	34,360
Potential Cases of Cancer Deaths in Exposed Population	Lung Liver Bone	2 (2.2)* 1 (8.2) <.5 (--)	50 (4.5)* 16 (18) 3 (20)		

*Value in ( ) is number of cases as a percentage of normally expected mortality from the same types of cancer in the given population.

TABLE 4.2.6-5

SUMMARY OF RADIOLOGICAL RISKS TO INDIVIDUALS
FROM IMMEDIATE INHALATION OF RADIOACTIVITY DURING CLOUD PASSAGE

IOWA ARMY AMMUNITION PLANT ALTERNATIVE, INTERMEDIATE RELEASE (30 kilograms)

Location of Individual	Organ	Incremental Risk of Eventual Cancer Death (chances/100,000 for an individual)		Radiological Dose Used in Estimate (50-year commitment, rem)	
		Median Dispersion; Wind to NE	Unfavorable Dispersion; Wind to E	Median Dispersion; Wind to NE	Unfavorable Dispersion; Wind to E
Site Boundary	Lung Liver Bone	130 40 9	270 86 18	30 27 62	64 57 130
(distance, km)		(2.45)	(1.8)	(2.45)	(1.8)
Nearest Residence	Lung Liver Bone	130 40 9	270 86 18	30 27 62	64 57 130
(distance, km)		(2.45)	(1.8)	(2.45)	(1.8)
Major Population Center	Lung Liver Bone	--- --- ---	100 31 7	--- --- ---	24 21 50
(name, distance)		(none)	(Burlington, 6.6 km)	(none)	(Burlington, 6.6 km)
"Average Individual"	Lung Liver Bone	10 3 1	25 8 2	2.4 2.1 4.8	5.8 5.1 12
Total Population Exposed		3,340	34,360	3,340	34,360
Potential Cases of Cancer Deaths in Exposed Population	Lung Liver Bone	<.5 (--)* <.5 (--) <.5 (--)	8 (0.80)* 3 (3.0) 1 (3.4)		

*Value in ( ) is number of cases as a percentage of normally expected mortality from the same types of cancer in the given population.

TABLE 4.2.6-6

SUMMARY OF RADIOLOGICAL RISKS TO INDIVIDUALS
FROM IMMEDIATE INHALATION OF RADIOACTIVITY DURING CLOUD PASSAGE

IOWA ARMY AMMUNITION PLANT ALTERNATIVE, LOW RELEASE (0.6 kilogram)

Location of Individual	Organ	Incremental Risk of Eventual Cancer Death (chances/100,000 for an individual)		Radiological Dose Used in Estimate (50-year commitment, rem)	
		Median Dispersion; Wind to NE	Unfavorable Dispersion; Wind to E	Median Dispersion; Wind to NE	Unfavorable Dispersion; Wind to E
Site Boundary	Lung Liver Bone	100 31 7	26 8 2	24 21 50	6.2 5.5 12
(distance, km)		(1.5)	(3.9)	(1.5)	(3.9)
Nearest Residence	Lung Liver Bone	100 31 7	26 8 2	24 21 50	6.2 5.5 12
(distance, km)		(1.5)	(3.9)	(1.5)	(3.9)
Major Population Center	Lung Liver Bone	--- --- ---	8 3 1	--- --- ---	1.9 1.7 3.9
(name, distance)		(none)	(Burlington, 6.8 km)	(none)	(Burlington, 6.8 km)
"Average Individual"	Lung Liver Bone	1 <.5 <.5	2 1 <.5	0.20 0.19 0.42	0.38 0.34 0.76
Total Population Exposed		3,340	34,360	3,340	34,360
Potential Cases of Cancer Deaths in Exposed Population	Lung Liver Bone	<.5 (--)* <.5 (--) <.5 (--)	<.5 (---)* <.5 (----) <.5 (----)		

*Value in ( ) is number of cases as a percentage of normally expected mortality from the same types of cancer in the given population.

TABLE 4.2.6-7

SUMMARY OF RADIOLOGICAL RISKS TO INDIVIDUALS
FROM IMMEDIATE INHALATION OF RADIOACTIVITY DURING CLOUD PASSAGE

HANFORD SITE ALTERNATIVE, MAXIMUM RELEASE (0.6 kilogram)

Location of Individual	Organ	Incremental Risk of Eventual Cancer Death (chances/100,000 for an individual)		Radiological Dose Used in Estimate (50-year commitment, rem)	
		Median Dispersion; Wind to NE	Unfavorable Dispersion; Wind to E	Median Dispersion; Wind to NE	Unfavorable Dispersion; Wind to E
Site Boundary	Lung	<.5	1	0.068	0.26
	Liver	<.5	<.5	0.061	0.23
	Bone	<.5	<.5	0.14	0.50
(distance, km)		(35)	(35)	(35)	(35)
Nearest Residence	Lung	<.5	1	0.068	0.26
	Liver	<.5	<.5	0.061	0.23
	Bone	<.5	<.5	0.14	0.50
(distance, km)		(35)	(35)	(35)	(35)
Major Population Center	Lung	<.5	1	0.040	0.14
	Liver	<.5	<.5	0.036	0.13
	Bone	<.5	<.5	0.081	0.28
(name, distance)		(Richland, 42 km)	(Richland, 42 km)	(Richland, 42 km)	(Richland, 42 km)
"Average Individual"	Lung	<.5	<.5	0.016	0.046
	Liver	<.5	<.5	0.013	0.040
	Bone	<.5	<.5	0.031	0.092
Total Population Exposed		119,000	119,000	119,000	119,000
Potential Cases of Cancer Deaths in Exposed Population	Lung	<.5 (--)*	<.5 (---)*		
	Liver	<.5 (--)	<.5 (----)		
	Bone	<.5 (--)	<.5 (----)		

*Value in ( ) is number of cases as a percentage of normally expected mortality from the same types of cancer in the given population.

TABLE 4.2.6-8

RISK COMPARISON
(increase in chance of death from various activities)

Activity or Event	Chance of Death Attributed to Activity or Event (Chances in 100,000	Lung Radiation Dose* Required for Same Level of Risk (rem)
Cigarette smoking** (cancer and heart disease)	15,000	3600
Maximum individual lung dose, assuming worst case accident under Iowa Army Ammunition Plant Alternative***	2,000	480
Working 10 years as a coal miner (black lung)	1,900	460
Maximum individual lung dose, assuming worst case accident under Pantex Plant Alternative***	740	170
Working 10 years as a coal miner (accident)	640	150
Dwelling in a large eastern city for 20 years (pollution-related diseases)	360	84
Traveling 300,000 miles by automobile (accidents)	100	23
Average individual lung dose, assuming worst case accident under Pantex Plant Alternative***	35	8
Traveling 300,000 miles by commercial jet (accident)	30	7
Traveling 300,000 miles by commercial jet (cosmic radiation)	5	1

*Risk coefficient 0.000043/person-rem.
**Moderate-to-heavy smoking (1 pack per day or more) for 40 years.
***These are probabilities of injury assuming that the postulated accident has already happened.

4.2.7 Decontamination

Plutonium will be deposited downwind from the passage of a cloud following an accidental release. Amounts deposited were calculated using the methods described in Section 4.2.5. If these concentrations were large enough to exceed contamination limits, the ground would have to be decontaminated.

Two possible plutonium contamination cleanup criteria were evaluated to indicate the range of possibly required actions. The first and more restrictive cleanup level (0.2 microcurie per square meter in the top centimeter of soil) was a screening level recommended as part of a proposed guidance to Federal agencies by the Environmental Protection Agency in 1977, but has never been officially adopted (46FR60956). The screening level was recommended as one below which the proposed dose guidance could be presumed to be met and no cleanup need be considered. This guidance was derived from the premise that the risk of developing a radiation-induced cancer from continuous exposure to the contamination should be less than 10 chances in 100,000 during the lifetime of an individual (USEPA 1977).

The second possible cleanup level was derived from the premise that no individual would receive a dose to any critical body organ greater than that recommended by the National Commission on Radiological Protection and Measurement, even after continuous exposure over a 70-year period (Healy 1977). This cleanup level would limit exposure in the maximum year to any organ of an individual to no more than 500 millirem. The two levels are stated in different terms, but, in general, the EPA-based level would result in cleanup to levels about 40 times lower than the level based on a 500-millirem-per-year organ dose.

Three types of land use (agricultural, suburban, and commercial) were addressed for the two possible decontamination levels (Wenzel 1982B). The decontamination methods and estimated costs were based on available literature (McGrath 1978, Smith 1978, Finley 1980). Cleanup of the higher levels of contamination would be accomplished by major vegetation and soil removal by farm or road machinery and washing structures with fire hoses. At lower levels, contamination could be reduced and stabilized by some vegetation removal, plowing, and heavy irrigation. Cost estimates ranged from about $500 to more than $100,000 an acre, depending on the type of land use and required cleanup. The estimates included, where appropriate, purchase of crops, costs of packaging, transportation, disposal of contaminated materials, temporary evacuation during cleanup, and restoration (Wenzel 1982B).

The results of the analyses are presented in Tables 4.2.7-1 through 4.2.7-7 for representative accident scenarios that illustrate the full range of possible consequences for each Alternative as indicated below.

Pantex Alternative

Table 4.2.7-1 Maximum Release (120 kilograms)
Table 4.2.7-2 Intermediate Release (30 kilograms)
Table 4.2.7-3 Low Release (0.6 kilogram)

Iowa Army Ammunition Plant Alternative

Table 4.2.7-4 Maximum Release (120 kilograms)
Table 4.2.7-5 Intermediate Release (30 kilograms)
Table 4.2.7-6 Low Release (0.6 kilogram)

Hanford Site Alternative

Table 4.2.7-7 Maximum Release (0.6 kilogram)

TABLE 4.2.7-1

ESTIMATED DECONTAMINATION AREAS AND COSTS (1981)
PANTEX ALTERNATIVE, MAXIMUM RELEASE (120 kilograms)

	Land Use	Median Meteorology Acres	Median Meteorology Cost (1981) $Millions	Unfavorable Meteorology Acres	Unfavorable Meteorology Cost (1981) $Millions
Cleanup to level based on Healy proposal	Agriculture Suburban Commercial	198,000 4,290 1,430	160 3.6 1.3	200,400 44,500 11,100	120 54 16
	TOTALS:	204,000	170	256,000	190
Cleanup to level based on EPA Proposed Guidance	Agriculture Suburban Commercial	198,000 4,290 1,430	720 15 5.4	200,400 44,500 11,100	680 160 45
	TOTALS:	204,000	740	256,000	890

TABLE 4.2.7-2

ESTIMATED DECONTAMINATION AREAS AND COSTS (1981)
PANTEX ALTERNATIVE, INTERMEDIATE RELEASE (30 kilograms)

	Land Use	Median Meteorology Acres	Median Meteorology Cost (1981) $Millions	Unfavorable Meteorology Acres	Unfavorable Meteorology Cost (1981) $Millions
Cleanup to level based on Healy proposal	Agriculture Suburban Commercial	155,300 4,490 1,500	77 2.4 1.6	154,400 23,800 7,930	75 16 5.6
	TOTALS:	161,300	81	186,000	97
Cleanup to level based on EPA Proposed Guidance	Agriculture Suburban Commercial	155,300 4,490 1,500	490 14 5.1	154,400 23,800 7,930	480 78 28
	TOTALS:	161,300	510	186,000	590

TABLE 4.2.7-3

ESTIMATED DECONTAMINATION AREAS AND COSTS (1981)
PANTEX ALTERNATIVE, LOW RELEASE (0.6 kilogram)

	Land Use	Median Meteorology Acres	Median Meteorology Cost (1981) $Millions	Unfavorable Meteorology Acres	Unfavorable Meteorology Cost (1981) $Millions
Cleanup to level based on Healy proposal	Agriculture Suburban Commercial	5,930 59 14	2.9 0.033 0.0068	4,770 1,540 512	2.3 0.73 0.97
	TOTALS:	6,000	2.9	6,820	4.0
Cleanup to level based on EPA Proposed Guidance	Agriculture Suburban Commercial	5,930 59 14	18 0.18 0.048	4,770 154 512	15 4.9 1.7
	TOTALS:	6,000	18	6,820	22

TABLE 4.2.7-4

ESTIMATED DECONTAMINATION AREAS AND COSTS (1981)
IOWA ARMY AMMUNITION PLANT ALTERNATIVE, MAXIMUM RELEASE (120 kilograms)

	Land Use	Median Meteorology Acres	Median Meteorology Cost (1981) $Millions	Unfavorable Meteorology Acres	Unfavorable Meteorology Cost (1981) $Millions
Cleanup to level based on Healy proposal	Agriculture Suburban Commercial	193,800 7,630 2,550	160 11 4.3	76,800 9,780 3,260	68 89 36
	TOTALS:	204,000	175	89,860	190
Cleanup to level based on EPA Proposed Guidance	Agriculture Suburban Commercial	193,800 7,630 2,550	700 31 11	76,800 9,780 3,260	320 120 47
	TOTALS:	204,000	742	89,860	490

TABLE 4.2.7-5

ESTIMATED DECONTAMINATION AREAS AND COSTS (1981)
IOWA ARMY AMMUNITION PLANT ALTERNATIVE, INTERMEDIATE RELEASE (30 kilograms)

		Median Meteorology		Unfavorable Meteorology	
	Land Use	Acres	Cost (1981) $Millions	Acres	Cost (1981) $Millions
Cleanup to level based on Healy proposal	Agriculture Suburban Commercial	78,300 3,090 1,030	41 2.7 0.98	70,400 6,750 2,250	36 8.9 3.5
	TOTALS:	82,450	45	79,420	48
Cleanup to level based on EPA Proposed Guidance	Agriculture Suburban Commercial	78,300 3,090 1,030	260 11 3.8	70,400 6,750 2,250	230 25 9.2
	TOTALS:	82,450	270	79,420	260

TABLE 4.2.7-6

ESTIMATED DECONTAMINATION AREAS AND COSTS (1981)
IOWA ARMY AMMUNITION PLANT ALTERNATIVE, LOW RELEASE (0.6 kilogram)

		Median Meteorology		Unfavorable Meteorology	
	Land Use	Acres	Cost (1981) $Millions	Acres	Cost (1981) $Millions
Cleanup to level based on Healy proposal	Agriculture Suburban Commercial	5,200 204 69	2.6 0.11 0.038	2,940 986 328	1.4 0.48 0.16
	TOTALS:	5,470	2.7	4,260	2.0
Cleanup to level based on EPA Proposed Guidance	Agriculture Suburban Commercial	5,200 204 69	16 0.65 0.23	2,940 986 328	9.1 3.1 1.1
	TOTALS:	5,470	17	4,260	13

TABLE 4.2.7-7

ESTIMATED DECONTAMINATION AREAS AND COSTS (1981)
HANFORD SITE ALTERNATIVE, MAXIMUM RELEASE (0.6 kilogram)

	Land Use	Median Meteorology		Unfavorable Meteorology	
		Acres	Cost (1981) $Millions	Acres	Cost (1981) $Millions
Cleanup to level based on Healy proposal	Agriculture	6,700 (onsite)	3.2	3,230 (onsite)	1.6
	Suburban	None	--	None	--
	Commercial	None	--	None	--
	TOTALS:	6,700	3.2	3,230	1.6
Cleanup to level based on EPA Proposed Guidance	Agriculture	6,700 (onsite)	21	3,230 (onsite)	10
	Suburban	None	--	None	--
	Commercial	None	--	None	--
	TOTALS:	6,700	21	3,230	10

4.2.8 Long-Term Exposure Health Consequences

Long-term exposure for the purposes of this document means the inhalation and ingestion of plutonium over many years. Plutonium would be initially deposited on the ground by the passage of the dispersion cloud from an accidental explosion. The deposited plutonium could be made available to humans by several natural processes termed "pathways." These pathways are resuspension to the air, ingestion of garden produce, and ingestion of meat products. Several important pathways were evaluated by computer model simulation to determine radiation doses and associated potential health effects. The most significant pathway (over 90 percent of the long-term radiation dose) to man is direct inhalation of resuspended particles of contaminated soil.

Three types of computer simulations were performed, one for each of the two levels of decontamination effort described in Section 4.2.7 and one assuming no decontamination for comparison. The uptake of plutonium from the soil to plants, from plants to foraging livestock, and from both plants and livestock to man was analyzed. Figure 4.2.8-A illustrates the major food pathways investigated for the Pantex region. This analysis assumed large areas of farmland are contaminated with plutonium. Both natural and agricultural pathways to man were simulated using appropriate computer codes. Site-specific data on climate, soil, vegetation, cropping, and agricultural practices were used in the computer program for these simulations (Wenzel 1982A).

The concentrations of plutonium in air, soil, vegetation, and meat were simulated for 50 years. These simulated concentrations were used to estimate the doses and health effects expected in individuals. For conservative estimates, the individuals were assumed to be living on and farming the contaminated areas. Based on these doses, associated risks of potential health effects were estimated by the same procedure described in Section 4.2.6.

Results for the ranges of accidents evaluated are summarized in Table 4.2.8-1 for the Pantex Plant Alternative and Table 4.2.8-2 for the Iowa Army Ammunition Plant Alternative. For the Hanford Site

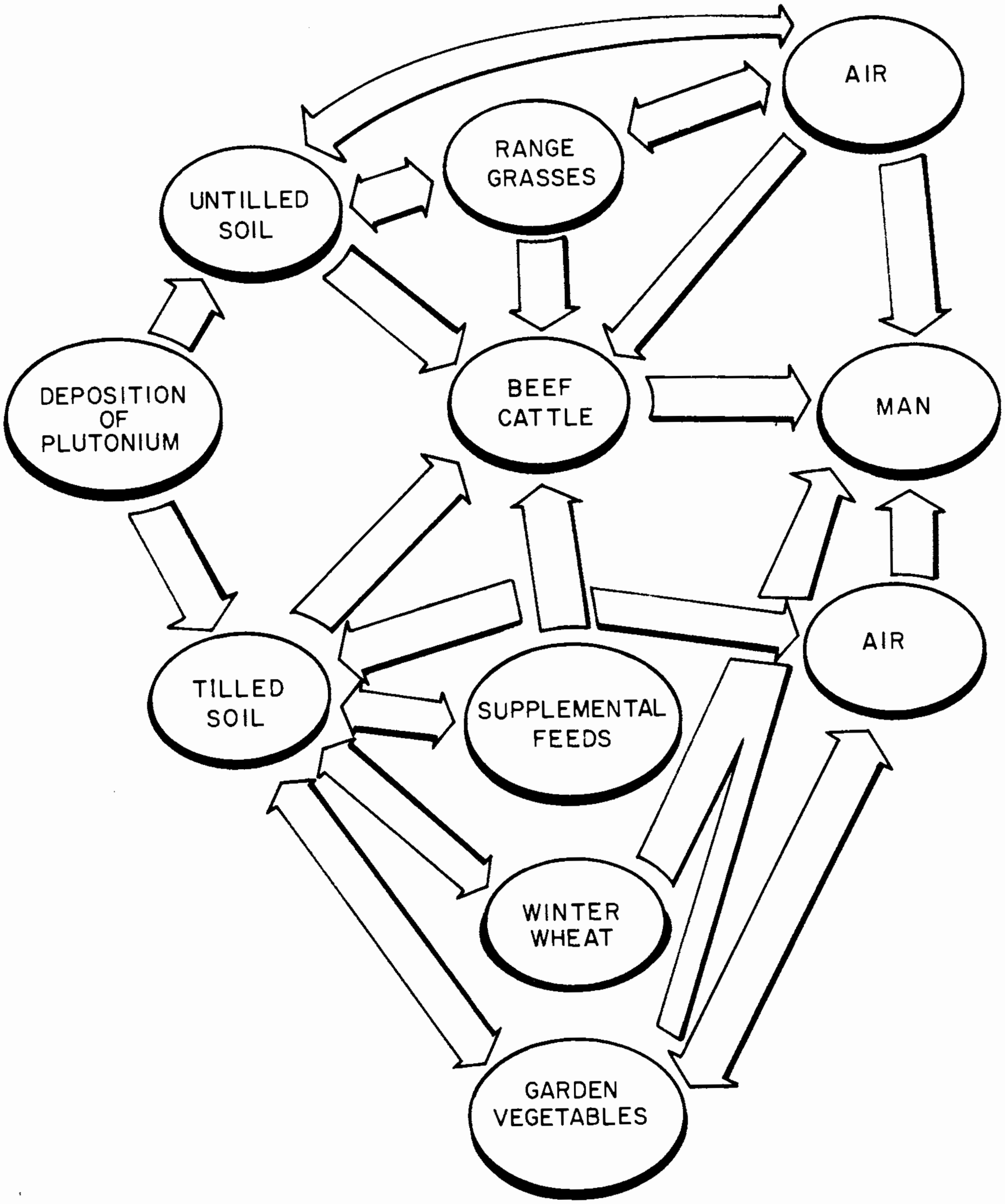


Figure 4.2.8-A. Major Pantex Plant food pathways simulated for potential accidents with plutonium.

Alternative, the offsite contamination levels even without cleanup were near the cleanup level based on the Environmental Protection Agency Proposed Guidance and no incremental risks were calculated. The values given are the incremental risk of cancers (lung, liver, and bone) for average individuals living on and farming the contaminated areas during the first year after deposition and for a total 50-year period. The values may be compared with the average individual incremental risk values given in Tables 4.2.6-1 through 4.2.6-7.

TABLE 4.2.8-1

INCREMENTAL RISK OF EVENTUAL CANCER DEATH* FROM LONG-TERM EXPOSURE TO RESIDUAL CONTAMINATION UNDER THREE CLEANUP ASSUMPTIONS

PANTEX PLANT ALTERNATIVE

(Chances in 100,000 for Average Individual)

Degree of Cleanup	120-Kilogram Release				30-Kilogram Release				0.6-Kilogram Release			
	Median Meteorology		Unfavorable Meteorology		Median Meteorology		Unfavorable Meteorology		Median Meteorology		Unfavorable Meteorology	
	First Year	50-yr Total	First Year	50-yr Total	First Year	50-yr Total	First Year	50-yr Total	First Year	50-yr Total	First Year	50-yr Total
No decontamination	0.85	1.7	3.6	7.2	0.40	0.82	2.0	4.0	0.31	0.65	0.11	0.22
Cleanup to level based on Healy proposal	0.57	1.1	0.92	1.8	0.39	0.78	0.73	1.5	0.31	0.65	0.11	0.22
Cleanup to level based on EPA Proposed Guidance	0.04	0.08	0.04	0.08	0.04	0.08	0.04	0.08	0.04	0.08	0.04	0.08

*Values are chances in 100,000 that an average individual living within the contaminated area for the period of time would eventually die of liver, lung, or bone cancer because of intake of residual plutonium contamination.

TABLE 4.2.8-2

INCREMENTAL RISK OF EVENTUAL CANCER DEATH* FROM LONG-TERM EXPOSURE TO RESIDUAL CONTAMINATION UNDER THREE CLEANUP ASSUMPTIONS

IOWA ARMY AMMUNITION PLANT ALTERNATIVE

(Chances in 100,000 for Average Individual)

Degree of Cleanup	120-Kilogram Release				30-Kilogram Release				0.6-Kilogram Release			
	Median Meteorology		Unfavorable Meteorology		Median Meteorology		Unfavorable Meteorology		Median Meteorology		Unfavorable Meteorology	
	First Year	50-yr Total	First Year	50-yr Total	First Year	50-yr Total	First Year	50-yr Total	First Year	50-yr Total	First Year	50-yr Total
No decontamination	5.9	9.6	8.5	14	1.2	2.0	3.1	5.2	0.34	0.54	0.22	0.36
Cleanup to level based on Healy proposal	0.50	0.83	0.70	1.2	0.39	0.52	0.67	1.1	0.34	0.54	0.22	0.36
Cleanup to level based on EPA Proposed Guidance	0.04	0.08	0.04	0.05	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06

*Values are chances in 100,000 that an average individual living within the contaminated area for the period of time would eventually die of liver, lung, or bone cancer because of intake of residual plutonium contamination.

4.2.9 Emergency Preparedness

Emergency Preparedness is discussed here only in relation to the Pantex Plant. Similar planning would be done for either the Iowa Army Ammunition Plant or the Hanford Site.

The Pantex Plant has comprehensive emergency plans that provide guidance and procedures designed to protect (1) life and property within the facility, (2) the health and welfare of surrounding areas, and (3) the defense interest of the nation during any credible emergency situation. Formal mutual assistance agreements have been made with the Amarillo Fire Department, the National Guard, and St. Anthony's Hospital. Informal agreements have been discussed with local police, sheriff departments, and other emergency agencies who will provide support in line with their respective charters. Planning is in progress with officials of the State of Texas to assure appropriate coordination with the Texas State Emergency Management Plan.

The Pantex Emergency Plan expresses the philosophy that the Pantex Plant be as self-sufficient as possible in handling emergency situations within the facility. Plant emergency response teams are composed of specialized personnel who are trained and knowledgeable in meeting emergency situations. These include such fields of expertise as fire fighting, security and nuclear materials protection, medical, radiation monitoring and health physics, nuclear safety, and environmental sciences. The groups are further supported by expertise in industrial safety, industrial hygiene, communications, utilities, and transportation. These response groups are responsible for providing the direction and appropriate action required to resolve any emergency situation.

Medical, decontamination, firefighting, and other emergency facilities and equipment are available onsite. An Emergency Radiation Treatment Facility with equipment is available at St. Anthony's Hospital in Amarillo to treat contaminated patients. Periodic exercises are conducted by Pantex Plant personnel with the hospital staff. The facility at the St. Anthony's Hospital was the first decontamination facility in the United States designed exclusively for handling contaminated patients in a community hospital (Waldron 1981, Kelly 1972).

In addition to the above response groups, there is an emergency coordinating team composed of Department of Energy and Plant contractor management personnel who conduct training exercises at an onsite emergency control center. Under accident conditions, this team would initiate the Pantex Emergency Plan and coordinate all onsite actions. If offsite areas could be affected, the Texas Department of Public Safety would be notified immediately. The Texas Department of Public Safety will make emergency notification to the public and local governmental agencies in accordance with Annex R of the State of Texas Emergency Management Plan (Texas 1982). The Pantex Plant has in-place communication channels with the Texas Department of Public Safety through the use of telephone (both standard and mobile), two-way radio, and the National Warning System.

The Pantex Plant has Radiological Assistance Teams with a total of 46 personnel who are equipped and trained to respond to an accident involving radioactive contamination either onsite or offsite. Members from this team have participated in the National Nuclear Weapons Accident Exercises in 1979 and 1981. In addition, the Joint Nuclear Accident Coordinating Center (JNACC) in Albuquerque, New Mexico, can be called upon, should the need arise. This call would mobilize radiation emergency response teams from the Department of Energy, Department of Defense, and other participating Federal agencies.

As discussed throughout Section 4.2, the only types of credible accidents that could lead to significant consequences for the general public or the environment are those that might disperse radioactive materials beyond the boundaries of the Pantex Plant. The Texas Department of Health has primary responsibility within the provisions of the State of Texas Emergency Management Plan for emergency response to prevent or reduce damage, injury, or loss of life or property from accidents involving radioactive materials. This planning will be documented in a special chapter on the Pantex Plant in the Federal Facility subsection (Annex L, Appendix 7, Tab 3) of the Radiological Emergency Response portion of the State Plan (Texas 1982). This planning will be along the same general patterns used for fixed nuclear facilities in the State of Texas Emergency Management Plan. Additional documentation will cover responsibilities and actions for other State of Texas agencies and local governments.

In the event of an accident resulting in offsite radioactive contamination, sheltering and simple respiratory protection would be effective in significantly reducing both individual and population doses. Where appropriate, the public could seek shelter in permanent structures such as houses or commercial/industrial buildings, which could be made reasonably airtight by closing windows, doors, and external air intakes. Persons traveling by motor vehicle could close windows, vents, and outside heating or cooling ducts, as well as avoid driving to the area where the cloud would be expected to travel downwind. Additional respiratory protection would be achieved by covering the nose and mouth with wet handkerchiefs or towels or by going into a bathroom, closing the door and turning on the water in the shower. If these measures were taken during the time of cloud passage (for example, one to a few hours in Amarillo), the potential maximum radiation doses and the corresponding risks of eventual cancers shown in Section 4.2.6 would be reduced substantially, possibly by factors of as much as 10 (Cohen 1979, Cooper 1981).

Once the initial debris cloud has passed, the remaining potential hazard from deposited radioactivity would be significantly smaller (Section 4.2.7). Because of the lower potential hazard, restoration and recovery could be carried out over a reasonable time period. Actions would probably include some of those discussed in Section 4.2.7, as well as measures such as access restriction or temporary evacuation of areas with the highest levels of contamination until cleanup could be accomplished.

Planning for Pantex Plant emergencies incorporates experience gained from decontamination of sites where plutonium dispersal resulted from high explosives detonation. These decontamination efforts were successful in managing health protection problems and in returning land and facilities to the public domain (USAF 1970, Place 1970).

4.3 IMPACTS OF RELATED DEPARTMENT OF ENERGY TRANSPORTATION OPERATIONS

Environmental impacts resulting from related transportation operations fall into one of two major categories--normal operations or accidents. Radiological and nonradiological consequences are assessed for both categories. The radiological consequences result from atmospheric release of radioactive materials such as plutonium and tritium.

Two transportation-related accidents were analyzed to be within the threshold of credibility if total mileage traveled in the United States is considered. One potential accident, a crash of a Department of Energy-chartered aircraft carrying components containing tritium, could result in a release probability of 4 chances in 100,000 per year. The second, a long-burning fuel fire resulting from a crash of a Safe-Secure Trailer with a loaded fuel tanker truck, was assessed to be at the threshold of credibility

(1 chance in 1 million per year). All other accidents having potential radiological consequences were found to be not credible. The complete environmental impact assessment of Pantex Plant transportation operations is by necessity classified and is documented in Smith 1982.

4.3.1 Transportation Systems

The Department of Energy transportation safeguards system is used for offsite transportation of nuclear weapons, nuclear components, and special assemblies containing radioactive material. This is a dedicated ground transportation system consisting of Safe-Secure Tractor/Trailers and Safe-Secure Railcars. The Department of Energy does not ship nuclear weapons by air. Safe-Secure Tractor/Trailers and Safe-Secure Railcars have features that make them especially safe in accidents. In addition, they provide security against theft or sabotage attempts. Transportation operations are regulated by Department of Energy standards for special equipment, guard escort, operating procedures, and emergency procedures. The Courier personnel are specially trained and equipped and have extensive experience in the transport of nuclear materials. Equipment includes special vehicles with secure communications capabilities to assure constant radio contact with Department of Energy Offices and facilities. This permits immediate notification of any unusual circumstances or problems during transport. Couriers have emergency response gear that would permit initial response in the case of any emergency until additional accident response support arrived. The full resources of the Radiological Assistance Program could be summoned if needed. The Radiological Assistance Program consists of 30 special teams stationed at Department of Energy facilities throughout the United States. In addition, the Department of Energy's Albuquerque Operations Office can call on special resources of the Department of Defense if required. Any response action would include appropriate notification and coordination with state emergency response agencies depending on the location.

Offsite shipments of the routine low-level radioactive waste (Section 3.2.6.1) are packaged in accordance with Department of Transportation Regulations in Department of Transportation-approved containers. The shipments are made by common carrier truck freight. The hazards are no different than similar low-level wastes such as that generated by nuclear medicine activities in hospitals or experimental radiochemistry laboratories in universities. Risks from transportation of such materials have been assessed as being insignificant in an Environmental Impact Statement by the Nuclear Regulatory Commission (USNRC 1977). Offsite shipments of high explosives and hazardous chemicals are handled by commercial carriers (truck and aircraft) under Department of Transportation guidelines. Onsite shipments use specific safety equipment and vehicles and comply with Pantex Plant operation and emergency procedures.

4.3.2 Normal Transportation Operations

Negligible environmental impacts result from expected conditions during transportation operations. An example is the radiation dose received by all individuals in the vicinity of nuclear shipments. These impacts are summarized in Table 4.3.2-1.

TABLE 4.3.2-1

PANTEX PLANT-RELATED TRANSPORTATION IMPACTS FROM NORMAL OPERATIONS

A. Radiological Impacts - Annual Maximum Individual Dose (millirem)	
Person living along transport link	<0.07
Person sharing transport link while vehicle moving	Negligible
Bystander near stopped vehicle	<0.5
Truck stop employee	<0.01
B. Nonradiological Impacts* 4.3.2.1 Pantex	
Pantex Motor Vehicle Traffic [19 million kilometers (12 million miles) per year]	
Amarillo Impact	1.0 percent
Texas State Impact	0.01 percent
United States Impact	0.0008 percent
Pantex Rail Traffic [390 thousand kilometers (240 thousand miles) per year]	
United States Freight Impact	0.006 percent
Pantex Air Operations (270 per year)	
Amarillo Airport Impact	0.3 percent

*Expressed as a percent of the traffic in the affected area.

4.3.2.1 Pantex Plant

Radiological--Nuclear Weapons

This impact is assessed in terms of dose. The dose for nonoccupational individuals is less than 0.01 millirem per year. The nonoccupational subgroups considered include members of the public exposed alongside the transport link and those nearby while the shipment is stopped.

Radiological--Other Sources

Included in this category are nuclear weapon components, radioactive sources, and radioactive waste. The maximum dose for a nonoccupational individual was assessed to be less than 0.5 millirem per year.

Nonradiological

The total annual traffic contribution for the Pantex Plant (Table 4.3.2-1) was calculated to be less than 1 percent for all affected areas. Therefore, the resultant nonradiological impacts are considered negligible.

4.3.2.2 Iowa Army Ammunition Plant Alternative

Radiological

The maximum individual exposure to a nonoccupational individual is a function of numbers of shipments rather than distance traveled so that value would be the same as reported for the Pantex Plant Alternative.

Nonradiological

If all or part of the nuclear weapons assembly operations were relocated to the Iowa Army Ammunition Plant near Burlington, Iowa, the amount of traffic in the local area would be expected to increase from the onset of Plant refurbishment. Ultimately, the local motor vehicle traffic would be expected to increase by 9 percent and the local air traffic would be expected to increase by 1 percent. The effect on nationwide travel would be negligible.

4.3.2.3 Hanford Site Alternative

Radiological

The maximum individual exposure to a nonoccupational individual is a function of numbers of shipments rather than distance traveled so that value would not be affected by site relocation.

Nonradiological

The total local motor vehicle traffic would be expected to increase by 5 percent. There would be about a 0.3 percent increase in local air traffic. The nationwide effects would be negligible.

4.3.3 Transportation Accidents

The primary concern is detonation of the high-explosives components of nuclear weapons with an ensuing aerosolization and release of plutonium to the atmosphere. Other concerns are detonation of conventional high explosives, release of chemical contaminants, burning combustible chemicals, primarily gasoline and diesel fuel, and release of tritium to the atmosphere. The same basic methods used for assessing plant-related accidents (described in Section 4.2) were used to evaluate potential transportation accidents.

4.3.3.1 Pantex Plant Alternative

Radiological--Nuclear Weapons

The following abnormal circumstances to which a nuclear weapon could be subjected in a transportation accident were considered: fire, impact, projectiles/shrapnel, spark/electrical discharge, crush, puncture, shearing, friction, pressure, lightning, and immersion.

Only one accident that could result in a release of radioactive materials, a collision between a Safe-Secure Tractor/Trailer and a fuel tanker truck resulting in a long-burning fire environment, was determined to be credible. On a nationwide basis, the annual probability of such an accident is about 1 chance in a million. About 5 percent of the total distance traveled is within a 80 kilometer (50-mile) radius of the Pantex Plant. Therefore, the chance of such an accident in the Amarillo area is about 1 chance in 20 million a year.

The consequence assessment for the Safe-Secure Trailer fuel tanker fire accident assumed a maximum authorized vehicle load of nuclear weapons containing plutonium that are most sensitive to the fire accident (Table 4.3.3.1-1). The selected accident location was in a large metropolitan area (population between 0.25 and 0.5 million) on an interstate highway near a major exit. For the worst case-wind direction and unfavorable dispersion conditions, the contaminated area was calculated to be 52 square kilometers (20 square miles) with estimated cleanup costs of $500 million, based on 1980 dollars. A maximum of 38 eventual cancer fatalities were calculated for this selected accident. Calculations were also made using the most likely wind direction and typical dispersion conditions. For this case, cleanup costs of $120 million and 8 eventual cancer fatalities were estimated.

TABLE 4.3.3.1-1

SAFE-SECURE TRACTOR/TRAILERS PLUTONIUM DISPERSAL CONSEQUENCE ASSESSMENT SUMMARY

Event: High-explosive nonnuclear detonation with plutonium dispersal from a fully loaded Safe-Secure Trailer

Location: Interstate Highway, near major exit, large metropolitan area with population between 0.24 and 0.5 million people

Item	Extreme Case Dispersion*	Typical Dispersion**
Risks from immediate inhalation		
Maximum individual first-year lung dose (rem)	31	31
Latent cancer fatalities		
Lung	14	3
Bone	18	4
Liver	6	1
Total	38	8
Potentially affected population	99,000	26,000
Average population density	2,700 persons per square kilometer	2,700 persons per square kilometer
Decontamination considerations		
Area contaminated (at greater than 0.2 microcuries per square meter)	52 square kilometers	52 square kilometers
Cleanup cost (in 1980 dollars)	500 million	120 million

*Based on assumptions of stability category D and wind speed of 2 meters per second.
**Based on assumptions of stability category D and wind speed of 4.2 meters per second.

Nuclear Components and Other Radioactive Materials

The Department of Energy also ships nuclear components and other radioactive materials as part of routine Pantex Plant-related operations. The only credible transportation accident involving these transportation operations that could result in a release of radioactivity is a crash and resulting fire from a Department of Energy-chartered aircraft carrying nuclear components containing tritium. This accident has a probability of tritium release of less than 4 chances in 100,000 per year. A consequence assessment based upon release and aerosolization of all of the tritium in all of the components predicted a maximum individual dose of less than 1 rem.

Special Shipments of Weapons Accident Residue and Associated Contaminated Soil Waste

The 18 remaining containers of nuclear weapons accident residue presently at the Pantex Plant (see Section 3.2.6.1) are expected to be transported to another Department of Energy facility by early 1984. The exact shipping arrangements will depend on whether all of the containers go to the same facility. Regardless of the final destination, shipment of these containers would be made in accordance with a special plan using specially trained and equipped Department of Energy courier personnel, who are experienced in the transport of nuclear materials, as described in Section 4.3.1. They would use similar equipment and would have all of the same resources available for any emergency encountered during transportation.

Approximately 1,500 cubic meters (40,000 cubic feet) of soil associated with the retrieval of the nuclear weapons accident residue is being treated as low-level radioactive waste. Some of this soil has already been packaged and shipped to the Nevada Test Site for final disposal. Current plans call for the rest of this to be packaged and shipped by early 1984. It will be packaged in accordance with Department of Transportation regulations (49 CFR 173.421 and 173.423) for handling by commercial freight carriers as limited-quantity radioactive material. Approximately 55 shipments will be required. The risk associated with these shipments is considered low, representing only a small fraction of the numerous commercial low specific activity shipments routinely made throughout the United States. These types of shipments have been assessed as having very low potential impacts, generically, in a Nuclear Regulatory Commission impact statement (USNRC 1977).

Because of the number of shipments, the possibility of some transportation accident is credible. However, because of the form of the material and the very low level of contamination, the consequences of even a severe accident that spilled the entire contents of a 20-ton shipment would not be environmentally significant. They would be correctable by a simple cleanup operation. An upper limit on consequences was estimated by assuming that no precautions to minimize blowing dust were taken for 24 hours prior to picking up the spilled soil with construction equipment. A nearby individual exposed to blowing dust for the entire time would receive a 50-year dose commitment to lung of no more than 1 millirem (Buhl 1983). This is less than 0.1 percent of the Radiation Protection Standard (USDOE 1980A) and less than 0.3 percent of typical annual background. The added risk of eventually contracting a fatal cancer would be less than 1 chance in 10,000,000 from such an exposure, assuming the accident has happened.

Nonradiological--High Explosives

High explosives, exclusive of radioactive materials, are shipped by contractor aircraft and by commercial trucks. For aircraft carrying conventional high explosives to and from Pantex Plant

(50 shipments per year) the crash probability is 3 chances in 1,000 per year. Because the damage area from detonation of the explosive cargo is always much less than the damage area associated with the plane crash, the hazard from an air crash with high explosives was assessed to be essentially the hazard of the crash.

For truck high-explosive shipments, fire is the dominant abnormal circumstance that could cause a reaction in the explosive cargo. Frequency of fires in trucks carrying high explosives to or from the Pantex Plant (10 trucks per year) is less than 6 chances in 10,000 per year. Approximately one-half of the trucks carry sufficient explosives loads to endanger people in unhardened buildings at radii greater than 175 meters (190 yards). Maximum loads have damage radii potential to 400 meters (437 yards). The Pantex Plant contribution to the overall risk of vehicle-related explosives shipments in the United States is 0.01 percent.

Nonradiological--Other Hazardous Materials

Other hazardous materials used at the Pantex Plant are standard industrial compounds, mainly solvents, cleaning materials, and fuels. Of these, the fuel tanker shipment risks dominate (25 shipments per year). The frequency of fuel tanker accidents resulting in a fire is less than 5 chances in 10,000 per year for Pantex Plant-related fuel transportation in the Amarillo area.

4.3.3.2 Iowa Army Ammunition Plant Alternative

Accidents because of shipping nuclear weapons or hazardous materials to and from the assembly plant are assessed to be directly proportional to the distances traveled. The total miles traveled to and from Burlington would approximate those to and from the Pantex Plant. Therefore, moving the nuclear weapons operations to Burlington would not affect the risk assessment of transportation-related accidents.

4.3.3.3 Hanford Site Alternative

The likelihood of accidents attributable to shipping nuclear weapons or hazardous materials to and from the assembly plant are assessed to be directly proportional to the distances traveled. Projections are that total distances that nuclear weapons and hazardous materials would be shipped to and from the Hanford Site would be about twice the total to and from the Pantex Plant or the Iowa Army Ammunition Plant. The risk to the general public because of incidents resulting from the transportation of nuclear weapons and hazardous materials would be approximately doubled by moving nuclear weapons operations from the Pantex Plant to the Hanford Site.

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- References: Purtymun 1982A, Purtymun 1982B

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- References: Rapp 1982

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- References: Wenzel 1982A, Wenzel 1982B, Wenzel 1982D

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7.0 INDEX

This brief index provides a means for cross-referencing sections of the document where different aspects of topics are covered. The references are to section numbers. The topics and concepts emphasize those related to issues raised during the scoping process.

8.0 APPENDIX

8.1 ENVIRONMENTAL RADIATION AND RADIOACTIVITY

Environmental radiation levels at all three sites are dominated by natural background radiation and, to a much lesser extent, by radiation resulting from worldwide fallout from nuclear weapons testing. The radiation dose component due to current or previous operations at all three sites is so small that it cannot be detected above natural background by environmental field measurements. Since the doses cannot be directly measured, they are indirectly estimated by calculation using site-specific meteorological, demographic, and environmental pathway data.

Radiation doses are reported in rem or millirem (one thousandth of a rem) dose equivalent. This unit permits comparisons to be made between the different types of radiation (such as alpha particles and gamma rays that deposit energy in tissue in different ways) and appropriate standards. Radiation may be received from both external and internal sources. External sources include such things as cosmic rays, natural radioactivity or worldwide fallout from weapons testing in soil and rocks, or x-ray machines. Dose from external sources depends on where a person is in relation to the sources and occurs only while a person is exposed to the source. Internal sources include natural or manmade radioactivity that enters the body with air, food, or water and may remain in the body or be incorporated into specific tissues for varying lengths of time. Such radioactivity deposited in the body continues to give off radiation and thereby results in an internal dose as long as it is in the body. Both types of sources were evaluated for both background and facility-related doses.

8.1.1 Background Radiation Doses

Background radiation has three components: cosmic, external terrestrial, and internal. The average contribution of each component to natural background was calculated for each site. These calculations are based on standard tables and graphs (NCRP 1975), and field measurements specially performed for this impact statement (Buhl 1982).

Cosmic radiation is influenced by several factors including altitude and latitude of the site and the solar activity cycle (NCRP 1975). The average cosmic radiation dose is subject to annual variations at any location because of changes in solar activity. The principal components of cosmic radiation are charged particles, photons, and neutrons.

External terrestrial radiation is produced by naturally occurring radioactivity in the soil, principally potassium-40, members of the thorium, uranium, and actinium decay series, and to a lesser degree by atmospheric radon daughters. There is also a small contribution from worldwide fallout from atmospheric weapons tests. The terrestrial dose rate at any particular location at any site will vary, depending on the local soil concentrations of radionuclides, as well as other factors such as snow cover and soil moisture.

Internal radiation levels are due to the intake into the body of radionuclides in air, food, or water. Internal radiation dose varies from organ to organ, based on the ability of the particular organ to accumulate different elements and the way the radionuclide behaves once inside the body. For example, natural tritium and potassium-40 are incorporated in many tissues and contribute to the whole-body background dose; while natural radon gas and its daughters inhaled with air contribute much of the lung background dose.

The internal radiation doses for a particular organ were calculated by computer model as 50-year dose commitments, the dose to the organ that an individual would receive during the 50 years following intake of a radionuclide into the body. The 50-year dose commitment is calculated in this impact statement for 1 year of exposure at estimated radionuclide concentrations in air, food, or water.

Radiation doses attributable to natural background for each of the three sites are summarized in Table 8.1.1-1. Values are included for whole body, lung, and bone from cosmic, external terrestrial, and internally deposited sources.

8.1.2 Emissions and Sources of Radioactivity

Two principal radionuclides are routinely emitted from operations at the Pantex Plant: depleted uranium and tritium. Plutonium is also handled at Pantex Plant, but no release of plutonium is possible from normal operations.

8.1.2.1 Depleted Uranium

Routine releases of depleted uranium result from dispersal mainly by explosive test shots. The number of tests and the amount of depleted uranium used has declined significantly in recent years. In 1970 about 3,500 kilograms (7,700 pounds); in 1980 the amount had decreased to about 12 kilograms (26 pounds). Less than 10 kilograms (22 pounds) a year is expected in the future. Deplete uranium released

TABLE 8.1.1-1

ESTIMATES OF CURRENT BACKGROUND RADIATION DOSES (millirem) PER YEAR AND EXPOSURE TO A TYPICAL INDIVIDUAL AT EACH SITE*

	Pantex Plant			Iowa Army Ammunition Plant			Hanford Site		
	Whole Body	Lung	Bone	Whole Body	Lung	Bone	Whole Body	Lung	Bone
Cosmic**	37	37	37	28	28	28	27	27	27
External Terrestrial	38***	38	38	26***	26	26	24+	24	24
Internal++	31	231	216	31	231	216	31	231	216
Total	106	306	291	85	285	270	82	282	267

*Estimates include a 10 percent reduction in cosmic radiation and a 20 percent reduction in external terrestrial radiation because of shielding by buildings and an additional 20 percent reduction in external terrestrial radiation because of self-shielding by the body (NCRP 1975).
**From NCRP (1975).
***From Buhl (1982).
+From Miller (1978).
++National average background internal doses based on NCRP (1975). Doses have been calculated from NCRP values using a quality factor of 20.

by these explosive tests at Pantex accounts for more than 99 percent of the doses estimated for annual emissions. Some depleted uranium has also been released in the past by a burning operation but was no more than a few percent of the releases from the explosive test shots.

Test shots containing depleted uranium are directed into the ground. As a result, about 83 percent of the uranium is recovered. Some remains on soil immediately adjacent to the firing site. About 5 percent, mostly in particulate form, is dispersed with the smoke cloud as uranium oxides.

Depending upon the amount of depleted uranium included in the special test shots each year, the airborne concentrations from the test shots in the past has probably ranged from one-tenth to eight times background values expected from natural uranium in soil. Special air sampling was performed at the Pantex Plant during a recent depleted-uranium test shot (January 26, 1982). The maximum downwind concentration, expressed as an annual average, was measured to be less than 0.01 percent of the Department of Energy annual Radioactivity Concentration Guide (Buhl 1982).

Before 1975 and during 1981 some disposal burning operations of high explosives including depleted uranium were conducted at one of the open earth pads. The burning was done to separate waste high explosives from depleted uranium components. Emissions measured in 1981 by special tests were found to be no more than a few percent of the annual releases from the test shots just discussed.

Some depleted uranium accumulates on soil in the immediate vicinity of test-firing facilities and, to a lesser extent, near one of the waste high-explosives burn areas. Contaminated soil from the firing site is removed periodically, placed in drums, and sent to the Nevada Test Site for disposal. Residual contamination is limited to surface soil. Test holes drilled and sampled to a depth of 8.5 meters (28 feet) in the firing area [approximately 30 meters (100 feet) from the pads] indicated no depleted uranium below the land surface. Some depleted uranium contamination exists on the soil adjacent to the burning pad but the highest levels are about one-tenth those found near the firing sites (Buhl 1982). At greater distances extending to the plant boundary, the accumulations are much smaller.

Outside the site boundary, depleted uranium could not be measured above expected background levels (Buhl 1982). These measurements were made by analyzing for changes from the uranium-235 isotope to uranium-238 isotope ratio that naturally occurs in soil. The ratios measured were those expected for naturally occurring uranium. The 20 percent variation previously reported for total uranium concentrations in soil is natural variability (USERDA 1976).

Offsite water at Lake Meredith and offsite soil and sediment samples indicate no uranium contamination (Purtymun 1982A).

In addition to the direct dispersal, some of the depleted uranium on soil particles that have accumulated over time is resuspended. About 90 percent of the resuspension dose is attributed to the firing site and about 10 percent to the burn pad area. These contributions together result in increments of uranium in air that are so small that they cannot be measured directly in the environment. Therefore, airborne depleted-uranium concentrations attributable to Pantex Plant operations were derived by theoretical calculations.

Air sampling for radioactivity at the Pantex Plant is routinely accomplished through the use of continuously operating air samplers located around the plant. In addition, a special 12-month air sampling program for radioactive materials was conducted by the Los Alamos National Laboratory (Buhl 1982). Measured ambient annual average concentrations of depleted uranium from both sampling programs were very small, less than 0.01 percent of the Department of Energy Concentration Guides. The levels are typical of background from natural uranium in resuspended dust.

8.1.2.2 Tritium

Small quantities of tritium, a radioactive form of hydrogen, are occasionally released when shipping drums for tritium-containing components are opened. A second source of tritium is routine operations in the quality assurance section of the plant. Total annual releases of tritium are less than 0.1 curie. Background levels are hundreds of times more than calculated site-boundary air concentrations for those releases (Buhl 1982).

No tritium concentrations above naturally present background tritium was measured by special sampling of water, soils, and sediments (Purtymun 1982A). A detailed agricultural pathway study found only background levels of tritium in range soil, grass, feed, cattle tissue, and meat (Wenzel 1982A). Routine air sampling has not shown any above-background tritium levels in atmospheric water vapor (MHSM 1982, Laseter 1982A, MHSM 1983).

The small amount of tritium released is about the same as that generated naturally in the atmosphere by cosmic rays over any land area the size of the Pantex Plant. Thus, the amount of tritium released by routine operations is <0.5 percent of the naturally produced tritium within an 80-kilometer (50-mile) radius of the Pantex Plant.

8.1.2.3 Plutonium

Plutonium is also handled at Pantex Plant, but only as solid forms in sealed containers. No release of plutonium is expected from normal operations. Monitoring has found no detectable plutonium concentrations in the Pantex Plant vicinity other than that expected from worldwide fallout. The measured values of plutonium on soils both on and off the Pantex Plant site were statistically identical, and they averaged less than one-half of the value determined to be the average for U.S. soils by the Environmental Protection Agency in the mid-1970's (Purtymun 1982A, USEPA 1977).

8.1.3 Food and Agricultural Pathways

A special study was undertaken for this Environmental Impact Statement to evaluate food and agricultural pathways. Foodstuffs (garden vegetables and beef cattle) from the Pantex Plant site were sampled and analyzed for several radionuclides (tritium, uranium, and plutonium). All foodstuffs sampled were found to be at background levels. There are no indications of any contamination of garden and livestock products grown on or near the Pantex Plant site (Wenzel 1982A, Buhl 1982). A brief description of the methodology and the results are presented here. Detailed results and methodologies are presented in the reference documents.

Garden vegetables were sampled from one garden on the Pantex Plant site, six on the perimeter, and nine in Claude, Texas, as a control. Claude is located about 25 miles southeast of the Pantex Plant, a direction unlikely to be affected in any way by Pantex Plant operations. Major vegetables gathered in

1981 were tomatoes, cucumbers, corn, okra, and black-eyed peas. These samples were prepared for analysis by washing in the normal manner as if they were to be eaten. Total uranium, tritium, and plutonium analyses indicated no statistically significant difference between the Pantex Plant garden vegetables and the Claude garden vegetables for these radionuclides (Buhl 1982). These analyses show that foodstuffs grown on or near Pantex Plant do not contain levels of tritium, total uranium, or plutonium in quantities above normal background levels. Therefore, these foodstuffs show no effect from the Pantex Plant operations.

Another food chain pathway to man was investigated by sampling the soil, native vegetation, grain, cattle tissues, and meat products. A leased Pantex Plant range being grazed by cattle owned by a local rancher was sampled for soil and vegetation. The range was approximately 200 acres in size, east of the Pantex Plant burning site and contained a small, dry playa. Ten heifers were purchased from the range site. Two animals were immediately butchered and dissected; selected tissue and meat samples were taken from these control animals. The remaining eight were placed in the onsite Texas Tech University Research Farm feedlot to be fed on milo raised near the Pantex Plant site. Twenty additional heifers were purchased at auction and four were immediately butchered and dissected as controls. Eight animals went to the Bushland, Texas, USDA feedlot as treatment controls and eight animals went to the Pantex Plant feedlot as a second treatment of feeding livestock grains grown at the Pantex Plant. All samples were analyzed for tritium, total uranium, and plutonium. These analyses showed no detectable differences between the cattle raised on or near the Pantex Plant and those raised in Bushland. The largest source of uranium in the cattle feed was found to be the commercial mineral supplements typically fed to cattle in the area (Wenzel 1982A).

Farming and ranching on and around the Pantex Plant facilities can be considered a land use activity compatible with the Pantex Plant. There is no indication that routine operations result in any effect to the public from consumption of foodstuffs grown there.

8.1.4 Calculation of Doses

Radiation doses to the public from current routine operations of the Pantex Plant and past operations at the Iowa Army Ammunition Plant are so small that they cannot be detected above natural background by environmental field measurements. Since the doses cannot be directly measured, they were indirectly estimated by a computer model AIRDOS-EPA (Moore 1979) using site-specific meteorological, demographic, agricultural, and emissions data. Doses due to radioactive material released into the environment were calculated for inhalation and ingestion of deposited material incorporated into vegetables, meat, and milk, and exposure to external radiation due to airborne radiation and radionuclides deposited on the ground (Buhl 1982). Radiation doses in 1981 resulting from Hanford Site operations were taken from Sula et al. (Sula 1982). Those doses were based on evaluation of pathways similar to those considered for the Pantex Plant and Iowa Army Ammunition Plants.

The internal radiation dose for a particular organ calculated by the computer model is the 50-year dose commitment, the dose to the organ that an individual would receive during the 50 years following intake of a radionuclide into the body. The 50-year dose commitment was calculated for 1 year of exposure at estimated radionuclide concentrations in air, food, or water.

Distributions of the population living within 80 kilometers (50 miles) of the Pantex Plant, the Iowa Army Ammunition Plant, and Hanford Site were determined in a special study undertaken for the dose calculations in this impact statement (LATA 1982). Data describing agricultural practices and productivity were taken from annual reports published by state and Federal agriculture departments (Texas 1980, Iowa 1981, Illinois 1981), and reports by Shor (1982) and McCormack (1981). Meteorological dispersion parameters for test shots releasing depleted uranium were calculated from standard procedures for puff releases (Buhl 1982). Dispersion parameters for the coal-fired power plant and resuspension of soil at firing sites were calculated by standard procedures for plume-type releases. Dispersion and dose calculations for the potential accident releases are summarized in Section 4.2 of the impact statement and detailed in several references (Dewart 1982, Elder 1982B, Wenzel 1982D).

8.1.5 Calculation of Health Effect Risks

Potential somatic and genetic health effects from routine radioactive emissions and natural background radiation were calculated using risk factors from BEIR III (BEIR III 1980) and the calculated doses. In calculating added risk of cancer mortality, a linear no-threshold relationship between dose and response was assumed for radiation with high linear energy transfer, such as alpha particles emitted by uranium. The linear quadratic model was used for low linear energy transfer radiation from natural background and tritium exposure. In estimating genetic effects, a linear no-threshold dose-response relationship was used. The risk of genetic disorder per live-born offspring in all subsequent generations was calculated (Buhl 1982).

The magnitude of risk associated with exposure to ionizing radiation is a point of controversy, especially for low dose or low-dose rate exposures. There is a disagreement over use of a purely linear dose-response model for low linear energy transfer radiation. However, this debate does not affect conclusions presented in this Environmental Impact Statement for health effects due to Pantex Plant routine releases. This is because the principal Pantex Plant releases are high-linear energy transfer radiations. The principal radioactive material routinely released from Pantex Plant is depleted uranium. Radiation dose from depleted uranium is almost entirely due to its high linear transfer alpha radiation, for which there is general agreement concerning risk. The small amounts of tritium that are released are of secondary importance compared to depleted uranium, which accounts for over 99 percent of the radiation risk to the public from Pantex Plant operations.

Similarly, the debate does not affect conclusions regarding potential doses or risks calculated for the various accident scenarios. The principal radiological dose would be attributable to weapons-grade plutonium, which is also predominantly an alpha particle emitter. The dose calculation models for the accident analysis are summarized in Section 4.2 of the main report and details are presented in a reference document (Elder 1982B).

The calculation of cancer risk due to natural background radiation is affected by the model used. The reader is referred to Buhl (1982), where added cancer risk is calculated for different dose response models.

8.2 GLOSSARY

Acre-Foot	The amount of water 1 foot deep required to cover 1 acre (43,560 cubic feet, or 326,000 gallons, or 1,234,000 liters).
Activation	The process of inducing radioactivity by bombardment with neutrons or other types of radiation.
Activity	A measure of the rate at which radioactive material is emitting radiation, usually given in terms of the number of nuclear disintegrations occurring in a given quantity of material over a unit of time. The special unit of activity is the curie (Ci).
Airborne Radioactive Material	Radioactive particulates, mists, and/or gases in air.
ALARA	An acronym for the philosophy to maintain exposure to radiation As Low As Reasonably Achievable.
Alpha Particle	A positively charged particle consisting of two protons and two neutrons, identical to the nucleus of a helium atom; emitted by several radioactive substances.
Ambient	Surrounding, especially of or pertaining to the environment about a body but undisturbed or unaffected by it, as in ambient air.
Animal Unit	The grazing equivalent of one mother cow plus her calf.
Aquatic	Living or growing in, on, or near water; having a water habitat.
Aquifer	A subsurface formation containing sufficient saturated permeable material to yield significant quantities of water.
Aquiclude	A porous formation that absorbs water slowly, and will not transmit it fast enough to furnish an appreciable supply for a well or spring.
Artifact	An object or portions of an object produced or shaped by human workmanship, especially a tool, weapon, or ornament of archaeological or historical interest.
Assembly Bay	A specially designed structure used for certain nuclear weapons operations; see Section 1.4.1.
Assembly Cell	A specially designed structure used for certain nuclear weapons operations; see Section 1.4.1.

Background Radiation	The radiation normally present in man's natural environment. It results from cosmic rays and the naturally radioactive elements of the earth, including those from within the human body, and worldwide fallout from nuclear weapons tests.
Backwash Water	Water or waves thrown back by an obstruction.
Beta Particle	An electron or positron emitted from a nucleus during the radioactive transformation of a nuclide in which the atomic number decreases by unity with no change in mass number.
Bioaccumulation	The process of taking up and storing elements or compounds in living tissue (plant or animal).
Biological Oxygen Demand (BOD)	A measure of the organic pollution of water determined by the extent to which bacteria and other organisms in a water sample will use dissolved oxygen in a given period of time; therefore, a measure of the residual oxygen in the water available for use by other organisms such as fish.
Biota	All of the named or namable organisms of an area; fauna plus flora of a region.
Blowdown	The process whereby 5 to 10 percent of the water within a wet-type cooling tower is continually drained off and replenished with a fresh supply to prevent the excessive concentration of certain salts, minerals, and other constituents within the system.
Caliche	A calcium carbonate deposit formed in the surface rocks of arid regions.
Cased High Explosive	A high explosive encapsulated so that no surfaces of the high explosive remain exposed.
Cold-Water Fishery	An aquatic ecosystem that maintains the proper temperature range to support species of the Salmonidae family (soft-rayed fish including the trouts, salmons, whitefishes, and graylings).
Computer Model	A representation or abstraction of a real system in which the important features of the real system and the relationships between these important features are defined quantitatively and expressed in a series of equations from which computer calculations can be performed to make inferences about the behavior of the real system.

Concentration Guide	The average annual concentration of a radionuclide in air or water to which a worker or member of the general public may be continuously exposed without exceeding radiation dose standards. The quantitative values applicable to either members of the general public (Uncontrolled Area Concentration Guides) or workers (Controlled Area Concentration Guides) are given in Chapter XI of reference USDOE 1980A. Throughout this impact statement, comparisons to Concentration Guides are made with Uncontrolled Area Concentration Guides for any circumstances where the general public could be exposed.
Contamination (contaminated material)	The deposition or infiltration of radionuclides on or into an object, material, or area, which then is considered to be "contaminated."
Conventional High Explosive	See High Explosive.
Cool Desert	An arid tract that exists far enough from the equator to have cold winters and is incapable of supporting a significant population without an artificial water supply.
Credible Event	An event whose probability of occurrence is above a specified threshold (used in this document to mean 1 chance in a million each year).
Crib	A porous underground structure for disposal of low-level liquid wastes.
Criticality	State of being critical; a self-sustaining neutron chain reaction (where the rates of production and loss of neutrons are exactly equal and there is no other neutron source).
Critical Wildlife Habitat	A habitat that is necessary to sustain the existence and/or perpetuation of a species at critical periods during its life cycle.
Cultural Resource	Nonrenewable remains of human activities, occupations, and endeavors as reflected in sites, buildings, structures, or objects, including works of art, architecture, and engineering. Cultural resources can be either prehistoric or historic, but each period represents a part of the full continuum of cultural values from the earliest to the most recent.
Cultural Resource Survey	An intensive examination of an area for the purpose of discovering and recording archaeological resources.

Curie (Ci)	A unit of radioactivity defined as the amount of a radioactive material that has an activity of 3.7×10^{10} disintegrations per second.
Daughter Products	The nuclides formed in the radioactive disintegration of a first nuclide (parent). In many cases, the daughter nuclides also may be radioactive.
Decay Chain	The sequence of radioactive disintegrations from one nuclide to another until a stable daughter is reached.
Deciduous	Vegetation on which the leaves shed or fall off at the end of a growing season, leaving bare stems.
Decommissioning	The execution of a planned and orderly program to take something out of service completely or partially.
Decontamination	The removal of radioactive or toxic material from a surface or from within another material.
Depleted Uranium	Uranium having a smaller percentage of uranium-235 than the 0.7 percent found in natural uranium. (See Natural Uranium.)
Dispersion	A process of mixing one material within a larger quantity of another. For example, the mixing of material released to the atmosphere with air causes a reduction in concentrations with distance from the source.
Dose	Also referred to as dose equivalent. Expressed in units of rem, implies a consistent basis for estimates of consequential health risk, regardless of rate, quantity, source, or quality of the radiation exposure.
Dose Commitment	The dose commitment refers to the radiation dose received during some period of exposure (normally either the duration of an acute, accidental release of radionuclides to the environment, or for 1 year of a chronic release) plus the dose accumulated over a period of years (50 years used for this document) resulting from radionuclides deposited within the body during the exposure period.
Dose Rate	The radiation dose delivered per unit time and measured, for instance, in rems per hour or millirems per year.
Dryland Farming	Production of agricultural crops using only natural precipitation for watering the crops.

Ecological Pathway	The route within an ecosystem by which a substance or compound is transferred from one level of a food chain to another.
Ecology	The branch of biological science that deals with the relationships between organisms and their environment.
Ecosystem	A habitat and its biota.
Effluent	Liquid that flows away from a discharge point, typically, as sanitary sewage or industrial process liquid wastes.
Emission	Any release of materials or compounds into the environment, typically, substances discharged into the air.
Endangered Species	Any animal or plant species in danger of extinction throughout all or a significant portion of its range.
Enriched Uranium	Uranium having a higher percentage of uranium-235 than the 0.7 percent found in natural uranium. (See Natural Uranium.)
Environmental Surveillance	A program to monitor changes in a surrounding region.
Eolian	The action or effect of the wind.
Epidemiology	The study of diseases in a population.
Escarpment	A cliff or steep slope of some extent, generally separating two levels or gently sloping areas, and produced by erosion or faulting.
Evapotranspiration	Discharge of water from the earth's surface to the atmosphere by evaporation from lakes, streams, and soil surfaces plus the transpiration from plants.
Exposure	The condition of being made subject to radiation.
Fallow	Land normally used for crop production but unused for one or more growing seasons.
Faulting	The movement that produces relative displacement of adjacent rock masses along a fracture.
Fauna	Animals or animal life.
Federal Impact Funds	Monies paid to local school districts or governments to pay for community services required by the presence of Federal activity.

Fission Products	The nuclides formed by the division of a heavier nucleus, usually in a nuclear reactor.
Floodplain	A level tract of land bordering rivers and formed by alluvial deposits that may be submerged by overflowing river water.
Flora	Plants or plant life.
Food Chain	A linear sequence of successive use of nutrient energy by a series of species.
Forb	Broad-leafed, nonwoody plant.
Fugitive Dust	"Fugitive Emissions" are those emissions released directly into the atmosphere, which could not reasonably pass through a stack, chimney, vent or other functionally equivalent opening. Fugitive dust means particulate matter composed of soil that is uncontaminated by pollutants resulting from industrial activity. Fugitive dust may include emissions from haul roads, wind erosion of exposed soil surfaces and soil storage piles, and other activities in which soil is either removed, stored, transported, or redistributed.
Gamma Ray	A high-energy photon such as that emitted by a nucleus in a transition between two energy levels.
Genetic	Information in the nucleotide sequences in deoxyribonucleic acid (DNA) that controls biological inheritance by determining the nature of all cell substances, cell structures, and cell effects.
Gravel Gertie	A specially designed structure that meets the requirements of an assembly cell used for certain nuclear weapons operations; see Section 1.4.1.
Ground Water	Water that exists or flows below the earth's surface (within the zone of saturation).
Ground Water Recharge	The process whereby water is fed back into the ground water system.
Habitat	The natural home or dwelling place of an organism.
Half-Life	The time required for the activity of a radionuclide to decay to half its value. It is used as a measure of the persistence of radioactive materials. Each radionuclide has a characteristic constant half-life.

Hectare	A unit of area in the metric system equal to 10,000 square meters.
High-Efficiency Particulate Air (HEPA) Filters	A filter capable of removing from an air stream at least 99.97 percent of the particulate material that is greater than 0.3 micrometers in diameter.
High Explosive	Metastable compounds and mixtures that react to give off gas products at high temperatures and pressures at energies of 10^{10} watts per square centimeter on a reaction zone that propagates at a velocity of 5 to 10 kilometers per second.
High Linear Energy Transfer	Types of radiation that result in the deposit of energy in a material at a high rate per unit distance traveled. In this document, alpha particles are the principal High LET radiation of interest.
Historic Properties	Districts, sites, structures, objects, and other evidence of human use considered to be of cultural and/or historic value; may be eligible for nomination to the National Register of Historic Places.
Hood	A canopy and exhaust duct used to confine hazardous materials and thus reduce the exposure of industrial workers.
Hydrology	The science dealing with the waters of the earth, their distribution on the surface and underground, and the cycle involving precipitation, flow to the seas, evaporation, and so on.
Igloo	An earth-covered facility used to temporarily hold high explosives or nuclear weapons.
Induced Employment	Jobs created in the market place by filling the needs of the new employer and his employees; typically in the area of service-oriented businesses such as restaurants, adding extra help to accommodate the increased business.
In-Migration	Movement of population into a community or region.
Inversion	A condition existing when temperature increases with height in the atmosphere.
Isotope	Nuclides with the same atomic number (that is, the same chemical element) but with different atomic masses. Although chemical properties are the same, radioactive and nuclear properties may be quite different for each isotope of an element.

Kilovolt (kV)	The electromotive unit of force equal to 1,000 volts.
Kilowatt (kW)	One thousand watts.
Kilowatt-hour (kWh)	A basic unit of electrical energy that equals 1 kilowatt of power applied for 1 hour.
Lithic Scatter	A concentrated area of rock material including projectile points, utilized flakes, cores, and debitage.
Loam	A soil consisting of a mixture of clay, silt, and sand in roughly equal proportions.
Low Linear Energy Transfer	Types of radiation that result in the deposit of energy in a material at a low rate per unit distance traveled; in this document x rays, gamma rays, and beta particles are the principal Low LET radiations of interest.
Macro Invertebrate	The large insects; organisms without a backbone and internal skeleton.
Man-Rem	A unit of population dose, calculated by adding together the individual doses (expressed in rems) of a given population.
Maximum Individual	A hypothetical individual whose location and habits tend to maximize his radiation dose, resulting in a dose higher than that received by other, more typical, individuals in the general population. In this document, the maximum individual is located offsite.
Megawatt (MW)	One million watts or 1 thousand kilowatts.
Meteorology	Science of the atmosphere.
Metric Ton (MT)	One thousand kilograms or 2,205 pounds.
Mitigation	Any of the following: (1) avoiding the impact altogether by not taking an action or part of an action; (2) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (3) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; (5) compensating for the impact by replacing or providing substitute resources or environments.

Mixing Height	The height of the well-mixed atmospheric layer beneath a stable layer.
Monitoring	Making measurements or observations for recognizing the status or adequacy of, or significant changes in, conditions or performance of a facility or area.
National Ambient Air Quality Standards (NAAQS)	The allowable concentrations of air pollutants in the ambient air specified by the Federal government for SO_2, TSP, NO_X, HC, O_3, and CO. The ambient air quality standards are divided into primary and secondary standards (based on the air quality criteria and allowing an adequate margin of safety). The primary standards are requisite to protect the public health. The secondary standards are requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of air pollutants in the ambient air.
National Register of Historic Places	A list of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, and culture, maintained by the Secretary of the Interior.
Natural Uranium	Uranium as found in nature, universally distributed in the lithosphere in varying concentrations and usually in equilibrium with its decay products. It contains about 99.3 percent of uranium-238 and about 0.7 percent of uranium-235.
Neutron	A particle existing in or emitted from the atomic nucleus; it is electrically neutral and has a mass approximately equal to that of a stable hydrogen atom.
Nonattainment Area	An area already characterized by significant levels of air pollution. Any significant increases in certain pollutants caused by new sources (industrial or power plant) are restricted.
Nonbasic Employment	See induced employment.
Nonnuclear Detonation	A chemical reaction within the high-explosive components of a nuclear weapon, which results in an explosion that can disperse radioactive materials in the weapon component but with no nuclear yield.
Nuclear Detonation	An energy release through a nuclear process that is equivalent to the detonation of more than four pounds of TNT within a few microseconds.

Nuclear Weapon	A packaged device capable of large energy release through nuclear processes within a few microseconds.
Nuclear Weapons Operations	In this document, collectively used to mean all operations associated with the production of new nuclear weapons; the maintenance, modification, and quality assurance testing of existing nuclear weapons in the military stockpile; and the retirement or disassembly of nuclear weapons.
Nuclide	A species of atom characterized by the number of protons, number of neutrons, and energy content of the nucleus; to be regarded as a distinct nuclide, the atom must be capable of existing for a measurable time period, generally greater than 10^{-10} seconds.
Nursery Crop	A crop planted to protect the seedlings of a slow-growing crop from exposure to the elements (wind, rain, and sun) until they are strong enough to survive.
Offsite	The area outside the boundary of a facility (that is, outside the property lines of the Pantex Plant, Iowa Army Ammunition Plant, or Hanford Site).
Onsite	The area inside the boundary of a facility (that is, inside the property lines of the Pantex Plant, Iowa Army Ammunition Plant, or Hanford Site).
Operational Reliability	The probability that the nuclear weapons operations system will continue to satisfactorily perform its intended function under various circumstances.
Order-of-Magnitude	Some small multiple of a quantity, usually means within a factor of 10.
Overpacked	Radioactive waste that has been double-packaged, sometimes because the original package has been damaged.
Overpressure	The transient pressure, usually expressed in pounds per square inch, exceeding existing atmospheric pressure and manifested in the blast wave from an explosion.
Particulate Matter	Finely divided solid material (for example, minute particles of coal dust, fly ash, and oxides temporarily suspended in the atmosphere).
Penetrating Radiation	A source of ionizing radiation with sufficient energy to go through tissue in the body (such as x rays, gamma rays, and energetic beta particles).

Permeability	A measure of the relative ease of fluid flow through porous rock, sediment, or soil.
Physics Package	The cased high explosive and nuclear material components of a nuclear weapon.
Phytotoxic	A substance toxic to plants.
Playa	A depression on a flat plain relatively free of vegetation, in which flood waters may create a lake.
Plutonium	A reactive metallic element in the transuranium series of elements used as nuclear fuel, used to produce radioactive isotopes for research, and used as a fissile agent in nuclear weapons.
Population Dose	The summation of the radiation dose (in rem) received by all individuals in a population group. Its use is principally for total body dose where it has units of man-rem (or person-rem). The technique is also used for collective total doses to specific organs.
Potentiometric	A measure of the static head of ground water and is defined by the level to which water will rise in an open hole.
Pressure Pulse	See Overpressure.
Prevention of Significant Deterioration Regulations	Regulations from EPA intended to protect clean air areas from degradation. Three area classes (I, II, III) are provided, which permit minimal, moderate and maximum increases to air pollution levels above existing conditions. The National Ambient Air Quality Standards may not be exceeded.
Prime Habitat	The optimal natural home or dwelling place of an organism.
Protected Species	Plants or animals that have some degree of state or Federal legal protection. The categories of threatened and endangered are associated with protected species.
Quality Assurance Testing	Testing and inspecting all or a portion of the various products to ensure that the desired quality level is achieved.
Radiation	(1) The emission and propagation of radiant energy: for instance, the emission and propagation of electromagnetic waves, or of sound and elastic waves. (2) The energy propagated through space or through a material medium: for example, energy in the form of alpha, beta, and gamma emissions from radioactive nuclei.

Radiation Protection Standard	Exposure standards for radiation exposure for an individual in the general public (USDOE 1980A).
Radioactive Material	Any material or combination of materials that spontaneously emits ionizing radiation.
Radioactivity	The property of certain nuclides of spontaneously emitting particles or electromagnetic radiation or of undergoing spontaneous fission. The quantity of radioactivity, usually shortened to "activity," is the number of nuclear transformations occurring in a given quantity of material per unit time. (See also curie.)
Radioactivity, Natural	The property of radioactivity exhibited by many naturally occurring radionuclides.
Radiography	The technique of producing a photographic image of an opaque specimen by transmitting a beam of x rays or gamma rays through it onto an adjacent photographic film.
Radioisotope	An isotope that exhibits radioactivity.
Radiological Protection	Protection against the effects of internal and external exposure to radiation and radioactive materials.
Radionuclide	A nuclide that exhibits radioactivity.
Raptor	Pertaining to a bird of prey.
Rare and Endangered Species	A species that through the loss of prime habitat or through extreme hunting pressure has declined in numbers to the point where it may be threatened with extinction.
rem	A unit of ionizing radiation, equal to the amount that produces the same damage to humans as 1 roentgen of high-voltage x rays. Derived from roentgen equivalent man.
Restricted Area	Any area to which access is controlled.
Roentgen	An exposure dose of x- or y-radiation such that the elections and positions liberated by this radiation produce, in air, when stopped completely, ions carrying positive and negative charges of 2.58×10^{-4} coulomb per kilogram of air.
Safe/Secure Railcar	A specially designed railcar for transporting nuclear weapons or by railroad.

Safe/Secure Trailer	A specially designed trailer for transporting nuclear weapons or certain nuclear weapon components.
Seismicity	The relative frequency and distribution of earthquakes.
Shielding	Material used to absorb radiation and thus protect personnel or equipment.
Silage	Green or mature fodder that is fermented to retard spoilage and to produce a succulent winter feed for livestock.
Somatic	Pertaining to the whole body of an individual, excluding the reproductive system.
Spawning Ground	The bottom of a body of water used by female aquatic life for depositing eggs, which are then fertilized by males of the species.
Standard Metropolitan Statistical Area (SMSA)	A definition employed by the U.S. Bureau of Census. Each SMSA must contain one city of not less than 50 thousand population or two contiguous cities with a combined minimum population of 50 thousand. An SMSA will, in general, encompass one or more entire counties in which the central city is located.
Stability (atmospheric)	A description of the effect of atmospheric forces on a parcel of air following vertical displacement in an atmosphere otherwise in hydrostatic equilibrium. If the forces tend to return the parcel to its original level, the atmosphere is stable; if the forces tend to move the parcel farther in the direction of displacement, the atmosphere is unstable; and if the air parcel tends to remain at its new level the atmosphere has neutral stability.
Steppe	A large semiarid grassland.
Stockpile Monitoring	Disassembly, inspection, and component testing of randomly sampled stockpile weapons and the denuclearization of randomly sampled weapons to be used in the joint DOE-DOD flight test program.
Stratigraphically	Pertaining to the form, arrangement, geographic distribution, chronologic succession, classification, correlation, and mutual relationships of rock strata, especially sedimentary rock.
Support Facilities	Those facilities not directly used for nuclear weapons operations, such as administration buildings, cafeterias, and garages.
Surface Water	All bodies of water on the surface of the earth.

Surveillance	Those activities necessary to ensure that the site remains in a safe condition (including inspection and monitoring of the site, maintenance of access barriers to radioactive materials left on the site, and prevention of activities on the site that might impair these barriers).
Terrestrial	Inhabiting or pertaining to the land.
Test Detonation	See Test Firing.
Test Explosion	See Test Firing.
Test Firing	The dynamic testing of high explosives or high-explosive components by detonating them at a firing site.
Test Shot	See Test Firing.
Thermal Contamination	Release of heat into the local environment such as hot water into cool streams.
Threatened Species	Any animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of their range.
Tillering	The process of a plant putting forth additional stalks.
Total Dissolved Solids	An aggregate of carbonates, bicarbonates, chlorides, sulfates, phosphates, and nitrates of calcium, magnesium, manganese, sodium, potassium, and other elements that form salts and are dissolved in water. High TSD values can adversely affect humans, animals, and plants. TSD is often used as a measure of salinity.
Trade Area	The geographic area sharing common general economic and social purpose as identified by the local Chamber of Commerce associations serving the several communities studied in this EIS (Amarillo Area; 11 counties; Burlington Area, 4 counties; and the Tri-Cities Area, 2 counties).
Tritium	The hydrogen isotope having a mass number 3; it is naturally radioactive and is constantly produced by cosmic rays in the atmosphere.
TSP	Total suspended particulates.
Uncased High Explosive	Bare or exposed high explosive.

Vegetation Type	A plant community with distinguishable characteristics; generally refers to the species or various combinations of species that have similar stature, morphology, and appearance, and that dominate or appear to dominate a site.
Warm-Water Fishery	An aquatic ecosystem that maintains the proper temperature range to support different species of the Centrarchidae family (spiny-rayed fish including the black basses and several sunfishes).
Wastes, Radioactive	Equipment and materials (from nuclear operations) that are radioactive and have no further economic use.
Water Table	Upper boundary of an unconfined aquifer surface below which saturated ground water occurs.
Weapons Maintenance	The periodic checking of all systems on a weapon and replacing components as necessary.
Weapons Retirement	The total disassemby of a weapon no longer required by the armed services.
Wind Rose	A diagram showing the distribution of prevailing wind directions at a given locations; some variations include wind speed groupings by direction.
Workload	See Nuclear Weapons Operations.

9. REFERENCES

ACGIH 1981: "Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment," American Conference of Governmental Industrial Hygienists, unnumbered report (1981).

Acquavella 1982: J. F. Acquavella, L. D. Wiggs, R. J. Waxweiler, D. G. Macdonell, and G. S. Wilkinson, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Occupational Work Force Mortality Study," report LA-9445-PNTX-Q (1982).

Allred 1956: B. W. Allred, "Mixed Prairie in Texas," in Grasslands of the Great Plains, J. E. Weaver and F. W. Albertson, Eds. (Johnson Publishing Company, Lincoln, Nebraska, 1956).

Amarillo 1979: "Amarillo, Texas, Proud New City of the Old West," Amarillo Board of City Development (1979).

Amarillo 1980: "Amarillo Community Profile," Amarillo Chamber of Commerce, Amarillo, Texas (1980).

Anderson 1982: Adrian D. Anderson, Iowa State Historic Preservation Officer, "Cultural Resources at Iowa Army Ammunition Plant," letter to K. Rea (March 19, 1982).

ANSI 1980: "Guidelines for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites," American National Standards Institute (ANSI) N-178 Draft 2 Revision 4 (April 1980).

Becker 1982A: N. M. Becker, Los Alamos National Laboratory, "Sewage Treatment Capacity at the Iowa Army Ammunition Plant," letter to W. D. Purtymun, H8-82-57 (February 8, 1982).

Becker 1982B: N. M. Becker and W. D. Purtymun, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Hydrologic Study for Pantex," report LA-9445-PNTX-A (1982).

Becker 1982C: N. M. Becker, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Hydrologic Study for the Iowa Army Ammunition Plant," Los Alamos National Laboratory report LA-9445-PNTX-B (1982).

BEIR III 1980: National Research Council, Committee on the Biological Effects of Ionizing Radiations, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation: 1980," National Academy Press, Washington, D.C. (1980).

Bell 1979: A. E. Bell and S. Morrison, "Analytical Study of the Ogallala Aquifer in Carson County, Texas," Texas Department of Water Resources report 242 (November 1979).

Biringer 1982: B. E. Biringer, Sandia National Laboratories, "Aircraft Impact Analyses, Burlington and Hanford Alternatives," letter to H. L. Horak (May 6, 1982).

Blume 1976: J. A. Blume and Associates, "Seismic Hazards and Building Structure Behavior at the Pantex Facility," prepared for USERDA, Amarillo Area Office (April 1976).

Bowen 1981: B. Bowen, Los Alamos National Laboratory, "Pollutant Air Concentration Surrounding Pantex, letter to L. Wiggs, H8-81-549 (May 15, 1981).

Briscoe 1981: G. J. Briscoe, EG&G Idaho, "Extreme Value Analysis and Loss Statistics," letter to H. L. Horak, BRI-16-81 (December 18, 1981).

Buhl 1982: T. Buhl, J. Dewart, T. Gunderson, D. Talley, J. Wenzel, R. Romero, J. Salazar, and D. Van Etten, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Radiation Monitoring and Radiological Assessment of Routine Releases," Los Alamos National Laboratory report LA-9445-PNTX-C (1982).

Buhl 1983: T. Buhl and J. Dewart, Los Alamos National Laboratory, "Shipment of Soil from Pantex to the Nevada Test Site," letter to A. Stoker, HSE8-83-393 (June 28, 1983).

Burlington 1981A: Linda M. Schulte, "Burlington Fire Department organization," letter to Craig Woodworth June 4, 1981.

Burlington 1981B: Kenneth L. Velharticky, "Burlington Facts and Figures," letter to Don Rapp September 28, 1981).

Butler 1983: R. I. Butler, Sandia National Laboratories Albuquerque, Safety Assessment Technology, Division 7233, "Probability of a Threshold Aircraft Crash into the Pantex Facility," letter to A. Stoker (June 21, 1983).

CBA 1981: "Amarillo International Airport, Environmental Impact Assessment Report," Cress-Bandy and Associates, Inc. (July 1981).

Chamberlin 1982: W. S. Chamberlin, H. L. Horak, and D. G. Rose, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Selected Topics of Accident Analysis," Los Alamos National Laboratory report LA-9446-PNTX (SRD) (1982).

Cohen 1979: A. F. Cohen and B. L. Cohen, "Infiltration of Particulate Matter into Buildings," U.S. Nuclear Regulatory Commission report NUREG/CR-1151, Sandia Laboratories report SAND 79-2079 (November 1979).

Cooper 1981: D. W. Cooper, W. C. Hinds, J. M. Price, "Expedient Methods of Respiratory Protection," U.S. Nuclear Regulatory Commission report NUREG/CR-2272, Sandia National Laboratories report SAND 81-7143 (November 1981).

Cowan 1964: M. Cowan, "Measurements from Gravel Gertie Tests," Sandia Laboratories report SC-R-64-127 (July 1964).

Cronin 1964: J. G. Cronin, "Summary of the Occurrence and Development of Ground Water in the Southern High Plains of Texas," U.S. Geological Survey Water Supply Paper 1693 (1964).

Davis 1973: D. D. Davis, "Air Pollution Damages - Trees," U.S. Forest Service report (1973).

Dawson 1974: G. W. Dawson, "The Chemical Toxicity of Elements," Pacific Northwest Laboratories report BNWL-1815 (June 1974).

Day 1942: "Log of Deep Wells Numbered 500-165-1: 500-165-2: 500-165-3: 500-165-4," Day and Zimmerman, Inc. (1942).

Dewart 1982: J. M. Dewart, B. Bowen, and J. C. Elder, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Dispersion Analysis for Postulated Accidents," Los Alamos National Laboratory report LA-9445-PNTX-D (1982).

Dobratz 1981: B. M. Dobratz, "LLNL Explosives Handbook: Properties of Chemical Explosives and Explosive Simulants," Lawrence Livermore National Laboratory report UCRL-52997 (1981).

Eddy 1981: P. A. Eddy and J. S. Wilbur, "Radiological Status of the Ground Water Beneath the Hanford Site, January-December 1980," Battelle-Pacific Northwest Laboratory report PNL-3768 UC-41 (1981).

Elder 1982A: J. C. Elder, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Review of Occupational Exposures to Radiation," LA-9445-PNTX-E (1982).

Elder 1982B: J. C. Elder, R. H. Olsher, and J. M. Graf, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Radiological Consequences of Immediate Inhalation of Plutonium Dispersed by Postulated Accidents," Los Alamos National Laboratory report LA-9445-PNTX-F (1982).

Elle 1981: D. R. Elle, DOE Richland Operations Office, "Threatened or Endangered Species at Hanford Site," letter to Ken Rea (December 18, 1981).

Elle 1982: D. R. Elle, DOE Richland Operations Office, "Native Americans near Hanford Site," letter to Ken Rea (August 6, 1982).

ERG 1981: "Iowa Army Ammunition Plant Contamination Report, Mason and Hanger-Silas Mason Co., Middletown, Iowa," Environmental Research Group Inc. Contract Number AAA09-78-C-3008 (October 1981).

Finley 1980: N. C. Finley, D. C. Aldrich, S. L. Daniel, D. M. Erickson, C. Henning-Sachs, P. C. Kaestner, N. R. Ortiz, D. D. Sheldon, J. M. Taylor, and S. F. Henied, "Transportation of Radionuclides in Urban Environs: Draft Environmental Assessment," Sandia Laboratories report SAND 79-0369 (1980).

Fitzner 1979: R. E. Fitzner and W. C. Hanson, "A Congregation of Wintering Bald Eagles," Condor 81, 311-313 (1979).

Fitzner 1980: R. E. Fitzner, "Impacts of a Nuclear Energy Facility on Raptorial Birds," in Workshop on Raptors and Energy Developments (Idaho Chapter of the Wildlife Society, January 25-26, 1980) pp. 9-33.

Friend 1965: J. P. Friend and D. M. C. Thomas, "The Determination of Particle Size Distribution of the Particulate Material Collected During the Double Tracks and Clean Slate 1 Events of Operation Roller Coaster," United Kingdom Atomic Energy Authority, Atomic Weapon Research Establishment report AWRE No. O-20/65 (Feburary 1965).

Fujita 1979: T. T. Fujita, "Tornado and High Wind Risks at Pantex Plant, Texas," Lawrence Livermore National Laboratory informal report for task number 4 of purchase order 4204909 (September 1979).

Gephart 1979: R. E. Gephart, R. C. Arnett, R. G. Baca, L. S. Leonhart, and F. A. Spane, Jr., "Hydrologic Studies within the Columbia Plateau, Washington: An Integration of Current Knowledge," Rockwell Hanford Operations Energy Systems Group report RHO-BWI-ST-5 (October 1979).

Hagood 1970: M. A. Hagood, D. E. Miler, and E. C. Larsen, "Water Holding Capacities of Columbia Basin Irrigation Project Soils," Washington Agricultural Experimental Station circulation 517, Washington State University (1970).

Healy 1977: J. W. Healy, "An Examination of the Pathways from Soil to Man for Plutonium," Los Alamos Scientific Laboratory report LA-6741-MS (1977).

Healy 1979: J. W. Healy and J. C. Rodgers, "Limits for the Burial of the Department of Energy Transuranic Wastes," Los Alamos Scientific Laboratory document LA-UR-79-100 (January 1979).

Herrington 1982A: LaVerne Herrington, Texas Historical Commission, "National Register Sites and Archaeology Near Pantex Plant," letter to Ken Rea (February 19, 1982).

Herrington 1982B: LaVerne Herrington, Texas Antiquities Committee, "Native Americans Near Pantex Plant," letter to Ken Rea (March 22, 1982).

Hirsch 1968: F. G. Hirsch, "Effects of Overpressure on the Ear--A Review," Annuals of the New York Academy of Sciences 152, 147-162 (1968).

Holzworth 1972: G. C. Holzworth, "Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States," U.S. Environmental Protection Agency Office of Air Programs report AP-101, Research Triangle Park, North Carolina (January 1972).

Honea 1973: F. I. Honea, W. A. Bullerdick, J. E. Wichmann, and T. K. Mehrhoff, "Disposal of Waste or High Explosives," Mason and Hanger-Silas Mason Co., Inc., report MHSMP-73-29 (1973).

Houston 1974: J. R. Houston, D. L. Strenge, and E. C. Watson, "DACRIN: A Computer Program for Calculating Organ Dose from Acute or Chronic Radionuclide Inhalation," Battelle-Pacific Northwest Laboratory report BNWL-B-389 (December 1974).

Houston 1980: J. R. Houston and P. J. Blumer, "Environmental Surveillance at Hanford for CY-1979," Battelle-Pacific Northwest Laboratory report PNL-3283 (1980).

Hughes 1981: J. T. Hughes and R. D. Speer, "An Archaeological Survey of the Pantex Plant, Carson County, Texas," Mason and Hanger-Silas Mason Co., Inc. (July 1981).

IAAP 1974: "Land Management Plan, Iowa Army Ammunition Plant," U.S. Army, Middletown, Iowa (1974).

IAAP 1979: "Iowa Army Ammunition Plant - Installation Environmental Impact Assessment," U.S. Army, Middletown, Iowa (December 1979).

IAAP 1981: "Protecting our Natural Environment," Iowa Army Ammunition Plant, Middletown, Iowa, unnumbered report (1981).

ICRP 1966: "Deposition and Retention Models for Internal Dosimetry of the Human Respiratory Tract," International Commission on Radiological Protection, Health Phys. 12(2), 173-207 (1966).

ICRP 1972: "The Metabolism of Compounds of Plutonium and Other Actinides," International Commission on Radiological Protection report ICRP 19 (1972).

ICRP 1974: "Report of the Task Group on Reference Man," International Commission on Radiological Protection report ICRP 23 (October 1974).

ICRP 1977: "Recommendations of the ICRP," International Commission on Radiological Protection report ICRP 26 (1977).

ICRP 1980: "Biological Effects of Inhaled Radionuclides," International Commission on Radiological Protection report ICRP 31 (1980).

IJS 1980A: "Commuting Patterns in Southeast Iowa," Iowa Job Service unnumbered report (1980).

IJS 1981A: Larry J. Holtkamp, Iowa Job Service, "Labor Force Information," letter to Donald Rapp (December 8, 1981).

IJS 1981B: "Commuting Patterns in Southeast Iowa, 1981," Iowa Job Service unnumbered report (1981).

Illinois 1981: "Illinois Agricultural Statistics Annual Summary 1981," U.S. Department of Agriculture and Illinois Department of Agriculture, Illinois Cooperative Crop Reporting Service (1981).

Iowa 1981: "Iowa Agricultural Statistics 1981," U.S. Department of Agriculture and Iowa Department of Agriculture, Iowa Crop and Livestock Reporting Service (1981).

Jacobsen 1970: J. S. Jacobsen and A. C. Hill, "Recognition of Air Pollution Injury to Vegetation: A Pictorial Atlas," Air Pollution Control Association information report No.1, Pittsburgh (1970).

Jamison 1981: J. D. Jamison, "Standardized Input for Hanford Environmental Impact Statements Part II: Site Description," Battelle-Pacific Northwest Laboratory report PNL-3509 (May 1981).

Johnson 1978: M. S. Johnson, R. W. Drake, P. F. Jones, J. S. Dittig, and C. W. Berndt, "Nuclear Explosives Abnormal Environments at the U.S. Pantex Plant," Mason and Hanger-Silas Mason Co., Inc., report MHSMP-78-4 (CRD) (February 1978).

Johnson 1981: M. Johnson, "Iowa Air Quality Annual Report for 1980," State of Iowa, Des Moines, Iowa (July 1981).

Kelly 1972: Francis J. Kelly, M.D., and Bobby D. Lemons, "Radiation Decontamination Facility for the Community Hospital," Journal of Medicine Vol.14 No. 12 (December 1972).

Knight 1982: J. P. Knight, "Supplementary Safety Evaluation Input - Geology and Seismology - Washington Nuclear Plant #2," Memorandum to R. L. Tedesco, U.S. Nuclear Regulatory Commission (June 29, 1982).

Krivokapich 1976: B. E. Krivokapich, "An Assessment of the Probability of Aircraft Impact with Pantex Plant Structures," Sandia Laboratories report SAND 76-0120 (June 1976).

Lacasse 1969: N. L. Lacasse and W. J. Moroz, Handbook of Effects Assessment - Vegetation Damage (Center for Air Environment Studies, Pennsylvania State University, 1969).

Laseter 1982: W. A. Laseter, Mason and Hanger-Silas Mason Co., Inc., "Utilities Consumption and Solvent Consumption at Pantex Plant," letter to Ken Rea (April 27, 1982).

Laseter 1982A: See p. 10-31 of this document.

LATA 1981: "Suitability Evaluation of Candidate Sites for Nuclear Weapons Assembly Facilities," Los Alamos Technical Associates, Inc., report LATA-LSL-25-02, Volumes 1-3 (July 1981).

LATA 1982: J. M. Greenwood and T. M. Rudell, "1990 Population Forecasts for the Pantex, Burlington, and Hanford Areas," Los Alamos Technical Associates (February 1982).

Long 1961: A. T. Long, "Geology and Ground-Water Resources of Carson County and Part of Gray County, Texas, Progress Report No. 1," Texas Board of Water Engineers Bull. 6102 (March 1961).

Luna 1969: R. E. Luna and H. W. Church, "DIFOUT: A Model for Computation of Aerosol Transport and Diffusion in the Atmosphere," Sandia Laboratories report SC-RR-68-555 (January 1969).

Macdonell 1982: D. G. Macdonell and J. M. Dewart, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Estimated Releases and Downwind Concentrations of Air Pollutants from Waste Organic Solvent Evaporation, Waste High Explosive Burning, and High Explosive Test Shots," Los Alamos National Laboratory report LA-9445-PNTX-G (1982).

McCormack 1981: W. D. McCormack, "Hanford Dose Overview Program Report," Battelle-Pacific Northwest Laboratory report PNL-3777 (1981) (Draft).

McDonald 1979: J. R. McDonald, "Assessment of Tornado and Straight Wind Risks at the Pantex, Texas, Site," McDonald, Mehta, and Minor, Consulting Engineers, Lubbock, Texas (December 1979).

McGrath 1978: P. E. McGrath, "Consequences of a Major Nuclear Reactor Accident after Initial Deposition of Released Radioactivity," Sandia Laboratories report (1978) (Draft).

MHSM 1971B: "Design Criteria for Critical Materials Support Facility," Mason and Hanger-Silas Mason Co., Inc., Burlington, Iowa (December 1971).

MHSM 1973: "Environmental Monitoring and Pollutant Inventory Program Report for Pantex Plant Covering Calendar Year 1972," Mason and Hanger-Silas Mason Co., Inc. (March 1973).

MHSM 1975A: R. E. Alexander, "Environmental Monitoring Report for Pantex Plant Covering 1974," Mason and Hanger-Silas Mason Co., Inc., report MHSMP-75-8 (May 1975).

MHSM 1975B: T. J. Koger, "On-Site Environmental Monitoring Report for Pantex Plant Covering 1974," Mason and Hanger-Silas Mason Co., Inc. (August 1975).

MHSM 1976: R. E. Alexander, "Environmental Monitoring Report for Pantex Plant Covering 1975," Mason and Hanger-Silas Mason Co., Inc., report MHSMP-76-8 (March 1976).

MHSM 1977A: R. E. Alexander, "Environmental Monitoring Report for Pantex Plant Covering 1976, Draft," Mason and Hanger-Silas Mason Co., Inc., report MHSMP-77-7 (March 1977).

MHSM 1977B: "On-Site Environmental Monitoring Supplement for Pantex Plant Covering 1976," Mason and Hanger-Silas Mason Co., Inc. (September 1977).

MHSM 1978: R. E. Alexander and C. N. Horton, "Environmental Monitoring Report for Pantex Plant Covering 1977," Mason and Hanger-Silas Mason Co., Inc., report MHSMP-78-7 (March 1978).

MHSM 1979A: R. E. Alexander and V. A Cornelius, "Environmental Monitoring Report for Pantex Plant Covering 1978," Mason and Hanger-Silas Mason Co., Inc., report MHSMP-79-24 (May 1979).

MHSM 1979B: R. E. Alexander and V. A. Cornelius, "Supplement to Environmental Monitoring Report for Pantex Plant Covering 1978 - DRAFT," Mason and Hanger-Silas Mason Co., Inc., report MHSMP-79-36 (June 1979).

MHSM 1979C: "Scope of Work for Upgrading of High Explosives Facilities, Pantex Plant, Amarillo, Texas," Vol. I, Prepared for the U.S. Department of Energy by Mason and Hanger-Silas Mason Co., Inc. (September 1979).

MHSM 1980A: R. E. Alexander and V. A. Cornelius, "Environmental Monitoring Report for Pantex Plant Covering 1979," Mason and Hanger-Silas Mason Co., Inc., report MHSMP-80-12 (May 1980).

MHSM 1980B: R. E. Alexander and V. A. Cornelius, "Supplement to Environmental Monitoring Report for Pantex Plant Covering 1979," Mason and Hanger-Silas Mason Co., Inc., report MHSMP-80-44 (September 1980).

MHSM 1980C: See Laseter 1982.

MHSM 1980E: "1980 Waste Management Site Plan Pantex Plant," Mason and Hanger-Silas Mason Co., Inc. (October 1980).

MHSM 1981B: "Standards for Radiation Protection," Mason and Hanger-Silas Mason Co., Inc. (August 1981).

MHSM 1981C: See Laseter 1982.

MHSM 1981G: Ronald E. Alexander and William A. Laseter, "Environmental Monitoring Report for Pantex Plant Covering 1980," Mason and Hanger-Silas Mason Co., Inc., report MHSMP 81-18 (1981).

MHSM 1982: William A. Laseter, "Environmental Monitoring Report for Pantex Plant Covering 1981," Mason and Hanger-Silas Mason Co., Inc., report MHSMP-82-14 (April 1982).

MHSM 1983: William A. Laseter, "Environmental Monitoring Report for Pantex Plant Covering 1982," Mason and Hanger-Silas Mason Co., Inc., report MHSMP-83-11 (March 1983).

Miller 1978: M. L. Miller, J. J. Fix, and P. E. Bramson, "Lognormal Analysis of Naturally Occurring Radionuclides in Soil and Vegetation of the Hanford Area," in Natural Radiation Environment III, Vol.2, Thomas F. Gesell and Wayne M. Lowder, Eds., U.S. Department of Energy, Symposium series CONF-780422 (1978).

Moore 1979: R. E. Moore, C. F. Baes III, L. M. McDowell-Boyer, A. P. Watson, F. O Hoffman, J. C. Pleasant, and C. W. Miller, "AIRDOS-EPA, A Computerized Methodology for Estimating Environmental Concentrations and Dose to Man from Airborne Releases of Radionuclides," Oak Ridge National Laboratory report ORNL-5532 (1979).

NCI 1975: "Third National Cancer Survey: Incidence Data," National Cancer Institute monograph 41 (March 1975).

NCRP 1975: "Natural Background Radiation in the United States," National Council on Radiation Protection and Measurements report NCRP-45 (1975).

Newcomb 1961: W. W. Newcomb, The Indians of Texas from Prehistoric to Modern Times (University of Texas Press, Austin, 1961), pp. 155-221.

NSC 1981: National Safety Council, Accident Facts (National Safety Council, 444 North Michigan Ave., Chicago, Illinois, 1981).

OSHA 1978: "OSHA Occupational Safety and Health Standards," Occupational Health and Safety Administration, 20 CFR 1910 (November 1978).

Oswalt 1978: Wendell H. Oswalt, This Land was Theirs: A Study of North American Indians (John Wiley & Sons, Inc., New York, 1978).

Place 1970: W. M. Place, F. C. Cobb, and C. G. Defferding, "Palomares Summary Report," Field Command Defense Nuclear Agency, Kirtland Air Force Base, (January 1975).

Poole 1982: C. R. Poole, Mason and Hanger-Silas Mason Co., Inc., "Fatalities at Pantex Plant," letter to Ken Rea (April 28, 1982).

PRPC 1981: Gordon R. Darrow, Panhandle Regional Planning Commission Health Systems Agency, "Acute Care Medical Facilities in Amarillo SMSA," letter to Donald Rapp (December 1981).

Purtymun 1982A: W. D. Purtymun, N. M. Becker, and Max Maes, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Geohydrologic Investigations," Los Alamos National Laboratory report LA-9445-PNTX-H (1982).

Purtymun 1982B: W. D. Purtymun and N. M. Becker, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Geohydrology," Los Alamos National Laboratory report LA-9445-PNTX-I (1982).

Rapp 1982: D. Rapp, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Socioeconomic Assessment," Los Alamos National Laboratory report LA-9445-PNTX-J (1982).

Rickard 1981A: W. H. Rickard, Battelle-Pacific Northwest Laboratories, "Threatened or Endangered Plant Taxa at Hanford," letter to D. R. Elle (September 22, 1981).

Rickard 1981B: W. H. Rickard, Battelle-Pacific Northwest Laboratories, "Threatened or Endangered Animal Taxa at Hanford," letter to D. R. Elle (October 15, 1981).

RPSC 1974: "Endangered Plants Native to Texas," Rare Plant Study Center, University of Texas at Austin (1974).

Schnurr 1982A: N. M. Schnurr, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Predictions of Energy Requirements," Los Alamos National Laboratory report LA-9445-PNTX-K (1982).

Schnurr 1982B: N. M. Schnurr, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: A Description of Facilities and Estimation of Resource Requirements," Los Alamos National Laboratory report LA-9445-PNTX-L (1982).

SCS 1972: Soil Survey Information and Interpretations, Iowa, Mahaska Soil Series, Iowa Soils-2, U.S. Department of Agriculture Soil Conservation Service (File Code Soils-12) (February 1969).

Shor 1982: R. W. Shor, C. F. Baes III, and R. D. Sharp, "Agricultural Production in the United States by County: A Compilation of Information from the 1974 Census of Agriculture for Use in Terrestrial Food-Chain Transport and Assessment Models," Oak Ridge National Laboratory report ORNL-5768 (1982).

Shreve 1965: J. D. Shreve, Jr., "Operation Roller Coaster: Scientific Director's Summary Report," Department of Defense report DASA-1644 (June 1965).

SIRPC 1981: "Survey of Hospital Facilities," Southeast Iowa Area XVI Regional Planning Commission unnumbered report (March 1981).

Skelly 1974: J. M. Skelly and R. C. Lambe, "Diagnosis of Air Pollution Injury to Plants," Virginia Polytechnic Institute, Extension Division report number 568 (1974).

Smith 1978: B. C. Smith and J. A. Lambert, "Technology and Costs for Cleaning Up Land Contaminated with Plutonium," in Selected Topics: Transuranium Elements in the Ground Environment, U.S. Environmental Protection Agency (CSD-78-1, 1978), pp. 489-545.

Smith 1982: R. E. Smith, B. E. Biringer, R. I. Butler, and J. M. Taylor, "Pantex Transportation Risk Assessment," Sandia National Laboratories report SAND 82-1047 RS 1233/81/34 (SRD) (1982).

SPSC 1981: "Information for Security Analysts," Southwestern Public Service Company, Amarillo, Texas (1981).

Stephens 1981: R. F. Stephens, U.S. Department of the Interior, Fish and Wildlife Service, Albuquerque, New Mexico, "Threatened or Endangered Species in Southwest," letter to K. Rea (August 26, 1981).

Stewart 1980: J. D. Stewart, "Report of the Status of Pantex Water System," unpublished report, Mason and Hanger-Silas Mason Co., Inc. (November 24, 1980).

Stone 1972: W. A. Stone, D. E. Jenne, and J. M. Thorpe, "Climatography of the Hanford Area," Battelle-Pacific Northwest Laboratories report BNWL-1605, UC-53 (June 1972).

Stump 1982: Sheila A. Stump, Office of Archaeology and Historic Preservation, State of Washington, "Archaeological and Historic Resources at Hanford Site," letter to Kenneth Rea (May 11, 1982).

Sula 1981A: M. J. Sula, P. J. Blumer, and R. L. Dirkes, "Environmental Status of the Hanford Site for CY 1980," Battelle-Pacific Northwest Laboratory report PNL-3729 (1981).

Sula 1981B: M. J. Sula and P. J. Blumer, "Environmental Surveillance at Hanford for CY-1980," Battelle-Pacific Northwest Laboratory report PNL-3728 (1981).

Sula 1982: M. J. Sula, W. D. McCormack, R. L. Dirkes, K. R. Price, and P. A. Eddy, "Environmental Surveillance at Hanford for CY-1981," Pacific Northwest Laboratory report PNL-4211 (May 1982).

TACB 1976: Cecil L. Bradford , Texas Air Control Board, "Outdoor Burning of High Explosive Material at Pantex," letter to P. R. Wagner (July 9, 1976).

Tang 1981: P. K. Tang, R. W. Andrae, J. W. Bolstad, K. H. Duerre, and W. S. Gregory, "Analysis of Ventilation Systems Subjected to Explosive Transients - Far Field Analysis," Los Alamos National Laboratory report LA-9094-MS (November 1981).

TCCC 1981: "Tri-City Facts," Tri-Cities Chamber of Commerce, Richland, Washington (1981)

TCRERC 1981: "Tri-Cities Real Estate Research Report," Tri-Cities Real Estate Research Committee report Volume 4, Number 1 (1981).

TEC 1981: Jeff L. Auld, Texas Employment Commission, "Amarillo Area Wage Rate Information Compiled by the Job Service of Texas," letter to Donald Rapp (December 3, 1981).

TEC 1982: Jeff Auld, Texas Employment Commission, "Labor Force Availability in the Amarillo Labor Force Service Area," letter to Donald Rapp (April 8, 1982).

Terracon 1981: Terracon Consultants, "Geotechnical Report Subsurface Contamination Investigation of Sites Z1, Z2, and Z3, Iowa Army Ammunition Plant, Burlington, Iowa," submitted to SCS Engineers, Long Beach, California (1981) (Draft).

Texas 1980: "1979 Texas County Statistics,"U.S. Department of Agriculture and Texas Department of Agriculture, Texas Crop and Livestock Reporting Service (1980).

Texas 1981: "Texas Air Surveillance Report," State of Texas report #AQ 01-05, AC 01-06 (1981).

Texas 1982: State of Texas, Division of Emergency Management, "State of Texas Emergency Management Plan," 1982 Edition (May 1982).

Texas Tech 1974: Texas Tech University, "Design Manual for Tornado Resistant Structures at the Pantex Plant Site," Department of Civil Engineering, Texas Technological University, Lubbock, Texas (November 1974).

UBC 1979: "Uniform Building Code," International Conference of Building Officials, Whittier, California (1979).

UEC 1981: "Union Electric Company Highlights," Union Electric Company, St. Louis, Missouri (1981).

UNENG 1979: "Alternative Energy Sources and Systems for the Pantex Plant," United Engineers for U.S. Department of Energy contract EW-78-C-04-5309 (February 1979).

Unger 1981: P. W. Unger and F. B. Pringle, "Pullman Soils, Distribution, Importance, Variability, and Management," U.S. Department of Agriculture bulletin B-1372 (September 1981).

UNSC 1977: "Sources and Effects of Ionizing Radiation," United Nations Committee on the Effects of Atomic Radiation, United Nations, New York, United States of America (1977).

USAEC 1974: "Standard Arch-Civil Design Criteria: Design Loads for Structures, Hanford Plant Standards," U.S. Atomic Energy Commission report SDC 4.1 revision number 7, Richland, Washington (1974).

USAF 1970: United States Air Force, "Special Edition: Project Crested Ice," Nuclear Safety 65, Part 2, No. 1 (January-March 1970).

USARMY 1973A: "Fish and Wildlife Management Plan, Iowa Army Ammunition Plant," U.S Army, Middletown, Iowa, File Number 85-205.2 (1973).

USARMY 1973B: "Forest Management Plan, Iowa Army Ammunition Plant," U.S. Army Middletown, Iowa, File Number 85-205 (1973).

USARMY 1980: Claude B. Noel, "Iowa Army Ammunition Plant Statistics for Use in Reports," letter to Distribution (February 28, 1980).

USARMY 1982: "Compliance Testing for Waste High Explosives Incinerator," U.S. Army Environmental Hygiene Agency, Aberdeen Proving Grounds, Aberdeen, Maryland (1982).

USDA 1978: "Prime and Unique Farmlands," U.S. Department of Agriculture, Soil Conservation Service report 43: 21FR 4030-4033 (1978).

USDA 1980: "Texas County Statistics," U.S. Department of Agriculture, Economics and Statistical Service bulletin 186 (September 1981).

USDA 1981A: "Invent Monit - Prime and Additional Prime Farmland Inventory," U.S. Department of Agriculture, Soil Conservation Service, Texas, bulletin TX290-1-11 (July 1981).

USDA 1981B: "Prime and Additional Potential Prime Farmland Maps," U.S. Department of Agriculture, Soil Conservation Service, Texas, bulletin 290-2-2 (October 1981).

USDC 1980: "Local Climatological Data (Annual Summary) 1979: Burlington, Iowa," U.S. Department of Commerce, National Climatic Center, Asheville, North Carolina (1980).

USDC 1981: "Local Climatological Data (Annual Summary) 1980: Amarillo, Texas," U.S. Department of Commerce, National Climatic Center, Asheville, North Carolina (1981).

USDOD 1975: Contract between Burlington Municipal Water Works and the US Army. Contract DAAA09-75-C-4005 (February 10, 1975).

USDOD 1978: "DoD Ammunition and Explosives Safety Standards," U.S. Department of Defense, Office of the Assistant Secretary of Defense, DoD 5154.4S (January 1978).

USDOE 1978: "Energy Performance Standards for New Buildings: Proposed Rule," U.S. Department of Energy, Office of Conservation and Solar Energy, United States Federal Register Vol. 44, No. 230, Part II (November 28, 1978).

USDOE 1980A: "Environmental Protection, Safety, and Health Protection Program for DOE Operations," U.S. Department of Energy Order 5480.1 (1980).

USDOE 1980B: "US Environmental Protection Agency Application for a Hazardous Waste Permit Consolidated Permits Program (Interim Status Applications)," U.S. Department of Energy, Amarillo Area Office, Pantex Plant (November 1980).

USDOE 1980D: "Final Environmental Impact Statement: Waste Management Operations, Hanford Site, Richland, Washington," U.S. Department of Energy (April 1980).

USDOE 1981A: "ALO Safety Analysis Report and Review System," U.S. Department of Energy review guide LA 5481.1 (February 1981).

USDOE 1981B: "Pantex Plant Environmental Impact Statement Implementation Plan," U.S. Department of Energy (1981).

USDOE 1981C: See USDOE 1983.

USDOE 1981D: "General Design Criteria Manual," U.S. Department of Energy Order 6430, Draft 6-10-81, (June 1981).

USDOE 1981E: "Environmental Assessment for the Alternate Energy Source Project, Pantex Plant, Amarillo, Texas," U.S. Department of Energy report DOE/EA-145 (April 1981).

USDOE 1982A: "Permian Basin Location Recommendation Report," U.S. Department of Energy, Office of Nuclear Waste Isolation draft report ONWI-288 (February 1982).

USDOE 1982C: "Draft Environmental Impact Statement: Operation of Purex and Uranium Oxide Plant Facilities, Hanford Site, Richland, Washington," U.S. Department of Energy report DOE/EIS-0089D (May 1982). See also USDOE 1983.

USDOE 1982D: "DOE Explosives Safety Manual," U.S. Department of Energy, Office of Operational Safety, DOE/EV/06194-1UC-45 (June 1982).

USDOE 1983: "Final Environmental Impact Statement: Operation of Purex and Uranium Oxide Plant Facilities, Hanford Site, Richland, Washington," U.S. Department of Energy report DOE/EIS-0089 (February 1983).

USEPA: "Comparison of NTAC, NAS, and Proposed EPA Numerical Criteria for Water Quality," U.S. Environmental Protection Agency undated and unnumbered report.

USEPA 1971: "Effects of Noise on Wildlife and Other Animals," U.S. Environmental Protection Agency, Office of Noise Abatement and Control, NTID 300.5 (December 1971).

USEPA 1976: "Compilation of Air Pollutant Emission Factors," U.S. Environmental Protection Agency report AP-42, OAQP5 second edition (February 1976).

USEPA 1977: "Proposed Guidance on Dose Limits for Persons Exposed to Transuranium Elements in the General Environment," U.S. Environmental Protection Agency, Office of Radiation Programs, Criteria and Standards Division, report EPA 540/4-77-106, Washington D.C. (1977).

USEPA 1981: Diana Dutton, Environmental Protection Agency, "Application for Hazardous Waste Permit," letter to G. W. Johnson (August 11, 1981).

USERDA 1975: "Final Environmental Statement, Waste Management Operations Hanford Reservation, Richland, Washington," U.S. Energy Research and Development Administration report ERDA-1538 (December 1975).

USERDA 1976: "Environmental Assessment, Pantex Plant, Amarillo, Texas," U.S. Energy Research and Development Administration, Washington, D.C. (June 1976).

USFWS 1981: "Endangered Species of Texas and Oklahoma, 1981," U.S. Fish and Wildlife Service, Region 2, Albuquerque, New Mexico (1981).

USNRC 1977: "Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes," U.S. Nuclear Regulatory Commission, Office of Standards Development, Docket No. PR-71,73 (40 FR 23768) report NUREG-0170 (December 1977).

USGS 1964: "Map of Flood-Prone Areas, West Burlington Quadrangle, Des Moines County, Iowa," U.S. Geological Survey (1964).

Waldron 1981: Robert L. Waldron II, Robert A. Danielson, Harold E. Shultz, Dieter E. Eckert, and Kenneth O. Hendricks; "Radiation Decontamination Unit for the Community Hospital," American Journal of Roentgenology 136: 977-981 (May 1981).

Wenzel 1982A: W. J. Wenzel, K. M. Wallwork-Barber, J. M. Horton, L. C. Hollis, E. S. Gladney, D. L. Mayfield, A. F. Gallegos, J. C. Rogers, R. G. Thomas, and G. Trujillo, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Agricultural Food Chain Radiological Assessment," Los Alamos National Laboratory report LA-9445-PNTX-M (1982).

Wenzel 1982B: W. J. Wenzel, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Decontamination Methods and Cost Estimates for Postulated Accidents," Los Alamos National Laboratory report LA-9445-PNTX-N (1982).

Wenzel 1982D: W. J. Wenzel and A. F. Gallegos, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Long-Term Radiological Risk Assessment for Postulated Accidents," Los Alamos National Laboratory report LA-9445-PNTX-O (1982).

WES 1982: Dean Schau, Washington Employment Security, "Information on P.U.D. Power Projects, WPSS and Puget Sound Power and Light Projects, and Highway projects in the Tri-Cities," letter to Donald Rapp (April 7, 1982).

Wiggs 1982A: L. D. Wiggs, G. S. Wilkinson, G. L. Tietjen, and J. F. Acquavella, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: A Comparison of County and State Cancer Mortality Rates," Los Alamos National Laboratory report LA-9445-PNTX-P (1982).

Wilson 1979: R. Wilson, "Analyzing the Daily Risks of Life," Technology Review, Massachusetts Institute of Technology, pp. 41-46 (February 1979).

WJS 1980: "Annual Planning Report 1980," Washington State Employment Security Department (July 1980).

WJS 1981A: "Annual Planning Report 1981," Washington State Employment Security Department (July 1981).

WJS 1981B: "Labor Area Summary," Washington State Employment Security Department (June 1981).

WSDCED 1980: "Washington State Standard Community Survey - Tri Cities," Washington State Department of Commerce and Economic Development (October 1980).

10.0 WRITTEN COMMENTS RECEIVED

In December 1982, the Department of Energy issued for public review a Draft Environmental Impact Statement on the Pantex Plant Site, Carson County, Texas. Comment letters were received from 45 individuals and organizations. These letters and the Department of Energy responses to them are published in this chapter. The substantive concerns raised in the written comments pertained to: (1) mitigation measures for aircraft-induced accidents, (2) the effects of noise, (3) the handling of radioactive wastes, especially nuclear weapons accident residue, (4) radiological monitoring, and (5) the potential for air and/or water pollution problems that would require additional permits.

The comment letters have been organized into two major categories--those for which a response was prepared and those for which no technical response was necessary. In each main category, the letters are organized according to source: Federal agencies, Texas, Iowa, and Washington. These letters were received from:

A. Department of Energy Response Prepared

- Federal Agencies

1. U.S. Department of the Army, Office of the Chief of Engineers, Washington, D.C. 20310
2. U.S. Environmental Protection Agency, Washington, D.C. 20460.
3. U.S. Department of Transportation, Federal Aviation Administration, 800 Independence Ave. S.W., Washington, D.C. 20591

- Texas

4. Office of the Governor, Sam Houston Building, P.O. Box 13561, Austin, Texas 78711
5. Texas Air Control Board, 6330 Hwy 290 East, Austin, Texas 78723
6. Texas Department of Health, 1100 West 49th Street, Austin, Texas 78756
7. Texas Department of Water Resources, 1700 N. Congress Avenue, Austin, Texas 78711
8. Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744
9. Air Transport Association of America, Southwest Regional Office, Room 213-Meacham Field, Fort Worth, Texas 76106
10. Amarillo Chamber of Commerce, 1000 South Polk, P.O. Drawer 15207, Amarillo, Texas 79105
11. Southwest Airlines Co., P.O. Box 37611, Love Field, Dallas, Texas 75235
12. Northwest Texas Clergy and Laity Concerned, 2031 C. S. Hughes, Amarillo, Texas 79109

- Iowa

13. Mr. Stuart L. Nachbar, 557 Sherman Hall, 909 South Fifth Street, Champaign, Illinois 61820

14. Mr. Clarence L. Adolph, 2100 S. 4th Street, Burlington, Iowa 52601

15. Citizens for Peace, A. C. Koengeter, 2332 Burlington Ave., Burlington, Iowa 52601

16. Ms. Elaine Cale, 602 Broadway, West Burlington, Iowa 52655

17. Mrs. Marvin L. Brown, Rt. 4, Box 287, West Burlington, Iowa 52655

- Washington

18. Washington Department of Ecology, Mail Stop PV-11, Olympia, Washington 98504

19. Washington Department of Emergency Services, 4220 East Martin Way, Olympia, Washington 98504

20. Washington Department of Transportation, Office of District Administrator, 2809 N. Main St., Union Gap, P. O. Box 52, Yakima, Washington 98907

21. Washington Department of Social and Health Services, Olympia, Washington 98504

B. No Technical Response Necessary

- Federal Agencies

22. U.S. Department of Transportation, Federal Aviation Administration, 800 Independence Ave., S. W., Washington, D.C. 20591

23. U.S. Department of the Interior, Fish and Wildlife Service, Ecological Services, 9A33 Fritz Lanham Building, 819 Taylor Street, Fort Worth, Texas 76102

- Texas

24. City of Amarillo, P.O. Box 1971, Amarillo, Texas 79186

25. General Land Office, Stephen F. Austin Building, 1700 North Congress Avenue, Austin, Texas 78701

26. Texas State Department of Highways and Public Transportation, Dewitt C. Greer State Highway Building, Austin, Texas 78701

27. Texas Department of Health, 1100 West 49th Street, Austin, Texas 78756

28. Texas Energy and Natural Resources Advisory Council, 200 East 18th Street, Austin, Texas, 78701

- Iowa

29. Ms. Elizabeth Lamb, Apt. 417, 2909 Woodland Avenue, Des Moines, Iowa 50312

30. Mr. M. D. Alexander, 845 40th Street, Des Moines, Iowa 50312

31. Ms. Sandra Walters, 426 E. Wheeler, West Burlington, Iowa 52655

32. Ms. Charlotte Walker, Box 294, Burlington, Iowa 52601

33. Mr. R. F. Uffelman, 2504 Amelia, Burlington, Iowa 52601

34. Mr. R. F. Uffelman, 2504 Amelia, Burlington, Iowa 52601

35. Name and Address Removed by Request

36. United Nations Association Burlington Chapter, Avis I. Long, President, 121 Crestview Drive, Burlington, Iowa 52601

37. Letter from:

    Mr. and Mrs. Paul Hemann, 1719 Madison Avenue, Burlington, Iowa 52601
    Mr. and Mrs. Robert Van Dewater, 1911 Madison Avenue, Burlington, Iowa 52601

38. Letter from:

    Mr. and Mrs. Tom Thomas, 633 South 6th Street, Burlington, Iowa 52601
    Mr. Wendell G. Burcham, 1007 Summer Street, Burlington, Iowa 52601

39. Ms. Edna A. Den Hartog, 1102 South 15th Street, Burlington, Iowa 52601

40. Citizens for Education on Nuclear Arms, Doug Calsbeck, 1014 Grand Park, Fairfield, Iowa 52556

41. Ms. Dorothy Schramm, 2700 South Main Street, Burlington, Iowa 52601

42. Mrs. W. H. Morgan, 1038 South Leebrick, Burlington, Iowa 52601

43. Mrs. Sally McMillan, 1825 Vogt Street, Burlington, Iowa 52601

44. Ms. Terri McGaffin, 1347 West 12th Street, Davenport, Iowa 52804

- Washington

45. Washington State Parks and Recreation Commission, 7150 Cleanwater Lane, KY-11, Olympia, Washington 98504

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20310

REPLY TO
ATTENTION OF:

11 MAR 1983

DAEN-ZCE

SUBJECT: Draft Environmental Impact Statement (EIS) for the Pantex Plant Site

Colonel John T. Weathers
Director, Division of Safety,
Environment, and Emergency Actions
Office of Military Application
Department of Energy
Washington, D.C. 20545

1. The subject EIS has been reviewed.

2. During the scoping period, the Department of the Army advised that the facilities at the Iowa Army Ammunition Plant were not available for other uses. Option 1 of the Iowa alternative recognized the need to replace facilities for Army operations.

3. Because conventional explosives are currently handled by the Army, production, test, and storage facilities are spaced apart in accordance with specific quantity distance requirements. Included in these distances are buffer zones to protect private property which accounts for much of the land leased for agricultural activity.

4. Although detailed proposals for siting facilities for nuclear weapons production have not been made available, the Army does not believe that both functions, involving conventional explosive materials, can be accommodated within the quantity distance requirements. The existing Army facilities and the quantity distance arcs required for safety reasons consume virtually all the land now held by Iowa Army Ammunition Plant. There are no known plans to excess any portion of this property.

1983 - AN ARMY OF EXCELLENCE

DAEN-ZCE
SUBJECT: Draft Environmental Impact Statement (EIS) for the Plantex Plant Site

5. Because of the described conditions, the Department of the Army requests that the use of Iowa Army Ammunition Plant not be considered as an alternative.

FOR THE CHIEF OF ENGINEERS:

KENNETH E. HALLERAN
Colonel, Corps of Engineers
Chief, Army Environmental Office

CF:
Mr. Alex R. Griego
Department of Energy
Albuquerque, New Mexico 87115

2

DOE Response to the Department of Army on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

1. (Subject EIS has been reviewed)

   No response needed.

2. (Need to replace facilities for Army operations)

   The Department of Energy agrees.

3. (Quantity-distance requirements must be maintained)

   The Department of Energy agrees.

4. (Concern that quantity-distance requirements were not considered)

All existing Iowa Army Ammunition Plant quantity-distance exclusion areas were considered, along with the appropriate quantity-distance exclusion areas from a Pantex Plant type of operation. The selection of a small portion of the Iowa Army Ammunition Plant for new construction was done in cooperation with local operations personnel at the Iowa Army Ammunition Plant. The existing, formerly used facilities were sited originally at quantity-distances that do not invalidate any of the existing safety requirements. These studies provided a basis for evaluating the environmental implications of the Iowa Army Ammunition Plant alternative. However, for a number of reasons, neither of the Iowa Army Ammunition Plant options are considered a preferred alternative by the Department of Energy.

5. (Request that Iowa Army Ammunition Plant not be considered)

   No further response needed.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 21 1983

OFFICE OF
THE ADMINISTRATOR

Mr. Alex Griego
Environmental Engineer
Operational Safety Division
Department of Energy
PO Box 5400
Albuquerque, New Mexico 87115

Dear Mr. Griego:

In accordance with Section 309 of the Clean Air Act, as amended, the US Environmental Protection Agency (EPA) has reviewed the US Department of Energy's (DOE) draft Environmental Impact Statement for the Pantex Plant Site at Amarillo, Texas. Our detailed comments are enclosed.

The EIS compares the alternatives of (1) continuing operations at the Pantex plant, with upgrading facilities there, (2) relocating all or portions of the operations to the Iowa Army Ammunition Plant, or (3) relocating all or portions of the operations to the Hanford site. Since these nuclear weapons operations were consolidated at the Pantex plant in 1975, the plant has had a lower injury and loss rate than the United States explosives industry. In addition, the probability of an accidental nuclear detonation of a nuclear weapon at the plant is not credible; air transport is nearby; the ground water supply has provided good quality water for over 40 years; the plant is not in or near a floodplain; and many special monitoring studies have not found detectable above-background offsite concentrations of uranium, plutonium or tritium. We therefore agree with your conclusion that existing facilities and the $53 million of construction nearing completion at this time not be relocated at an alternate site.

Although EPA is concerned that less information is presented in the EIS for the Washington and Iowa sites than for the Texas site, there is no environmental reason for relocating the activities from Pantex to any of the other sites.

In keeping with EPA's procedures we are rating this draft EIS LO-2. This means we have requested more information concerning this project. If you have any questions concerning EPA's review of this project, please contact Dr. W. Alexander Williams (FTS 382-5909) of my staff.

Sincerely,

Paul C. Cahill

Paul C. Cahill
Director
Office of Federal Activities

Detailed Comments of the
U.S. Environmental Protection Agency
on the US Department of Energy's
Draft Environmental Impact Statements
for the Pantex Plant Site, Amarillo, TX

1. Water Pollution

The Pantex plant has been in operation for about 30 years and can reasonably be expected to handle many tons of radioactive, high-explosive materials and toxic substances for many years in the future. We are concerned that this continually increasing amount of materials over this long time period could contaminate groundwater in the area. The Ogallala Formation extends under the Pantex plant and provides a groundwater supply to the plant as well as to many other towns and cities throughout Western Texas and Oklahoma. We recommend that shallow monitoring wells be drilled on the plant site and sampled periodically to ensure that contaminants are not introduced into the underlying aquifer. We recommend that some of the wells be drilled near the onsite playas.

2. Air Pollution

On page 2-9 the EIS discusses beryllium being included in air emissions from Facility Number 11 built last year. Beryllium is defined in 40 CFR 61 as a hazardous pollutant and beryllium emissions require TACB approval. It is not clear if the emissions received this approval. This should be clarified in the Final EIS. Also, the PSD permit application number for the boiler should be listed in the Final EIS.

3. Alternative Costs

Tables 2.2-1 and 2.2.1-1 show the estimated cost of the Pantex Plant Alternative Option 4 as $53 Million as compared to other alternatives. This is misleading because, by the time the Final EIS is published, this money will have already been spent or irrevocably committed. The comparative cost of this option is essentially nothing since the cost can not be changed.

This $53 Million is also apparently included in the costs of other options of the Pantex Alternative but not in the costs of the other two Alternatives. This is misleading because the costs of Alternatives are not directly comparable. These Tables should contain only comparative costs.

4. Noise

The Draft EIS discussed explosions, detonations, high explosive test-fires and blasts, but did not evaluate the effect of noise pollution on the environment. The Final EIS should include this evaluation.

5. Epidemiological Study

We understand that a study of past and present Pantex Plant workers is currently in progress. We request that at least a summary of the results of the study to date be included in the Final EIS.

6. Accidental Release of Plutonium

The EIS discusses reducing the chance of a plutonium dispering accident on page 2-30 by expanding the prohibited airspace above the plant and moving the nearby VORTAC navigational aid but does not address the potential adverse impacts of these mitigating actions. The adverse impacts should be quantified in the same terms as those used to express the benefits of the mitigating actions. This quantification should help to provide a clear basis for choice and enable the DOE to determine the comparative merits of the proposed mitigation. DOE may wish to consult the Federal Aviation Agency concerning these adverse impacts.

7. Radiological Dose

We recommend the conclusion that bone is the critical organ for coal-fired plant emissions of radioactivity (p.4-12) be reviewed. Recent work (H.L. Beck, et al., Purturbations on the Natural Radiation Environment due to the Utilization of Coal as an Energy Source, presented at Natural Radiation Environment, III, Oak Ridge, TN 1980) concluded that the radioactive nuclides are less soluble than previously believed, because of the glassy matrix structure of the emissions, and that the critical organ is the lung.

8. At the Hanford site, our preliminary estimates suggest that the project would exceed the Prevention of Significant Deterioration (PSD) threshold levels. The Final EIS, therefore, should address whether the project is subject to review under the PSD regulations. Additionally, because the project would be considered a major stationary source built near a public highway that runs through the Hanford Reservation, the Final EIS should address ambient air impacts along the highway. The Draft EIS refers to air quality impacts at the reservation boundaries only.

9. At the Burlington site, the EIS states that elevated levels of barium, nitrates and phosphates, as well as high explosives and their decomposition products are present in both surface and shallow ground waters. It should indicate methods for prevention of additional degradation if this alternative is chosen. Current and predicted emissions from the incinerators and power plant should have been included in the EIS. Changes in wastewater treatment facilities, effluent quality and impacts on receiving streams should have been documented. The EIS has not stated if hazardous waste disposal sites are available or will be developed on the IAAP site. It should include a plan for hazardous waste management.

10. In the event that DOE decides to locate some or all of these activities at Burlington or Hanford, EPA believes a supplemental, site-specific EIS should be prepared for issues such as building location, emissions, effluents, and the like. Both of these sites are discussed on only a conceptual basis in this EIS. The comparison is adequate to support continued operations at Pantex but is not adequate to justify relocation of some of the Pantex activities.

DOE Response to U.S. Environmental Protection Agency on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

1. Water Pollution (Concern expressed about possible contamination of ground water and the need for a monitoring program)

No hazardous waste (as defined in 40 CFR 261) is discharged into playas nor is any buried as solid wastes. Therefore, no special ground-water monitoring should be required. The playas are monitored to assure that no hazardous wastes are present, and a test well is used to monitor a perched-water body above the main aquifer in the Ogallala. Further monitoring is performed in water supply wells completed in the Ogallala.

Recent data submitted to the Texas Department of Water Resources indicate that a special ground-water monitoring program for hazardous waste disposal at the Pantex Plant is unnecessary. Analyses of the pH levels at the Neutralization-Evaporation Pit and residues from incinerated high-explosive wastes demonstrate the nonhazardous characteristics of these two waste operations. Analyses of soil borings taken from around the old solvent disposal pit show a low potential for migration of waste products to surface or ground waters. This, coupled with the current water-monitoring program, should allow early detection of any potential future problem and allow for corrective measures to be taken before significant adverse effects occur.

2. Air Pollution (Concern expressed over possible release of beryllium)

The new interim high-explosive test-fire facility is currently undergoing performance tests. It is expected to become operational sometime in 1983. This facility will totally contain the byproducts from the test detonation, permit settling of particulate matter, and then bleed off the gas through high-efficiency-particulate filters. These filters are at least 99.97 percent efficient in removing particulates. This will prevent release of beryllium and depleted uranium to the environment. Pantex Plant personnel have discussed this facility design with the Texas Air Control Board, and the Texas Air Control Board will not require special permits because there will essentially be no releases.

Discussions with the Texas Air Control Board indicated that the proposed coal-fired cogeneration plant probably would not require a Prevention of Significant Deterioration (PSD) permit, because the emissions will not classify it as a major stationary source. The anticipated emissions are shown in Table 4.1.1.1-1 and the predicted air concentrations are given in Table 4.1.1.1-2. The plant is currently being planned as a gas-fired facility with fuel oil backup; however, the plant will be designed to retain the future option to use coal. As more detailed design progresses, the Texas Air Control Board will be consulted to assure compliance with any applicable regulations.

3. Alternative Costs (Uncertainty expressed about whether or not the $53 million cost was included in all Alternatives)

The $53 million estimated cost for projects already underway is included in the costs for the Iowa Army Ammunition Plant alternative, options 1 and 2 [see Sections 2.2.2.1 (last paragraph) and 2.2.2.2 (last paragraph)] and the Hanford Site Alternative [see Section 2.2.3 (last paragraph)]. Thus, Table 2.2-1 values reflect directly comparable cost bases in terms of actual cost to the taxpayer. All of the figures in Table 2.2-1 could be adjusted downward by $53 million to represent only future uncommitted costs. These costs would include the following.

Pantex Plant Alternative	Estimated Cost ($ millions)
Option 1	145
Option 2	611
Option 3	1,186
Option 4	0
Iowa Army Ammunition Plant	
Option 1	163
Option 2	1,435
Hanford Site Alternative	1,499

4. Noise (Concern expressed over lack of noise evaluation)

Section 3.2.12.4 has been added to the Environmental Impact Statement to address noise. Test firing high explosives creates high impulse noise levels (pressure waves) that can potentially cause severe health effects in animals (ruptured ears, lungs, and internal organs). The current quantity--distances (quantity of high explosive versus distance to nearest person) and other control procedures at the Pantex Plant prevents injury to humans. Wildlife enter these restricted zones during test-firing operations; however, because of the relatively small area involved, native species have adjusted their living habits around these areas.

5. Epidemiological Study (Concern about including the work force mortality study in the final Environmental Impact Statement)

This study has been published as Acquavella 1982.* A summary of this study is included in Sections 2.3.12 and 3.2.12.1 of the Environmental Impact Statement.

6. Accidental Release of Plutonium (Concern over impacts of restricting airspace or moving the VORTAC navigational aid currently located near the Pantex Plant)

As stated in the response to the Federal Aviation Administration letter, any mitigation measure that significantly reduces air traffic over or near the Pantex Plant is desirable. Interaction with the Federal Aviation Administration has resulted in potential mitigating measures being restated in Section 2.6.2 in a more general way to provide for greater flexibility in selection of specific options and to avoid adverse limitation on local airport operations.

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*Acquavella 1982: J. F. Acquavella, L. D. Wiggs, R. J. Waxweiler, D. G. Macdonell, and G. S. Wilkinson, "Supplementary Document for an Environmental Impact Statement Regarding the Pantex Plant: Occupational Work Force Mortality Study," Los Alamos National Laboratory report LA-9445-PNTX-Q (1982).

7. Radiological Dose (Concern about bone being the critical organ for coal-fired plant emissions)

As noted in Buhl 1982,* radionuclides in the fly ash were considered quite insoluble and were assigned the most insoluble classification of those recommended by the International Commission on Radiological Protection for each radionuclide. The report by Beck, Gogolak, Miller, and Lowder cited in the Environmental Protection Agency comment was used as a basic reference for the assessment of impacts from the coal-fired power plant. The magnitude of the bone dose resulted from conservative assumptions made for food consumption rates for the maximum exposed individual. These rates, which were taken from recommendations of the U.S. Nuclear Regulatory Commission (1977)** for environmental assessments around nuclear reactors, are several times larger than rates for average individuals. However, even with the high food consumption rates, the bone dose and lung dose to the maximum exposed individual at each site are about equal.

8. Hanford Site (Concern about exceeding Prevention of Significant Deterioration threshold levels)

The State of Washington is scheduled to be granted Prevention of Significant Deterioration (PSD) review authority in September 1983. The Federal and proposed Washington PSD regulations are the same as the Texas PSD regulations. The Texas Air Control Board has indicated that the coal-fired powerplant will probably not be subject to PSD review because none of the projected emissions (Table 4.1.1.1-1) exceed the 250-tons-per-year PSD threshold. Note that corrections were made in Table 4.1.1.1-1 including changing the expected annual emissions of nitrogen oxides to be based on the average load factor for the plant. Data in that table in the Draft Environmental Impact Statement were based on emission of nitrogen oxides at the maximum plant capacity rate. At the average rate, the expected annual emissions would be about 142,000 kilograms (156 tons), substantially l[illegible] tons per year PSD threshold.

Emissions from waste high-explosive burning at the Pantex Plant are small enough that, even if they were added to those of the coal-fired powerplant, PSD review would not be required for the project as a whole.

The closest public road to the proposed coal-fired cogeneration plant at the Hanford Site is State Route 24. The impacts of the coal-fired cogeneration plant on State Route 24 (where it crosses the Hanford Site) would be less than those presented for the Pantex Plant in Table 4.1.1.1-2 of the Environmental Impact Statement for two reasons. First, the concentrations presented were based on burning 1 percent sulfur coal; current design parameters identify a 0.5 percent sulfur coal as the most typical coal to be burned. Secondly, the maximum concentrations were predicted to occur within 2 kilometers (1.2 miles) of the stack for average meterological dispersion conditions. The distance from the coal-fired cogeneration plant at the Hanford Site to State Route 24 is approximately 8 kilometers (5 miles). Thus, the impact of the coal-fired cogeneration plant at the Hanford Site would not cause the National Ambient Air Quality Standards to be exceeded.

*Buhl 1982: T. Buhl, J. Dewart, T. Gunderson, D. Talley, J. Wenzel, R. Romero, J. Salazar, and D. Van Etten, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Radiation Monitoring and Radiological Assessment of Routine Releases," Los Alamos National Laboratory report LA-9445-PNTX-C (1982).

**USNRC 1977: "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," U.S. Nuclear Regulatory Commission Regulatory Guide 1.109 (October 1977).

9. <u>Burlington Site</u> (Concern about additional degradation of the environment at the Iowa Army Ammunition Plant)

If nuclear weapons operations were moved to the Iowa Army Ammunition Plant or Hanford Site, there would be no further deterioration of the environment (soil, sediment, or water) as long as current waste management practices as used at the Pantex Plant were employed.

Predicted emissions from the proposed coal-fired cogeneration plant are compared to both National Ambient Air Quality Standards and Prevention of Significant Deterioration Increments in Table 4.1.1.1-2. These predicted emissions would be applicable at any of the three alternate sites. The incinerators at the Iowa Army Ammunition Plant have been emission tested; however, the final reports on these emission tests were not available from the Army at this time.

Section 3.2.3.2 states that the Iowa Army Ammunition Plant management currently controls the production, procurement, storage, handling, use, and disposal of hazardous materials. Details for handling these hazardous materials are found in the Iowa Army Ammunition Plant Spill Prevention, Control, and Countermeasure Plan (IAAP 1980).*

10. <u>Site-Specific Environmental Impact Statement for Relocation</u> (Concern about the need for more information if one of the alternate sites was selected instead of the Pantex Plant)

If the Department of Energy decides to relocate some or all nuclear weapons operations to either the Iowa Army Ammunition Plant or the Hanford Site, some additional site-specific evaluations would be prepared especially regarding [illegible]ction. Emissions [illegible] effluents would be [illegible]cted to be the same as described in the Environmental [illegible] Statement f[illegible] Plant [illegible] and documented in more detail in the various supplementary documents.

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*"Spill Prevention, Control, and Countermeasure Plan, ENG-13," Mason and Hanger-Silas Mason Co., Inc., Iowa Army Ammunition Plant, Middletown, Iowa, unnumbered report (December 10, 1980).

U.S. Department
of Transportation

**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

APR 2 8 1983

Colonel John T. Weathers
Director, Division of Safety, Environment
and Emergency Actions
Department of Energy
Washington, D.C. 20545

Dear Colonel Weathers:

This is in response to Draft Environmental Impact Statement (DEIS) dated December 1982 concerning the Pantex Nuclear Facility at Amarillo, Texas.

Pursuant to our review of the DEIS and meetings with you on February 24 and April 6, 1983, we believe there are several important factors that should be considered in your deliberations preparatory to the Environmental Impact Statement (EIS). First, it is our understanding that the risk estimate presented in the DEIS projects a "worst case" scenario and postulates a probability of 1 in 6,700 per year of an accidental release of plutonium caused by an aircraft impacting a sensitive area. In terms of aircraft operations in the Amarillo area, this translates to a risk factor of one in a billion or more aircraft operations based on current activity. It is also our understanding that the DEIS data base was developed using national crash statistics for general aviation, air carrier, and military noncombat activity and did not contain any site specific crash data. In our most recent meeting, we provided you with NTSB data that will facilitate adjustments in the original data base and allow a more realistic and localized risk analysis.

In addition to considering the overall safety records of the particular types of air carrier and military aircraft that utilize the Amarillo Airport, we feel consideration should be given to the mitigating effect that the predominantly good weather conditions of the Amarillo area would have on an aircraft in a distress situation. Further, experience has shown that in most all instances an aircraft in a distress situation is controllable to some degree prior to impact. This is evidenced by pilots being able to direct their disabled aircraft away from populated areas and other structures before making ground contact. The open, flat terrain immediately surrounding the Pantex facility offers an excellent emergency landing area under theose conditions and should, in our opinion, be addressed as a mitigating effect.

There are other circumstances and events that should be included in this particular risk analysis. In August 1983, we expect to begin a project to replace the Amarillo instrument landing system (ILS). The system to be installed will have no localizer back course navigational signal which will eliminate one of the instrument approaches that pass over the Pantex Facility. Next, TransWorld Airlines discontinued service to the Amarillo Airport late last year which reduces the number of large aircraft that routinely pass over or near Pantex. Finally, one of the low altitude airways (V-81W) extending northwest from the Amarillo VORTAC will be revoked on June 9, 1983, reducing the number of airways near Pantex.

We are confident that these factors and events will have a positive effect on the final risk analysis. We will continue to work with you in exploring other means should you consider them necessary. It must be recognized, however, that the expansion of the Pantex Prohibited Area to dimensions described in the DEIS would have an adverse effect on aircraft arrival and departure flow patterns in the Amarillo area, as well as on aircraft transitioning the area via the high and low altitude airway structure.

Should we receive a formal proposal to expand the prohibited area, we will conform to rulemaking procedures and circularize the proposal in a Notice of Proposed Rulemaking (NPRM). This will afford all user groups an opportunity to comment on the proposed action. A review of all comments and a more in-depth study of operational impact would be accomplished prior to our taking further action.

Please advise if we have other data that would be useful in your final analysis.

Sincerely,

for B. Keith Potts

R. J. Van Vuren
Director, Air Traffic Service

DOE Response to the Federal Aviation Administration on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

(Concern that better data could be used for crash statistics and that several mitigative measures were overlooked)

Meetings were held with the Federal Aviation Administration on February 24 and April 6, 1983, to discuss details of the aircraft crash analysis. Subsequent to these meetings, the Federal Aviation Administration has provided certain additional data on both crash statistics and flight operations in the Amarillo area.

The new data included printouts of National Transportation Safety Board tapes (from which precise in-flight crash statistics were obtained for air carriers and for general aviation aircraft) and flight strips from the Amarillo and the Albuquerque control centers (from which detailed statistics on the number and location of actual flight operations were obtained). Recent crash dynamics calculations at Sandia National Laboratories/Albuquerque led to the calculation of effective skid distances and effective target areas for the various classes of aircraft. These calculations, combined with precisely defined flight paths, aircraft types, and modes of operation for all aircraft in the vicinity of Pantex Plant, led to the prediction of threshold crash probabilities at Pantex Plant that are based on the conditions and modes of operation pertinent to this site.

A threshold crash is defined as a crash in which the dynamics are sufficient to detonate the high-explosive components of a nuclear weapon contained within a structure at Pantex Plant. Final results of revised calculations are reported in appropriate sections of the Environmental Impact Statement. In particular, see the Summary IV-B, and Sections 2.4.2, 2.4.3, 2.6.2, and 4.2. These final results show that the probability of a plutonium-dispersing accident resulting from an aircraft crash (that is, a threshold crash) is decreased to approximately one-half of the previously calculated values for the Pantex Plant (Option 4). No similar revised calculations were made for the other sites since the crash probability change for Pantex Plant was a reduction of relatively minor magnitude. A qualitative review of pertinent parameters associated with the other sites indicates they would change in a similar manner.

Two mitigating factors suggested by the Federal Aviation Administration were not considered in the quantitative aircraft crash analysis. It is generally believed that good weather conditions in areas such as Amarillo result in a local crash probability that is smaller than the national average. Further, it is believed that pilots are able to avoid populated areas and structures for some severe accident situations that result in an aircraft crash. It is likely that good weather conditions also contribute to pilot avoidance. However, there are not currently any credible statistical data that directly consider the effects of these potential mitigating measures. In such a case, the Council on Environmental Quality regulations (Title 40, Part 1502.22) require that, "when an agency is evaluating significant adverse effects and there are gaps in relevant information or scientific uncertainty, it shall include a worst case analysis."

Three factors are identified by the Federal Aviation Administration that have recently occurred or are expected to occur that will mitigate the threshold crash probability for the Pantex Plant. These include:

(1) elimination of the back-course navigational signal at Amarillo Airport, thus eliminating one approach that currently passes over the Pantex Plant.

(2) discontinuation of one TransWorld Airlines flight into Amarillo, which reduced the number of large aircraft that routinely pass over or near the Pantex Plant.

(3) elimination of a low-altitude airway (V-81-W) extending northwest from the Amarillo VORTAC.

Elimination of the back course navigational signal will force aircraft to use an alternate approach. A likely alternate is the VORTAC approach. The effect would be to shift aircraft farther north and away from buildings containing nuclear weapons. This would result in a reduction in threshold crash probabilty of 50 percent for the airport operations and 6 percent overall, when considering both airport and enroute operations.

Elimination of the TransWorld Airlines service results in an assessed 1 percent reduction on the threshold crash probability for the airport operations. This reduction is small because of the relatively small crash probability of air carriers versus general aviation and military. For Pantex Plant Option 4, the overall threshold crash probability for airport operations (enroute overflights not included) is about 1 chance in 100,000 per year. This is composed of 4 percent for air carriers, 30 percent for general aviation, and 66 percent for military aircraft.

Elimination of the V-81-W low-altitude airway reduces the enroute crash probability by less than 1 percent, because this airway is relatively far [7.8 kilometers (4.8 miles)] from the Plant-sensitive areas. For Pantex Plant Option 4, the threshold crash probability for enroute operations is about 1 chance in 14,000 per year and is composed of 18 percent for air carriers, 3 percent for general aviation, and 79 percent for military aircraft.

Possible mitigation measures suggested in the Draft Environmental Impact Statement (Section 2.6.2) were to enlarge the prohibited airspace and move the existing VORTAC. Preliminary calculations indicated a threshold crash probability reduction by factors of more than 40. These mitigating measures were used as examples to assess the possible benefit of reducing aircraft traffic over and near the Pantex Plant. This Final Environmental Impact Statement has been revised to include a more general statement of potential mitigating measures. These could include implementing a variety of operational, procedural, or system changes that reduce operations over or near the Pantex Plant. If, for example, changes in the enroute traffic could be made so that all airways were 10 kilometers (6 miles) or farther from sensitive Plant areas, and if all takeoff and landing operations were modified such that those currently flying over the Plant used an approach pattern no closer to sensitive areas than the present VORTAC approach, the overall threshold crash probability could be reduced by up to a factor of 100. These measures would result in an assessed threshold crash probability for Pantex Plant, which would be near 1 chance in a million per year.

The Department of Energy intends to continue discussions with the Federal Aviation Administration with the goal of trying to implement reasonable measures that will effectively reduce risk without significant adverse effects on air traffic. Interactions to date with the Federal Aviation Administration suggest that this goal is feasible.

OFFICE OF THE GOVERNOR

MARK WHITE
GOVERNOR

March 24, 1983

Colonel John T. Weathers, Director
Division of Safety, Environment, and
Emergency Actions
U.S. Department of Energy
Washington, D.C. 20545

Dear Colonel Weathers:

The Governor's Office of Planning and Intergovernmental Relations has received the draft environmental impact statement prepared on the Pantex Plant Site in Amarillo, Texas. This document has been reviewed under the State Environmental Impact Statement Identifier number of 3-01-50-005.

The Texas Department of Water Resources (TDWR) requests that information from Pantex be included in the statement regarding the discharge of industrial and domestic wastes as required under existing permits and registration with TDWR. The Texas Department of Health (TDH) requested to work with the Department of Energy to devise an emergency response plan and cited the need for clarification of impacts from the existing facility expansion. Additional technical changes and requests concerning tritium air samples and the proper placement within the statement of pertinent data are also recommended by TDH. Texas Parks and Wildlife Department has requested Pantex Lake habitat data, not included in the impact statement, in order to determine potential impacts on flora and fauna. The Texas Air Control Board comments that certain actions contained in the impact statement may require permitting.

We appreciate the opportunity to comment on this project and will be monitoring the response to the enclosed comments. Please contact this office if we may provide additional information during the environmental review.

Sincerely,

David Nesenholtz, Assistant Director
for Intergovernmental Relations
Office of Planning and Intergovernmental
Relations

clt

SAM HOUSTON BUILDING • P. O. BOX 13561 • AUSTIN, TEXAS 78711

Comments enclosed: Texas Air Control Board
Texas Department of Health
State Department of Highways and Public Transportation
Texas Department of Water Resources
Texas General Land Office
Texas Parks and Wildlife Department
Texas Energy and Natural Resources Advisory Council

cc: Alex Griego
Albuquerque

TEXAS AIR CONTROL BOARD

6330 HWY. 290 EAST
AUSTIN, TEXAS 78723
512/451-5711

JOHN L. BLAIR
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Vice Chairman

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FRANK H. LEWIS
R. HAL MOORMAN

February 15, 1983

Mr. Harden Wiedemann, Director
Governor's Office of Planning and
Intergovernmental Relations
P.O. Box 13561
Austin, Texas 78711

Subject: Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Near Amarillo, Texas

Dear Mr. Wiedemann:

Three sites are under consideration for the Pantex Plant siting project. One is the Iowa Army Ammunition Plant at Burlington, Iowa, and another is the Hanford Site located in southeastern Washington. Our comments are confined to the Texas facility in Carson County.

The Texas Air Control Board (TACB) must be contacted for the purpose of determining whether permits or exemptions will be required for certain areas of the proposed processes described for this project. You may contact Mr. Lawrence Pewitt of the Permits Division at (512) 451-5711, ext. 203.

Carson County meets the national primary and secondary air quality standards for carbon monoxide, nitrogen dioxide, sulfur dioxide, and particulates (TSP) and is, therefore, in a designated "attainment area" for these criteria pollutants. This same area is designated "unclassifiable" for ozone. There has been no designation established for lead.

The project, as described, will be consistent with the Texas Air Pollution Control Implementation Plan when TACB permits or exemptions have been obtained.

Mr. Gerald Hudson, Supervisor of Region 2 in Lubbock, has been contacted and would be happy to answer further questions. You may reach him at (806) 744-0090.

Thank you for the opportunity to provide this assistance. If further help is needed, please contact me or our regional staff.

Sincerely,

Roger R. Wallis, Deputy Director
Standards and Regulations Program

cc: Mr. Gerald Hudson, P.E., Regional Supervisor, Lubbock

DOE Response to Texas Air Control Board on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

(Concern about the possible need for additional air permits)

Representatives from the Pantex Plant will maintain close contact with the Texas Air Control Board Permit Division to assure timely permitting of any facility requiring special permits. A project-by-project review will be held, and any subsequent modifications to a project that affects emissions will be brought to the attention of the Texas Air Control Board.

TEXAS SESQUICENTENNIAL 1836-1986

THE STATE OF TEXAS

Texas Department of Health

Robert Bernstein, M.D., F.A.C.P.
Commissioner

1100 West 49th Street
Austin, Texas 78756
(512) 458-7111

Robert A. MacLean, M.D.
Deputy Commissioner
Professional Services

Hermas L. Miller
Deputy Commissioner
Management and Administration

March 11, 1983

Mr. Harden Wiedemann, Director
Governor's Office of Planning
and Intergovernmental Relations
P. O. Box 13561, Capitol Station
Austin, Texas 78711

RECEIVED
MAR 16 1983
OFFICE OF THE GOVERNOR
O.M.B./O.P.I.R.

Subject: Pantex Plant Site
Carson County, Texas
Supplements "A" Through "P"
U. S. Department of Energy
Governor's Office of Planning and
Intergovernmental Relations
Draft EIS No. 3-01-50-005

Dear Mr. Wiedemann:

A The Draft Environmental Impact Statement (DEIS) and Supplements "A" through "P" (DEIS) for the Pantex Plant Site have been reviewed for their public and environmental health implications. Although the title of the DEIS indicates that the Pantex Site is in Amarillo, it is noted that the Plant is actually located in Carson County northeast of Amarillo.

B The enclosed copy of the DEIS and the Supplements contain suggested changes.

C Our review of the DEIS indicates a lack of information which would be necessary to prepare a Texas Department of Health (TDH) emergency response plan to cover a nuclear accident at the Pantex Plant. The credible accidents described in the DEIS have measurable long-term effects only, that is, greater than five years. The Health Department accident response plan would encompass immediate actions following an accident and short-term recovery procedures. This Department expects to continue to work with Pantex officials to develop a suitable coordinated response plan.

Mr. Harden Wiedemann
Page Two
March 11, 1983

D Nonradioactive waste produced by Pantex is considered to be an industrial solid waste and is disposed of on-site at the Pantex Plant. These waste disposal areas are operated by Pantex and are regulated and permitted by the Texas Department of Water Resources (TDWR). The TDH will coordinate public health aspects of solid waste management with the TDWR.

E The DEIS includes discussions of alternate sites; emphasis is placed on the characteristics of alternate sites rather than on the environmental impacts of the Pantex facility -- this detracts from the primary purpose of the document. We would find the DEIS more useful if the discussion of environmental impacts of the Pantex facility and its proposed expansions were separated from the discussion of the Iowa and Hanford sites. The consideration of alternate sites is noted primarily in Chapters 2, 3 and 4 of the DEIS.

F The DEIS contains references to data contained in Supplements "A" through "P". It is suggested that summaries of sampling data on which conclusions regarding environmental impacts are based be included in Chaper 3.2 of the DEIS.

G The locations of the firing site and burning ground are indicated on page 3 of Supplement "H". It is suggested that Supplement "C" be modified to include the locations of the firing site, burning ground and other pertinent operational areas on the drawings which show the locations of sites for sampling of air and soil and for dosimeter placement.

H Page 3-26 of the DEIS implies that air sampling was conducted for tritium. However, evidence was not found that the sampling was included in the studies performed in support of the DEIS. The DEIS states that depleted uranium and tritium are the two principal radioactive materials emitted in the Pantex operations. However, the supporting radiation monitoring study reported in Supplement "C" did not include analyses of tritium in the air. Supplement "C" states that "Atmospheric tritium was not sampled because an insignificant amount (less than 0.1 Ci/yr) is released by Pantex." Existing data on tritium in air, from other studies, should be included to confirm this statement.

I The DEIS presupposes and stresses a need for expansion and improvement of the existing facilities at Pantex. However, it fails to clarify whether the existing facilities and construction already in progress under option 4 can handle the projected workload. It also fails to clarify or give details on whether or how options 1, 2, and 3 will provide substantially increased reliability and increased protection of the public, workers, and environment. In this respect, it should be brought out more clearly that the "Current Criteria" are already met in the new facilities under construction under option 4 and in part at the existing assembly cells and assembly bays. The designation of option 4 as the "No Action" phase and its separation from option 1 are somewhat misleading, because option 4 includes construction of six of the eleven facilities proposed in option 1. These six facilities were scheduled for initiation of construction by the date of the DEIS, December 1982.

J We appreciate the opportunity to review and comment on the DEIS and Supplements "A" through "P" of the DEIS for the Pantex Plant Site.

Sincerely,

David M. Cochran, P.E.
Associate Commissioner for Environmental
and Consumer Health Protection

DLH:fhk

Enclosure

cc: Public Health Region 1, TDH
Bureau of Radiation Control, TDH
Bureau of Solid Waste Management, TDH
Water Hygiene Division, TDH
Occupational Health Program, TDH

DOE Response to Texas Department of Health on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

The paragraphs in the written comments were lettered for ease of reference.

Paragraph A (Title of Draft Environmental Impact Statement indicates the Pantex Plant is in Amarillo)

The title of the Environmental Impact Statement has been modified to reflect the Plant's location in Carson County.

Paragraph B (Enclosure of Draft Environmental Impact Statement and supplementary documents with comments)

Most of the remarks written on pages of the Draft Environmental Impact Statement were editorial and require no further comment other than the assurance that appropriate editorial changes were made to the text. Comments on the Draft Environmental Impact Statement that required written response are answered first; responses to comments on the supplementary documents are included subsequently in a separate section.

Section 2.2.1.1 (Concern expressed over possible beryllium emissions from the Interim Test-Fire Facility)

The text was modified to explicitly state that no beryllium or depleted uranium emissions will result from operation of the interim high-explosive test-fire facility.

Table 2.3.8-1 (Concern over operational work forces needed for partial move of nuclear weapons operations)

Figures for operational work forces are correct. If a partial move of nuclear weapons operations to the Iowa Army Ammunition Plant were to occur, a duplication of support operations would also occur. This duplication of effort would result in some redundancy in the work force (similar jobs at both Iowa and Texas).

Section 3.2.6.1 (Concern expressed over tritium monitoring and radioactive waste or accident residue being temporarily held at Pantex Plant)

See the discussion on tritium presented in response to paragraph H.

All previously stored operational radioactive waste has been removed from the Plant site and shipped to the Nevada Test Site. Currently generated waste is accumulated for up to 1 year in about 25 208-liter (55-gallon) steel drums. The level of contamination on the operational wastes (paper towels, rubber gloves, filters, etc.) is comparable to what is generated by a hospital performing radioisotope diagnosis and treatment or a university radiochemical laboratory. Additional information has been incorporated into Sections 2.3.6, 3.2.6.1, 4.3.1, and 4.3.3.1 regarding the routine wastes and their transportation.

The residue from military nuclear weapon accidents was all removed from below ground to aboveground storage in 1981. After measurement of its contents, about half was determined to be radioactive waste and was shipped to the Nevada Test Site. About 18 containers still remain at the Pantex Plant awaiting final decisions on whether some of those materials are recoverable or reusable. Additional information on the remaining weapons accident residue, contaminated or potentially contaminated soil associated with retrieving the accident residue, methods of transportation, and transportation risks have been added to Sections 2.3.6, 3.2.6.1, and 4.3.3.1.

Section 4.1.1.1 (Concern expressed over how standards for hydrogen fluoride will be met)

Hydrogen fluoride gas emissions from burning plastic-bonded explosives are controlled by a new set of administrative controls on the quantity of plastic-bonded explosives that may be burned at one time. These controls will assure that the high-explosive burning operations meet Texas State hydrogen fluoride standards. The establishment of these controls is described in Macdonell 1982.* The reference has been added to Section 4.1.1.1.

Section 4.1.6.1 (Concern expressed over emissions and ash from the proposed coal-fired power plant)

Under the most recent project plan for Pantex Plant, a power plant burning natural gas is proposed for construction. This plant will have the capability to use oil as a backup fuel and will retain the option to be converted to coal in the future. In spite of this, a design for a coal-fired plant was used in the Environmental Impact Statement because it would be expected to result in the maximum environmental impact.

In the event the powerplant were to be converted to coal at some future date, approximately 26,500 metric tons (29,200 tons) of coal with a 5 percent ash content would be burned per year, generating about 1,330 metric tons (1,460 tons) of ash. Except for the 1 percent of the fly ash that would escape the filters, all ash--about 1,330 metric tons (1,460 tons)--would be placed in a storage pit. The radionuclide concentrations in the ash are expected to be approximately 12 picocuries per gram for uranium series radionuclides, 10 picocuries per gram for thorium series radionuclides, and 28 picocuries per gram for naturally radioactive potassium. A discussion of this data is found in Buhl 1982.**

The ash would be contained to prevent blowing of the ash by the wind and transport through rain/snow runoff and/or percolation. Because of the proposed closed-waste storage system, only minimal release of ash would be expected, and the environmental impact would be insignificant. When a sufficient amount of ash was accumulated, the ash would be sold to a local manufacturer of concrete blocks or disposed of by a method developed to be acceptable under state and Federal regulations in effect at that time.

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*Macdonell 1982: D. G. Macdonell and J. M. Dewart, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Estimated Releases and Downwind Concentrations of Air Pollutants from Waste Organic Solvent Evaporation, Waste High-Explosive Burning, and High-Explosive Test Shots," Los Alamos National Laboratory report LA-9445-PNTX-G (1982).

**Buhl 1982: T. Buhl, J. Dewart, T. Gunderson, D. Talley, J. Wenzel, R. Romero, J. Salazar, and D. Van Etten, "Supplcmentary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Radiation Monitoring and Radiological Assessment of Routine Releases," Los Alamos National Laboratory report LA-9445-PNTX-C (1982).

Section 4.2.5 (Concern expressed over lack of data on particle sizes used in dispersion analysis)

A complete description of the dispersion analysis including particle size distributions is found in Dewart 1982.*

Paragraph C (Need for information for Texas Department of Health to develop an emergency response plan)

An environmental impact statement is not expected to provide a sufficient level of detail for complete development of an emergency response plan. However, representatives from the Pantex Plant are working with officials of the state, appropriate counties, and city of Amarillo to assure that appropriate information is available at all levels to develop comprehensive emergency plans.

Paragraph D

No response needed.

Paragraphs E and F (Organization and level of detail in the Draft Environmental Impact Statement were questioned)

The Draft Environmental Impact Statement was prepared in close conformity with Council on Environmental Quality regulations. The regulations at 40 CFR 1502.14 (b) indicate the requirement for "substantial treatment of each alternative considered in detail so that reviewers may evaluate their comparative merits." Thus, each alternative was treated in the Draft Environmental Impact Statement at a comparable level of detail.

At 40 CFR 1502.7, the regulations limit the size of the Environmental Impact Statement to "...normally be less than 150 pages and for proposals of unusual scope or complexity shall normally be less than 300 pages." Further, at 40 CFR 1502.15 the regulations regarding the description of the affected environment (Chapter 3 in the Draft Environmental Impact Statement) require that "The descriptions of the area(s) to be affected shall be no longer than is necessary and analyses in a statement shall be commensurate with the importance of the impact, with less important material summarized, consolidated, or simply referenced." Because of the judgment that existing impacts were insignificant, the summaries in Chapter 3 were brief. It is believed that Section 3.2, in particular, contains an appropriate amount of detail, given the importance of the impacts. The sources of more detailed information are identified as references. To satisfy the interest for more information regarding the Pantex Plant site, some elaboration on the radiological studies was included as Appendix 8.1 in the Draft Environmental Impact Statement.

Paragraph G (Locations of the firing sites and burning grounds are not shown on all figures)

The information is already available in the documents as published.

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*Dewart 1982: J. M. Dewart, B. Bowen, and J. C. Elder, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Dispersion Analysis for Postulated Accidents," Los Alamos National Laboratory report LA-9445-PNTX-D (1982).

Paragraph H (Concern was expressed over apparent lack of sampling for airborne tritium as part of the special Environmental Impact Statement studies)

The only two sources of routine release of tritium at the Pantex Plant are from opening incoming shipping containers and from disassembly of weapon components. The amounts released are based on measurements or other quantitative knowledge of the operations. During 1981 the estimated quantity of tritium released was 0.095 curie, which is an insignificant amount. [In 1982, the amount released was 0.083 curie (MHSM 1983);* annual releases in the future are expected to be no more than 0.1 curie as stated in Section 4.1.6.1 of the Environmental Impact Statement.]

The Pantex Plant routinely monitors for tritium in atmospheric water vapor, water, and vegetation in and around the Pantex Plant (Laseter 1982A,** MHSM 1982***). During 1981, as in previous years, there was no statistically significant difference between the tritium content of atmospheric water vapor, water, and vegetation samples taken at the Pantex Plant and the tritium content of similar samples taken at background locations. All atmospheric tritium samples (19 stations sampled weekly or about 950 total samples) during 1981 were less than 0.001 percent of the Department of Energy's Concentration Guides for tritium in air. Explicit reference to the routine measurements document was added to Section 3.2.6.1.

In addition to the sampling for tritium described above, environmental doses resulting from the release in 1981 of 0.095 curie of tritium were calculated using the AIRDOS-EPA computer code. The calculated 50-year dose commitment to the maximum exposed individual was less than 0.01 millirem (to whole body, the organ receiving the dose that is the highest fraction of the Radiation Protection Standards) per year of exposure. This dose is less than 0.001 percent of the 500 millirem per year Radiation Protection Standard for members of the public. It can be compared with the estimated 106 millirem per year whole-body dose from background radiation to persons living in the Pantex Plant area. The whole-body population dose from tritium to the persons living within 80 kilometers (50 miles) of the Pantex Plant area. The whole-body population 0.000002 person-rem. The whole-body population dose caused by background radiation to this same population was estimated to be 30,600 person-rem in 1981. The small doses predicted by AIRDOS-EPA suggest that radiological impacts from releases of this small amount of tritium are insignificant.

As further insight on the basis for the conclusion that the estimated 0.1-curie-per-year release is insignificant, the next three paragraphs discuss other sources of tritium and tritium found in some consumer products.

Tritium is produced naturally in the environment through the action of cosmic rays at the rate of 0.16-0.20 tritium atoms per square centimeter per second (NCRP 1979).+ This corresponds to 0.0077-0.0097 attocurie per square centimeter per second. Assuming that this global average rate is approximately valid

*MHSM 1983: William A. Laseter, "Environmental Monitoring Report for Pantex Plant Covering 1982," Mason and Hanger-Silas Mason Co., Inc. report MHSMP-83-11 March 1983.

**Laseter 1982A: William A. Laseter, "Summary of On-Site Environmental Monitoring Data for Pantex Plant Covering 1981," Mason and Hanger-Silas Mason Co., Inc., December, 1982.

***MHSM 1982: William A. Laseter, "Environmental Monitoring Report for Pantex Plant Covering 1981," Mason and Hanger-Silas Mason Co., Inc. report MHSMP-82-14 April 1982B.

+NCRP 1979: "Tritium in the Environment," National Council on Radiation Protection and Measurements report 62 (1979).

for the Pantex Plant area, we estimate that during 1 year 0.09-0.11 curie of tritium would be naturally produced by cosmic rays over any 3,700-hectare area (an area equal to the Pantex Plant), or an amount roughly equal to that released by Pantex Plant operations.

The contributions of the tritium released from natural processes and from Pantex Plant operations to tritium-in-air concentrations around Pantex Plant are expected to be small, compared to contributions from other sources. This can be seen from total global tritium inventories reported by the NCRP (1979). The global inventory of tritium in 1981 was estimated to be 1.2 billion curies, of which 1.1 billion curies resulted from atmospheric testing of nuclear weapons, 70 million curies came from natural processes, and the remainder from other sources. Air concentrations of tritium in the area around Pantex Plant can then be expected to be dominated by tritium from worldwide weapons fallout, with minor contributions from naturally produced tritium and tritium released by Pantex Plant operations.

Tritium is used in luminous wristwatches, either in tritium-activated paint used on watch hands and numerals, or in sealed sources behind liquid crystal display (LCD) units. According to the NCRP (1977),* the average tritium content per timepiece using tritiated paint ranged from 0.0013 to 0.0017 curie. The 0.1-curie-per-year release from Pantex Plant operations is equal to the amount of tritium found in 60 to 80 such timepieces. The LCD luminous wristwatches contain up to 0.2 curie of tritium (NCRP 1977). Thus, the amount of tritium released annually at Pantex Plant is roughly half that found in one of these watches. Doses from tritium releases at Pantex Plant, of course, are estimated to be many orders of magnitude smaller than the limit because of atmospheric dispersion, and the long 1-year release time (which would result in the tritium being dispersed in all wind directions over the year, rather than one person receiving the entire release).

Paragraph I (Requests clarification on capabilities of existing and proposed facilities, and expressed some concern over the definition of a "no action" alternative)

Section 2.1.2 provides summary information about the capabilities of existing structures and the Current Criteria applicable to new construction. Extensive additional detail on the design requirements for new construction are specified in the Department of Energy design manual cited in that section. Section 2.2.1.4, which defines Option 4, was revised to indicate that Current Criteria will be met by facilities now under construction.

Of the five facilities that were started in 1982, only No. 1 provides significant workload capacity and it represents more than 40 percent of the total $53 million cost. This $53 million is only about one-fourth of the complete cost for option 1. If option 1 were selected, projects No. 2, 3, and 4 scheduled for construction starting in late 1983 (see Table 2.2.1-1) would represent a much more significant increase in workload capacity. Since the Plant already exists, option 4 truly represents the best definition of "no action" where an ongoing program continues as new plans are developed.

This definition is supported by the Council on Environmental Quality, which states "the no action alternative may be thought of in terms of continuing with the present course of action until that action is changed" (46 FR 18027).

Paragraph J

No response required.

*NCRP 1977: "Radiation Exposure from Consumer Products and Miscellaneous Sources," National Council on Radiation Protection and Measurements report 56 (1977).

DOE Response to Texas Department of Health on Supplemental Documents to the Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

The Supplemental Documents are identified by their reference citations as used in the Environmental Impact Statement and their subtitles that indicate subject matter.

Buhl 1982; Radiation Monitoring and Radiological Assessments of Routine Releases

Procedures for Leak Testing Sealed Sources (Concern expressed that these procedures were not described)

Sealed sources containing plutonium, enriched uranium, and radioactive cobalt are present at the Pantex Plant. Each plutonium and uranium source is leak tested and inspected upon receipt by wiping the source and analyzing the wipe for alpha activity. Care is taken that the wipe is dry when counted to prevent absorption of alpha particles by moisture. Since these sources are only at Pantex Plant for a short time, they are usually leak tested once.

The radioactive cobalt sources are leak tested at least every 6 months. The leak test is capable of detecting at least 0.005 microcurie of removable contamination.

Reporting of Radiological and Chemical Data for Playa Lake No. 1 (Statement that radiological and chemical data should be presented in this report)

The geohydrological data has been reported in Purtymun 1982A.* That report documents the methodology and data of the ground water, surface water, soil, and sediment sampling performed in determining potential geohydrological transport of chemicals and radionuclides.

Atmospheric Tritium (Concern that atmospheric tritium sampling was not included in the special studies)

Results of the routine monitoring program for tritium were considered complete. Additional discussion of tritium was provided in the response to the Texas Department of Health comment, paragraph H.

Dewart 1982; Dispersion Analysis for Postulated Accidents

Base Maps (Question about use of particular scale for discussion topic)

The same base maps were used for all discussions. This was done under the assumption that using the same base maps in all documents would be less confusing to the majority of readers. The socioeconomic discussions required an 80-mile (130-kilometer) radius, and this radius was used uniformly on all base maps.

*Purtymun 1982A: W. D. Purtymun, N. M. Becker, and Max Maes, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Geohydrologic Investigations," Los Alamos National Laboratory report LA-9445-PNTX-H (1982).

Purtymun 1982A; Geohydrologic Investigations

Agricultural Water Usage (Question on why a comprehensive study of irrigation water was not performed)

This question is answered by the response to the Texas Parks and Wildlife Department.

Purtymun 1982B; Geohydrology

Figure Showing Contours on Top of Aquifer (Question about validity of conclusions drawn from figure)

The land surface is close enough to flat to draw correct conclusions from this figure. The figure was taken from a Texas Department of Water Resources report; however, the citation's date should have been 1979. This document will not be republished to correct this minor error.

Solid Waste Landfill Areas (Concern about possible burial of radioactive waste)

No radioactive wastes are buried in any of the landfill areas. All radioactive wastes are packaged and shipped to the Nevada Test Site for disposal.

Brine Contamination of Aquifers (Question about how aquifers could be contaminated by brines in surface pits when statements are made that virtually no chance of aquifer contamination exists at the Pantex Plant)

The hydrologic setting at Pantex Plant is entirely different than in the Panhandle oil and gas field. This information was included to provide a regional context. The oilfield brines were disposed of into pits in the area of Skellytown, Pampa, and Lefors. The Ogallala Formation in that part of the Panhandle oil and gas field is thin or absent, stripped off by erosion, and is not considered an aquifer to supply water for industrial, domestic, municipal, or agricultural uses. "Contamination of ground water by oil field brines has been in shallow aquifers (less than 100 ft) where the soil is sandy. The Panhandle oil and gas field was developed in a belt of highly mineralized waters. As a consequence industry had to obtain water outside this belt for most industrial use and municipal supply." (See Texas Water Commission Bulletin 6402, 1964). The depth to water at the Pantex Plant is over 90 meters (400 feet) with the upper section of the Ogallala Formation consisting of relatively impermeable silts and clays.

Schnurr 1982B; A Description of Facilities and Estimation of Resource Requirements

Termination of Nuclear Weapons Operations (Question about the Department of Energy's responsibility)

This Environmental Impact Statement does not attempt to analyze and evaluate the possible alternatives to the Nation's nuclear defense policies, for example, the alternative of putting "a freeze on production, testing, and deployment of nuclear weapons." The statement does not assess the environmental impacts of the U.S. nuclear defense policy, but rather focuses on the site-specific environmental impacts of conducting nuclear weapons production, maintenance, modification, surveillance, and retirement operations at Pantex Plant and/or elsewhere.

U.S. defense policy and nuclear weapons requirements in support of that policy restrict alternatives as to the Department of Energy's nuclear weapons operations. However, the converse is not true. The Department of Energy's production of nuclear weapons does not foreclose options with respect to the overall U.S. national defense program.

Decontamination and Demolition (Concern about what work would need to be performed and what it would cost)

An estimate of the cost of decontaminating and demolishing the Pantex Plant was prepared for the Environmental Impact Statement. This estimate assumed that the entire area would be decontaminated and all building materials would be removed. The grounds would then be returned to farming or used for other industrial purposes.

The estimate was based on a figure of $6.59 per square foot for demolition ($4.69 per square foot for labor and $1.90 per square foot for materials). Decontamination costs were assumed to be 10 percent of the demolition cost plus a minimal amount for material costs. The general cleanup costs were assumed to be 20 percent of the decontamination costs. Typical construction markup rates were used.

The intent of this analysis was to provide a rough estimate of the cost of decontamination and decommissioning. A more accurate estimate would require a detailed study of construction plans for all facilities (more than 200 buildings). The simplified procedure was judged to be satisfactory for use in the Environmental Impact Statement.

Wenzel 1982A; Agricultural Food Chain Radiological Assessment

Potential Crop Contamination (Concern that crops and irrigation water should be sampled and analyzed)

Crops grown onsite and water from onsite were sampled. The details of these studies are presented later in the subject report. Additional related data on soils and garden produce are given in Buhl 1982.* The results of these studies show no levels of tritium, uranium, or plutonium above background levels in foodstuffs. The soil samples showed no offsite levels of uranium or plutonium above background; soils collected at the firing sites did show elevated uranium, as expected. In addition to these special studies, routine monitoring at Pantex Plant samples air, soil, water, vegetation, and wildlife. The results of this monitoring program are published annually in a surveillance report (MHSM 1982, MHSM 1983).

Wiggs 1982A; A Comparison of County and State Cancer Mortality Rates

Study Design (Concern expressed about study design)

When this investigation was designed to study cancer mortality rates in the counties near the Pantex Plant, three rates were considered for comparisons: (1) U.S. cancer mortality rates; (2) pooled cancer

*Buhl 1982: T. Buhl, J. Dewart, T. Gunderson, D. Talley, J. Wenzel, R. Romero, J. Salazar, and D. Van Etten, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Radiation Monitoring and Radiological Assessment of Routine Releases," Los Alamos National Laboratory report LA-9445-PNTX-C (1982).

mortality rates for a group of similar Texas counties; and (3) Texas state rates. United States rates were not considered the most desirable because cancer rates vary by geographic region. Therefore, United States rates might not be a good comparison for cancer mortality among Texas residents.

The use of pooled county rates as a basis for comparison had three major problems. First, it was very difficult to select appropriate counties for comparison because numerous factors (availability of medical services, industrialization, population density, etc.) can influence a county's cancer mortality rate. These factors often affect cancer rates for various anatomical sites differently, which compound the difficulty for making meaningful mortality comparisons for many cancer sites. Second, the age-specific county cancer mortality rates (which are required to pool county rates) were not available at the time of the study. Third, pooled county rates would be based on a relatively small population base and have a large associated standard error. This precludes using a single county (e.g., Armstrong) as a useful comparison.

Texas state rates were adopted because they were considered more representative of the study population than United States rates and because they are more stable than county rates. It was recognized that comparisons with Texas state rates were not ideal; however, for the purpose of this study the Texas rates were considered suitable. Important confounding factors like age, sex, and race were controlled by the use of sex- and race-specific age-specific rates. Another important factor, population density, was similar, although not identical, in both the study region and the entire state. In practice, moderate differences in population density do not greatly affect mortality rate comparisons. This is especially true in this instance because both the State of Texas and the counties included in the study would be grouped similarly with respect to urbanization in most analyses. Finally, the possible confounding effect of ethnicity on mortality comparisons was considered. However, the percentage of persons of Hispanic descent was lower in the study areas than in the state of Texas. The higher percentage of Hispanics in the state of Texas rates would act to highlight high mortality rates for most cancer types near the Pantex Plant because cancer mortality is generally lower among Hispanics. However, the opposite would be true for liver and stomach cancer, which are known to be more frequent among Hispanic populations. The difficulty in obtaining accurate census counts of Hispanic residents in the State and by the county precluded analysis of this possible effect of ethnic variation on cancer rates.

The data that served as a basis for the analysis did not include rates for periods before 1950. Indeed, pre-1950 data was not generally available and would be of limited usefulness as a baseline because of the tremendous changes in medical care and cancer reporting over the past 40 years. The period 1950-1959 is considered a more appropriate baseline because the long latent (or induction) period associated with cancer precludes any influence from Plant operations (beginning in 1951) on cancer mortality at the Pantex Plant. Further, the recently completed analyses of worker mortality provides a much more sensitive measure of health effects related to Plant operations because occupational exposures to radiation and chemicals would be higher than any offsite ambient exposures (Acquavella, 1982).* In this context, the study of county mortality rates should be considered preliminary to the more definitive work force study.

*Acquavella 1982: J. F. Acquavella, L. D. Wiggs, R. J. Waxweiler, D. G. Macdonell, and G. S. Wilkinson, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Occupational Work Force Mortality Study," Los Alamos National Laboratory report LA-9445-PNTX-Q (December 1982).

The results of the work force study showed that mortality is significantly lower than expected among Pantex Plant workers. Moreover, length of employment, time since first employment, or radiation exposure did not affect either the frequency or cause-specific distribution of worker mortality. Thus, general population effects from Pantex Plant operations are highly unlikely. In any event, the statistical detection of valid general population effects was probably optimized by use of the Texas State rates as a basis for comparison.

TEXAS DEPARTMENT OF WATER RESOURCES
1700 N. Congress Avenue
Austin, Texas

TEXAS WATER DEVELOPMENT BOARD
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February 18, 1983

RECEIVED
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OFFICE OF THE GOVERNOR
O.M.B./O.P.I.R.

Mr. Harden Wiedemann, Director
Governor's Office of Planning and
Intergovernmental Relations
P. O. Box 13561
Austin, Texas 78711

Dear Mr. Wiedemann:

RE: U.S. Department of Energy - Draft Environmental Impact Statement (DEIS) Relative to Government-owned Pantex Plant Site, Amarillo, Texas. Report No. DOE/EIS-0089-D. December 1982.

In response to your memorandum of January 29, 1983, members of the Texas Department of Water Resources (TDWR) staff have reviewed the subject DEIS which evaluates and justifies the Department of Energy's proposed action to continue nuclear weapons operations and to construct additional facilities for nuclear weapons operations at the Pantex Plant, located in the Panhandle of Texas in Carson County, near the City of Amarillo.

We offer the following staff review comments from the standpoint of our responsibilities relative to water resources planning, development, and regulation, and the governmental interagency review requirements of Federal Executive Order 12372:

1. Reference is made to DEIS section 3.2.2.1, page 3-13 regarding Permit No. 02296, issued by the Texas Department of Water Resources to the U.S. Department of Energy Pantex Plant on May 19, 1980, authorizing the disposal of specified wastewaters, pursuant to the provisions of Chapter 26 of the Texas Water Code. In view of the following special provision in section VI of Permit No. 02296, we suggest that the discussion in the DEIS be expanded to clarify whether the proposed additional facilities at the Pantex Plant will result in changes to the permitted quantity (i.e., 600,000 gallons per day), quality, and point of discharge (specified in section V of Permit No. 02296) of industrial and domestic wastes discharged at the Plant, or result in other changes in specified quantitative special provisions of the Permit:

   "8. In the event the industrial operations at the Pantex Plant are expanded, the permittee shall notify the Texas Department of Water Resources and submit an application for an amended permit if the quantity and quality of the discharge will be changed due to addition of industrial facilities."

P. O. Box 13087 Capitol Station • Austin, Texas 78711 • Area Code 512/475-3187

Mr. Harden Wiedemann
Page 2
February 18, 1983

2. Reference is made to DEIS Section 3.2.3.1, page 3-16 regarding "permit 30459" pertaining to the handling and disposal of hazardous and toxic solid wastes generated at the Pantex Plant. To be accurate, we suggest that the expression "State of Texas permit 30459" be revised to read "Texas Department of Water Resources Industrial Solid Waste Registration No. 30459." The registration of data relative to industrial solid wastes and the associated disposal facilities is not a permit; it does not constitute authorization of the registered wastes, disposal facilities, or the operation pertaining thereto. The registration does, however, reflect a company's responsibilities for complying with TDWR Solid Waste Management Rules pertaining to shipping and reporting requirements for Class I and Class II wastes and deed recordation requirements for ultimate disposal facilities. The registration also provides the State and Federal regulatory and management agencies concerned, access to stored information pertaining to industrial solid waste management, in order to carry out the State regulatory program pursuant to requirements of the Federal Resources Conservation and Recovery Act and the Texas Solid Waste Disposal Act. Generators of industrial solid wastes in Texas have a continuing responsibility to provide the TDWR with a written notice of any changes in waste management. Waste management at each facility is reviewed by the TDWR staff for compliance with the Rules of TDWR and the provisions of the Texas Solid Waste Disposal Act and the Federal Resource and Recovery and Conservation Act. The information collected from waste generators provides a data base for solid waste management planning, especially in assessing facility needs and predicting quantities of wastes generated. (REFERENCE: Subchapter III B of Volume II of the SOLID WASTE MANAGEMENT PLAN FOR TEXAS, 1980-1986. Texas Department of Water Resources, January 1981). Hence, we suggest that the DEIS include assurance that TDWR will be notified if the proposed additional facilities at the Pantex Plant will result in changes in the types, quantities, and methods of management of the industrial solid wastes, previously registered. Similarly, notification should be given if any new wastes, not previously registered, will be generated as a result of plant expansion. A permit may be required for new hazardous waste management activities.

3. Reference is made to the evaluation of industrial solid waste handling and disposal presented in DEIS section 3.2.3.1, pages 3-16 and 3-17. The TDWR staff believes that the evaluation in the DEIS should be revised so as to reflect a careful consideration of the TDWR rules as applicable. The following summarizes the TDWR staff review of the solid waste management facilities based on information provided by Pantex in the current Industrial Solid Waste Registration No. 30459 and the Part A Hazardous Waste Permit Application form.

(1) Neutralization-Evaporation Pit (Registration No. 30459, Facility No. 1).
The hypalon-lined pit is shown to receive a Class II waste stream (Waste Code 200830). The Part A application does not show this facility as being used for hazardous waste management. Please note that if the pH of the stream into pond ever falls below 2.0 standard units or if the concentrations of metals listed under 40 CFR 261 exceed the limits of EP toxicity the unit would appear to be a hazardous waste management unit, thus subject to applicable regulations.

(2) Open Controlled Incineration Site (Registration 30459 Facility No. 4)
According to the facility Part A Hazardous Waste Permit Application, high explosive contaminated solvents and waste materials are burned at the "Burning Ground." Please note that open burning allowed under TAC Section 335.386 applies only to waste materials which have the potential to detonate as defined by that paragraph and which cannot be safely disposed of through other modes of processing. This would apply to wastes currently being generated as well as wastes generated as a result of any expansion at this facility.

(3) Landfill (Registration Facility 2)
Although the registration file indicates only Class II and III wastes are placed into this facility, we understand that residues from incinerated wastes also are collected and landfilled. We feel that the placement of any hazardous substances into the landfill will require compliance with the hazardous waste rules. We recommend that Pantex test these residues to determine their hazardous characteristics, if any, and review the waste management system to determine if residues from any listed hazardous wastes are placed in the unit.

(4) Retention Basin (Playa Lake)
No hazardous characteristics were noted in the numerous analyses of wastewater which is discharged to the Playa. However, if listed hazardous wastes are managed in any solid waste management unit which discharges to the playa, the playa would appear to be subject to the hazardous waste regulations.

It should be noted that RCRA ground-water monitoring was to have been in effect by November 19, 1981 at all applicable hazardous waste facilities. Therefore, it is suggested that the DEIS reflect the fact that the Pantex facilities have been screened to ensure that appropriate actions have been taken to bring the

Mr. Harden Wiedemann
Page 4
February 18, 1983

Pantex waste operations into compliance with applicable State and federal laws and regulations.

Sincerely,

Charles E. Nemir
Executive Director

DOE Response to Texas Department of Water Resources on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

1. Permit No. 02296 (Concern expressed over whether the proposed action will result in changes to the permitted quantity, quality, or points of discharge, or result in other changes that violate the permit)

Section 4.1.2.1 has been modified to explicitly state that no significant change in either quantities, quality, or points of discharge is expected from any option.

Proposed Project 8 (Alternate Energy Source Project) in the Draft Environmental Impact Statement (Section 2.2.1.1) has been changed from a coal-fired to a natural-gas-fired power plant. The Pantex Plant will notify the Texas Department of Water Resources concerning possible changes in Permit No. 02296.

The Damaged Weapon Complex (part of Project 2) in the Draft Environmental Impact Statement (Section 2.2.1.1) will not be built. Therefore, it will not affect Permit No. 02296.

All the other proposed projects are mechanical assembly facilities or replacements of existing facilities, so they will have minimal effect on the quantity, quality, and points of discharge of the liquid effluents (specified in Section V of Permit No. 02296). The Pantex Plant will notify the Texas Department of Water Resources if any proposed project results in changes in liquid effluents that would not meet the provisions of Permit Number 02296.

2. Permit No. 30459 (Citation of permit needs correction, and the Texas Department of Water Resources needs notification if there are changes in the types, quantities, or methods of management of the industrial solid wastes)

Section 3.2.3.1 has been modified as requested. Any changes in the types, quantities, or methods of management of industrial solid or hazardous wastes that have been previously registered will promptly be brought to the attention of the Texas Department of Water Resources. Likewise, notification will be given if any new wastes, not previously registered, are generated as a result of plant expansion or operational changes in the future.

3. Industrial Solid Waste (Careful consideration of the Texas Department of Water Resources rules for solid waste handling and disposal is necessary)

Representatives from the Pantex Plant have maintained close contact with the Texas Department of Water Resources concerning ground-water monitoring requirements pursuant to Solid Waste Registration No. 30459. Texas Department of Water Resources staff indicated that monitoring would not be required if the wastes were nonhazardous or if there were a low potential for migration of wastes into water supply wells or surface waters (Johnson 1983A).* Subsequent analyses and information have been provided to the Texas Department of Water Resources showing that no hazardous wastes (as defined by 40 CFR 261) are disposed of

*Johnson 1983A: G. W. Johnson, Amarillo Area Office Department of Energy, "Ground Water Monitoring Requirements," letter to C. R. Miertschin, Texas Department of Water Resources (March 2, 1983).

at the Pantex Plant (Johnson 1983B).* Pantex Plant waste operations are monitored to ensure that appropriate actions will be taken to maintain these operations in compliance with applicable state and Federal laws and regulations.

(a) Neutralization--Evaporation Pit (Concern that this facility may be handling hazardous waste)

The nitrate mixture from the high-explosive synthesis facility is neutralized with caustic before being pumped into a plastic membrane-lined pit. Analysis of the effluent water from the pit indicates no problems with toxic metals. See Table XX in Laseter 1982.**

(b) Open Controlled Incineration Site (Concern that materials not covered by permits were being burned at the incineration site)

High-explosive-contaminated solvents are evaporated in tanks. The dry residue containing high explosive that remains after evaporation is burned. Permission to burn high-explosive-contaminated materials was granted by the Texas Air Control Board [(1) Letter from Charles R. Barden, Executive Director of the Texas Air Control Board to P. R. Wagner, Area Manager, U.S. Atomic Energy Commission, dated August 1, 1974 and (2) Letter from Cecil L. Bradford, Director of Compliance Division of the Texas Air Control Board to P. R. Wagner, Area Manager, U.S. Energy Research and Development Administration, dated July 9, 1976].

A new waste incinerator at the burning ground is being considered as an FY 1985 project. It will be designed to burn high-explosive-contaminated solid waste (cardboard boxes, industrial wipes, etc.) and high-explosive-contaminated solvents. It will be natural-gas fired. Needs for air pollution control equipment and/or monitors have not yet been determined; however, appropriate interaction with the Texas Air Control Board will be initiated during design to assure compliance with all applicable regulations.

(c) Landfill (Concern that the residue placed in the landfill from incinerated wastes may be classified as a hazardous substance)

Residues from burning pads where high-explosive waste materials are incinerated are scraped from the pads about every 4 to 6 weeks and buried in a landfill near the burning ground site. Normally, a few pounds [about 0.03 cubic meters (1 cubic foot)] of residues from each cleanup are buried. Analysis of these residues show that they contain less than about 15 parts per million TNT and less than about 1.5 parts per million HMX. These are extremely low levels of high-explosive contamination and are not considered hazardous. After performing these analyses on the residues and reviewing the waste management system, the conclusion was that no hazardous substances are now being buried in the landfill (Johnson 1983).

(d) Retention Basin (Playa Lake No. 1) (Concern that discharges to the playa may contain hazardous wastes)

No hazardous wastes are managed in any solid waste management unit that discharges its effluents to the playa.

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*Johnson 1983B: G. W. Johnson, Amarillo Area Office Department of Energy, "Ground Water Monitoring Requirements ," letter to Robert Fleming, Texas Department of Water Resources (May 11, 1983).

**Laseter 1982: W. A. Laseter, Mason Hanger-Silas Mason Co., Inc., "Summary of On-Site Environmental Monitoring Data for Pantex Plant Covering 1981" (December 1982).

TEXAS
PARKS AND WILDLIFE DEPARTMENT

CHARLES D. TRAVIS
EXECUTIVE DIRECTOR

4200 Smith School Road
Austin, Texas 78744

February 3, 1983

Mr. Harden Wiedemann, Director
Governor's Office of Planning and
Intergovernmental Relations
Post Office Box 13561
Austin, Texas 78711

Re: Pantex Plant Site, Amarillo, Texas.
EIS #3-01-50-005

Dear Mr. Wiedemann:

The following information is provided concerning the above-referenced project.

Since the proposed work would presumably entail only an expansion of the present existing facility, significant adverse impacts upon extant wildlife resources are not apparent. However, providing basic information on the flora and fauna found at Pantex Lake would be helpful in assessing the possible impacts of project construction upon the wetland habitat.

The opportunity to provide comments on this project is appreciated.

Sincerely,

Charles D. Travis
Executive Director

CDT:RWS:jlm

DOE Response to Texas Parks and Wildlife Department on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

The Texas Parks and Wildlife Department expressed concern over lack of habitat data at Pantex Lake. Pantex Lake is an intermittent lake several miles northeast of the Pantex Plant. The site is retained by Department of Energy for possible well-field expansion to furnish water for the Pantex Plant. Pantex Lake does not receive discharges from Plant operations, nor is it expected to receive any discharges from future Plant operations. In addition, Pantex Lake would not qualify as a wetland habitat because it is dry most of the year. Leaseholders irrigate portions of Pantex Lake for crop production and use the remainder as pasture for livestock. Organic chemicals (pesticides) carried by runoff from farming operations could be present in the intermittent lake. However, no pollutants from Pantex Plant operations would be present, as no hydrologic connection exists between the intermittent lake and the Pantex Plant's operation.

If Pantex Lake was confused with Playa Lake Number 1 at the Pantex Plant, the following materials should answer your concerns. The EIS states in Section 3.2.4.1:

> "...most elements and pollutants measured are below the desired maximum levels for irrigation waters (Dawson 1974) and also are below the proposed Environmental Protection Agency criteria for agricultural usage. Additional water and sediment sampling done specifically for this Environmental Impact Statement (Purtymun 1982A, Purtymun 1982B) also show priority pollutants to be at or near background levels. Based on the low levels of pollutants, no environmental impacts would be expected. Wildlife using this playa or the other playas would not ingest heavy metals or other pollutants at levels considered harmful. Therefore, further field studies of the various food chains or ecological pathways associated with these aquatic ecosystems were deemed unnecessary."

Playa measurements were compared with values expressed in the Dawson report on chemical toxicity of elements* and proposed criteria for agricultural practices** because both sets of values are generally far below levels required to produce measurable adverse impacts. Because levels of pollutants measured in the playas are near or below the compared limits, ecological pathway studies are not considered necessary because measurable adverse impacts will not be present.

The attached table shows (1) measured levels of pollutants in Playa Lake Number 1 for 1981, (2) the Dawson criteria, and (3) the agricultural criteria. The data show that most measured pollutants are below the proposed limits; therefore, additional studies were not performed.

The value of one pollutant (cyanide) was three times the proposed criterion for fresh-water aquatic life. Jones (1964) reported that free cyanide concentrations from 0.01 to 0.05 milligram per liter can be fatal to sensitive species.*** However, the sensitive species studied by Jones are members of the

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*G. W. Dawson, "The Chemical Toxicity of Elements," Pacific Northwest Laboratories report BNWL-1815 (June 1974).

**"Comparison of NTAC, NAS, and Proposed EPA Numerical Criteria for Water Quality," U.S. Environmental Protection Agency, undated and unnumbered report.

***J. R. E. Jones, Fish and River Pollution (Butterworth and Co., London, 1964).

trout family (Salmonidae); and warm-water temperatures in playas preclude these species. Public Health Service Drinking Water Standards allow up to 0.2 milligram per liter of cyanide;* this is an amount 15 times higher than the average concentration (0.014 milligram per liter) measured in Playa Lake Number 1.

As shown in Table I, fluoride levels in Playa Lake Number 1 are slightly above those levels proposed as agricultural limits by the Environmental Protection Agency. At the levels measured, livestock drinking this water may develop mottled teeth; however, these levels are not excessive from the standpoint of animal health or the deposition of this element in meat or milk.** Fluoride levels must be elevated to 10 to 15 milligrams per liter before chronic fluoride poisoning of livestock occurs.*** In addition, the levels of fluoride measured in Playa Lake Number 1 are similar to fluoride levels found in ground water throughout Carson County, Texas,+ and are a direct result of the ground water used for drinking water and sanitary discharges at the Pantex Plant.++

An additional point of interest is that Playa Lake Number 1 would be dry most of the year without effluent from Pantex Plant operations. This small aquatic ecosystem is a direct result of the discharge of treated effluents from the Pantex Plant sanitary treatment plant.

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*"Public Health Service Drinking Water Standards," Public Health Service, Department of Health, Education, and Welfare, Washington, DC, 1962.

**"Proposed Criteria for Water Quality--Volume 1," United States Environmental Protection Agency, unnumbered report (October 1973).

***E. J. Underwood, Trace Elements in Human and Animal Nutrition (3rd Edition, Academic Press, Inc., New York, 1971).

+Cris Guard, "Ground Water Conditions in Carson County, Texas," Texas Board of Water Engineers bulletin 5802 (1959).

++W. D. Purtymun and N. M. Becker, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Geohydrology," Los Alamos National Laboratory report LA-9445-PNTX-I (1982).

TABLE I

COMPARISON OF 1981 POLLUTANT CONCENTRATIONS IN PLAYA LAKE NUMBER 1 TO PROPOSED CRITERIA FOR WATER QUALITY (milligrams per liter)

Pollutant	Playa Lake No. 1	Dawson's Aquatic Life	Dawson's Agriculture Irrigation	EPA Agriculture Irrigation	EPA Agriculture Livestock	EPA Fresh-Water Aquatic Life
Ag (Silver)	<0.01	0.01	--	--	--	--
As (Arsenic)	<0.01	0.20	0.10	0.10	0.20	--
Ba (Barium)	<0.20	0.50	1.0	--	--	--
Cd (Cadmium)	<0.003	0.0001	0.005	0.01	0.05	0.03
Cr (Total Chromium)	<0.003	--	--	0.1	1.0	0.05
Cr^{+6} (Hexavalent Chromium)	<0.01	0.05	1.0	--	--	--
Cu (Copper)	0.011	0.20	0.20	0.20	0.50	--
CN^{-1} (Cyanide)	0.014	--	--	--	--	0.005
F^{-1} (Fluoride)	2.3	--	--	2.0	2.0	--
Fe (Iron)	0.060	0.20	5.0	5.0	--	--
Hg (Mercury)	<0.0001	0.01	--	--	0.0001	--
NO_3 (Nitrate)	0.72	--	--	--	100.0	--
Pb (Lead)	0.004	0.10	5.0	5.0	0.1	0.03
Phenols	0.011	--	--	--	--	0.10
PO^{-3} (Phosphate)	0.93	40.0	--	--	--	--
Se (Selenium)	0.005	0.01	0.02	0.02	0.05	--
SO_4^{-2} (Sulfate)	86.0	1400.0	200.0	--	--	--
Zn (Zinc)	0.048	0.10	5.0	--	25.0	--
pH	7.5	--	--	4.5-9.0	--	6.0-9.0
TSS	0.7	--	--	--	--	80.0
TDS	496.0	--	--	500-1000	--	--

Air Transport Association **ata** OF AMERICA

Southwest Regional Office
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March 11, 1983

Mr. Alex Griego
Environmental Engineer
Operational Safety Division
Department of Energy
Albuquerque Operations Office
P. O. Box 5400
Albuquerque, New Mexico 87115

Dear Mr. Griego:

This refers to Draft Environmental Impact Statement, DOE/EIS-0098-D, Pantex Plant Site, Amarillo, Texas.

One of the alternative measures being investigated is a proposal to extend the existing P-47 Prohibited Area to be vertically unlimited and reach horizontally out to 4 kilometers beyond the plant boundary.

The P-47 airspace was designated 5 years ago to protect the Pantex installation from low flying aircraft. As was recognized at that time, because of airspace used and required to operate Amarillo International Airport, it is not feasible to designate an unlimited prohibited area. Any expansion of P-47 vertically or any expansion horizontally toward the airport would adversely affect approaches to Runway 22 and departures from Runway 4.

Because of the conflict with airspace required to provide air service to Amarillo, we consider the proposed expansion of P-47 not acceptable as an alternative measure.

Sincerely,

D. Merrill

Denzil Merrill
Director

(Concern expressed over mitigation measure of extending the existing P-47 Prohibited Area to reduce air traffic)

The proposal to enlarge the prohibited airspace presented in the Draft Environmental Impact Statement had the goal of increasing the distance between flight paths and the Pantex Plant facilities. This Final Environmental Impact Statement has been modified to include other types of administrative control measures, some of which are being planned for implementation by the Federal Aviation Administration and others that will be discussed further between the Department of Energy and the Federal Aviation Administration that could reach the same goal without adverse disruption of local air traffic. These proposed measures are discussed in Section 2.6.2, and elaborated in responses to the Federal Aviation Administration and to Southwest Airlines comments.

AMARILLO
CHAMBER OF COMMERCE
Phone 806/374-5238 1000 South Polk
P. O. Drawer 15207 Amarillo, Texas 79105

March 7, 1983

Mr. Alex Griego
Environmental Engineer
Operational Safety Division
Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, NM 87115

Dear Mr. Griego:

On behalf of the Amarillo business community, as represented by our membership of approximately 1,300 business firms, our Board of Directors has authorized this response to the Department of Energy's draft environmental impact statement for the Pantex Plant Site, Amarillo, Texas (DOE/EIS-0098-D).

The Amarillo Chamber of Commerce supports fully the DOE proposal "...to continue operations and to construct additional facilities at the Pantex Plant near Amarillo, Texas..."

Before commenting upon the DEIS, we call attention to the tremendous positive attitudes of Amarillo citizens. This is a factor not included in the Statement, yet it is of immeasurable value in terms of productivity and enjoyment of life for Plant personnel.

A study by Adcock and Associates of Albuquerque was presented to the Department of Energy in September of last year. This random sample survey of a cross section of the community revealed that more than three out of four consider Amarillo a good place to live and raise a family, rating the community seven on a scale of one to ten. About one half see the quality of life as improving.

Over 82 per cent of the respondents said they favor continued operation of Pantex Plant. Only 7.2 per cent were opposed.

The percentage favoring major expansion/renovation of the Plant was only slightly less (81.4 vs. 916 opposed).

Over 82 per cent also said they experienced no stress or anxiety about Pantex Plant, and less than five per cent said that major expansion/renovation would cause more stress.

These opinions and attitudes were reflected with little variation across the spectrum of age, sex, income, education, race, religion, etc.

The DEIS contains abundant justification to retain and expand the Pantex Plant, but little or no support for relocation.

Retention and expansion at Amarillo would be the least expensive alternative. Considering the three extreme cases of complete relocation to Burlington, Iowa or Richland, Washington, or complete replacement of major facilities at Pantex, estimates (in 1981 dollars) are $1.488 billion for Burlington, $1.552 billion for Richland, and only $1.437 billion for Amarillo, even including all planned new construction ($198 million) under Option 1 before complete replacement is undertaken under Option 3. (DEIS S-3).

Relocation of operations from the Pantex Plant also would create some significant additional costs by disrupting the present permanent work force, and by losing part of that work force.

Environmental considerations offer no support for relocating any of the Pantex Plant operations. Those studies are summarized in the DEIS (S-5) as follows:

> "Studies of the enviroment in and around the Pantex Plant, which has operated for more than 30 years, found no significant accumulations of pollutants (including radioactive materials), no significant adverse effects on air or water, and no significant adverse impacts on the use of surrounding lands. None would be expected from normal operations under any option."

> "An epidemiology study revealed no indication of unusual cancer mortality patterns in counties near the Pantex Plant or any effect attributable to the Plant."

Local supplies of water, energy, labor and community services are more than adequate for Pantex expansion (DEIS S-5,6).

The Amarillo economy would suffer serious losses by relocation of the Pantex Plant. Some of those losses are highlighted in the DEIS (2-22, 3-36, 4-19,22):

2,400 jobs at Pantex Plant

2,400 other jobs in the Amarillo area

5.5% of the labor force in the Amarillo trade area

4.7% of the population within commuting distance of Pantex Plant

$54.4 million payroll at Pantex Plant (in 1981)

$3.5 million Pantex Plant local purchases of goods and services

$48.5 million secondary payrolls

$54.9 million in retail sales

$65,000 per year in Federal impact funds to local school districts

Such major losses would result in negative growth for Amarillo for at least the next five to ten years. It would be the second such experience in recent years due to relocation of a Federal government facility. Amarillo population declined by 7.9% from 1960 to 1970, due directly to the closure of Amarillo Air Force Base in 1968.

With regard to the potential for an accident that would release radioactive materials, the DEIS concludes that aircraft crashes are virtually the only credible source (2-28). It estimates the "upper limits" of that risk at 1 chance in 6,700 per year of operation under Option 4 (existing facilities), based on 1981 aircraft traffic over the plant site (4-28).

Obviously there is some chance of a crash onto the Pantex Plant Site when aircraft fly over it. That chance has been greatly reduced by the present prohibition of overflights below 1,200 feet (AGL). There is still a much lesser chance that an aircraft will crash into a building, since about 80 per cent of the 9,100 acres of land within the Plant boundary is leased for agricultural purposes (DEIS 3-2).

The estimate of 1 chance in 6,700 would appear to be at the very extreme "upper limit" range of risk, to say the least. Since this estimate is based on 1981 aircraft traffic over the Plant Site, it must mean that crashes onto a building containing radioactive materials are expected to occur at the rate of 1 per 6,700 overflights per year.

There were a total of 102,515 aircraft operations at Amarillo International Airport in 1981. If the DEIS estimate were applied there, 15 crashes should have resulted. But there were no crashes anywhere around the airport, much less within a very small, defined area.

The DEIS suggests the risk be mitigated either (1) by enlarging the prohibited air space vertically from the present lower limit of 1,200 feet (AGL) to infinity, and horizontally from the Plant boundary to 2.5 miles beyond the boundary, or (2) by modifying plant structures to reduce the consequences.

Enlargement of the prohibited air space would very seriously impact aircraft landings at Amarillo International Airport. It would <u>prohibit</u> IFR approaches to runway 22 southwest, and prevailing wind direction; and it would require substantial modification of VFR approaches.

The airport is located approximately seven miles southwest of the Pantex Plant. The final approach course to primary runway 22 lies over the Plant, a situation that has existed the entire life of the Plant. An air space restriction as suggested would erect a barrier 12 to 15 miles wide, with an unlimited ceiling, less than five miles from the end of the runway.

Such a handicap at a major air carrier airport is impractical and without precedent.

We suggest that the proposed enlargement of restricted air space deserves no further consideration. At the very least, any further study should also examine the full impact of such a restriction on the airport and on the community; and it should include recommendations for Federal assistance to preserve the full value and use of the airport.

To summarize, we consider the Pantex Plant operation a great asset to the community. It has contributed in many ways, not the least of which has been community leadership, providing us with a Mayor, a Chamber of Commerce President, a United Way Chairman and many others. We look forward to a continuation of this long and pleasant relationship and stand ready to serve in any way possible.

Sincerely,

George Lokey
President

DOE Response to Amarillo Chamber of Commerce on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

(Two statements need technical corrections; one on the cost of the alternatives and one on the probability of an aircraft-induced accident)

Pantex Plant Alternative Option 3, as stated in the Draft Environmental Impact Statement (Section 2.2.1-3) includes approximately $100 million for projects identified under Option 1 for a total of $1,239 million. (If it were to include all of Option 1, the estimated cost would be about $1,337 million.)

The chance of 1 in 6,700 per year (revised in this Final Environmental Impact Statement to a value approximately one-half as likely--see response to Federal Aviation Administration letter and Section 2.4.3), is the calculated chance per year that any aircraft will crash into a building that may contain nuclear weapons with crash dynamics that are sufficient to detonate the high-explosive components of the nuclear weapons. This estimate considers all aircraft traffic near the Pantex Plant: both enroute and local. It does not imply crashes are expected to occur at a rate of 1 per 6,700 overflights. It does say crashes are expected to occur at a rate of 1 in 6,700 (or as revised) per year based on all nearby air traffic and using actual counts provided by the Federal Aviation Administration.

The Amarillo Chamber of Commerce letter also discusses and suggests that no further consideration be given to the proposed mitigation measure that would increase the prohibited area. As stated in the response to the Federal Aviation Administration letter, any mitigation measure that significantly reduces air traffic over or near the Pantex Plant is desirable. Potential mitigating measures have been restated in Section 2.6.2 in a more general way to provide for greater flexibility in selection of specific options and avoid major adverse limitation on local airport operations.

SOUTHWEST

SOUTHWEST AIRLINES CO.

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March 4, 1983

Mr. Alex Griego
Environmental Engineer
Operational Safety Division
Department of Energy
Albuquerque Operations Office
P.O.Box 5400
Albuquerque, NM 87115

Subject: Potential Prohibition On Overflight Over The Amarillo Pantex Plant Prohibited Zone P-47

Dear Mr. Griego:

Southwest Airlines strongly objects to raising the altitude limit of Prohibited Area P-47 from the present 4,800 feet MSL to infinity.

Runway 4-22 is the only runway at Amarillo suitable for air carrier aircraft. Since the prevailing winds at Amarillo are from the southwest, runway 22 is the primary runway. All present instrument approaches to runway 22 and some approaches in visual conditions to runway 22 involve overflight of the prohibited area. Raising the altitude limit of the prohibited area would disrupt our operations by eliminating all of the present instrument approaches to runway 22. This would prevent us from operating approximately 5% of our Amarillo flights (based on National Weather Service Climatological data). This would equate to approximately 170 flights annually. The changes to the airport necessary to minimize the impact on airport operations are extensive and costly. It would involve additional navigation facilities and moving existing facilities. It would also require an additional runway with a cost of 25 million dollars.

We feel the chance of occurrence of an aircraft impacting the plant is greatly overstated. Furthermore, raising the altitude limit of the prohibited area would have negligible effect on decreasing the minimal probability of an aircraft impacting the Pantex plant. If an aircraft developed a problem, exploded, or collided over the prohibited area, the aircraft or the major debris would not descend vertically and strike the plant. Inertia would carry it away from the area, and this effect increases with increased altitude and the attendant increase in speed.

We would like to propose the following as an alternative to raising the altitude limit of the prohibited area:

1. Change ATC procedures to avoid overflying the prohibited area when weather permits visual approaches. (According to climatological data this would be the case 95% of the time.)

2. Eliminate practice instrument approaches to runway 22.

3. Allow overflights of the prohibited area only when weather conditions require instrument approaches to runway 22.

We feel the above steps will significantly reduce any real exposure to an aircraft accident at the Pantex site with minimal expense and disruption of air transportation and that is the most realistic solution.

Sincerely,

James L. Rice

Capt. James L. Rice
Manager of Flight

JLR/sh

cc: Mr. Tom Hoff, Vice President-Ground Operations, Southwest Airlines

DOE Response to Southwest Airlines Company on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

(Concern expressed that mitigation measures as presented would have large negative impact on flights approaching Runway 22 and that analysis was not entirely correct)

The third paragraph states that the effect of an increased prohibited area would be negligible in decreasing the probability of an aircraft impacting the Pantex Plant. This statement is not true. The goal of the prohibited area concept proposed in the Draft Environmental Impact Statement was to increase the perpendicular distance between the Plant and nearby flight paths and not to prevent accidents that could occur over the Plant that may result in a crash beyond the Plant boundaries.

An increased prohibited area (as proposed in the Draft Environmental Impact Statement) or other administrative controls (as discussed in this Final Environmental Impact Statement) could remove flights that currently go over or relatively near the Plant to a greater distance from the Plant boundary. This would result in an increased perpendicular distance between the flight paths and buildings at the Pantex Plant that may contain nuclear weapons. Aircraft crashes initiated by an accident or other malfunction anywhere along the flight path have a statistical distribution around the nominal flight paths with the probability of impact decreasing as a function of perpendicular distance from the flight path. Thus, since an expanded prohibited area or other administrative controls would increase the perpendicular distance from flight paths that currently go over the Plant, the probability of a crash into buildings at the Plant would decrease.

To conclude, any measure that removes flights from over or near the Plant will mitigate the probability of a crash into the Plant. The three suggestions given by Southwest Airlines would mitigate crash probability. They are conceptually included in the possible additional mitigating measures discussed in Section 2.6.2. To some extent, suggestions 1 and 3 are already being followed by the Air Traffic Control at Amarillo in that when weather and other factors permit, aircraft are directed away from the Pantex Plant. Existing mitigation measures are considered in the crash probability model.

Northwest Texas Clergy and Laity Concerned

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March 2, 1983

Alex Griego
Environmental Engineer
Operational Safety Division
Department of Energy
Albuquerque Operations Office
Albuquerque, NM 87115

Mr. Griego:

I have enclosed written comments on the Pantex Draft Environmental Impact Statement. Obviously, we believe there are serious problems with the Statement, with the proposed action, and with the policies that legitimate it. We will appreciate your consideration of our comments.

We would appreciate it even more if you would encourage your agency to begin acting responsibly and to provide an adequate basis for critical comment by an informed public.

Sincerely,

Steven Schroeder, Ph.D.
Director

RESPONSE TO THE PANTEX DRAFT ENVIRONMENTAL IMPACT STATEMENT

A

I. BACKGROUND: The Pantex Plant, located in Carson County about 20 miles northeast of Amarillo, was first used for conventional ammunition during World War II. In 1950, the Atomic Energy Commission began rehabilitating existing facilities and building new ones to be used in nuclear weapons production. Since 1951, the Pantex Plant has been the site of final assembly of nuclear weapons in the U.S. arsenal; since 1975, it has been the only final assembly point in the United States.

B

The Department of Energy, which administers the plant, describes it as "an assembly facility that receives conventional high-explosive materials . . . and prefabricated weapons components from external suppliers. There are three major operations: (1) production of new nuclear weapons; (2) maintenance, modification, and quality assurance testing of nuclear weapons already in the military stockpile; and (3) retirement by disassembly of nuclear weapons no longer required in the military stockpile."[1]

C

As a result of an out of court settlement of a lawsuit filed in response to expansion plans for the plant, the Department of Energy has prepared a Draft Environmental Impact Statement to analyze "environmental effects of the Department of Energy's proposal to continue operations and to construct additional facilities at the Pantex Plant . . . to meet the Department of Energy's continuing responsibilities for nuclear weapons assembly, stockpile monitoring, maintenance, modifications, and retirements (disassembly) as mandated by Presidential direction and Congressional authorization and appropriation" and to analyze "a range of alternatives to the proposed action."[2]

D

II. INTRODUCTION: DOE's Draft Environmental Impact Statement on the Pantex Plant Site is an interesting work of fiction. Calling it a work of fiction is not the same as calling it a lie: a work of fiction is a self-consciously crafted narrative intended to convey a truth. It is always legitimate to ask what such a narrative is intended to convey, how it conveys it, and for whom it is a truth.

E

It doesn't take a great deal of imagination to conclude that this document is a truth for the Department of Energy and others who have committed themselves to continued operation and expansion of Pantex to fulfill "continuing responsibilities" for nuclear weapons production, stockpile maintenance, and stockpile expansion. In the simplest possible terms, it is intended to convey the legitimacy of that commitment.

F

For those who do not share the commitment, the document is not a persuasive work. It is nothing but an extended statement of a commitment we do not share, a ritual repetition of the conviction that the production process at Pantex is both "necessary" and "safe."

G

Calling the work "interesting" is not intended to suggest that it contains new or surprising information; it doesn't. Nor is it intended to suggest that it is a noteworthy example of its <u>genre</u>; it isn't. For the most part, the statement relies on repetition of poorly documented assertions, assertions that are <u>never</u> substantiated by independent or critical observers. As a fiction, it is merely an exercise in self-justification and knows no rhetorical device other than repetition. Its interest derives from the fact that it is represented as an "objective" assessment of "environmental" issues involved in continued operation and expansion of the Pantex Plant. It is a self-consciously crafted narrative intended to convey a truth, but it is promulgated as a critical study intended to explore alternative possibilities.

NORTHWEST TEXAS CLERGY & LAITY CONCERNED
2031-C S. HUGHES
AMARILLO, TEXAS 79109

H The study is bracketed by a disclaimer that absolves the government of responsibility for "accuracy, completeness, or usefulness" of information that it contains and an impressive "list of preparers," complete with qualifications including "years of professional experience." On the one hand, we are invited to take note of the highly qualified preparers of the report, but, on the other hand, we are warned not to hold the government responsible for their work. This has the effect of removing the study from contact with objective reality: no one is responsible for it, and, ultimately, its accuracy, completeness, and usefulness are irrelevant.

I Its only purpose is to legitimate a course of action already underway; it is a confession of faith, not an exploration of alternatives. Because the confession is trite and bankrupt, the document's interest derives more from its lack of clarity (or honesty) about its purpose than from its content.

J III. CRITICAL RESPONSE: One of the most glaring problems with the statement is the decision (disguised as a nondecision) involved in isolation of continued operation of Pantex from "national policies regarding nuclear weapons." This is a decision to accept as "given" the assumption that present policy will not change,and, by eliminating a whole range of alternatives from consideration, it discourages adequate consideration of their implications.

K One of the most important of these alternatives is the possibility of a freeze on production, testing, and deployment of nuclear weapons. Such a possibility is obviously realistic given the political climate in the United States, with a substantial portion of the population favoring a freeze and at least one house of Congress moving increasingly toward a resolution in support of that action. Failure to consider the possibility results in failure to consider (to use DOE's phrase) "mitigative procedures."

L Blanket statements of combined payroll and purchases and potential increased retail sales[3] seem intended to imply that a policy shift toward implementation of a freeze would devastate the economy. That implication grows directly out of failure to consider alternate uses for the plant and the job skills it employs. There is no good reason to eliminate consideration of alternate use from the Draft Environmental Impact Statement; the only reason is a prior commitment to the assumption that weapons production will continue at the present rate or will be expanded. The same is true of the statement that Pantex provides "stability" in the Panhandle economy.[4] This is only true if one assumes steady or steadily increasing production of nuclear weapons. Otherwise, the plant is a source of potential instability as it becomes increasingly central to the economy at the same time that a freeze becomes an increasingly realistic political possibility.[5]

M Equally important is the consistent failure of the document's authors to define their terms. Throughout the statement, we are told that there are no "significant" or "important" releases of radioactive material, that "credible" accidents would not be likely to have "significant" impacts.[6] We are given confident statements of potential cancer deaths and cleanup costs but no basis on which to assess whether those statements are accurate. This is evidence of the point made earlier in the introduction, that the statement is a legitimation of actions that have already been undertaken and decisions that have already been made.

N It is hardly surprising that the government would tell us that the plant's adverse impact is negligible. What we need is a basis on which to judge that statement.

O Given the importance of nuclear waste disposal for this region, it is also significant that the Draft Environmental Impact Statement deals--at least peripherally--with questions of radioactive waste at the plant. We are told that no "waste" is "disposed of" but that "residue from cleanup of military accidents" is "still being held." DOE's precision in language use on this issue is astounding. We are expected to join the authors in distinguishing "waste" from "residue" and "disposal" from "temporary holding," even though it is difficult to imagine "residue" from an accident as anything other than waste and even though "temporary" seems to be stretched somewhat as we realize that some of the "residue" has been held as much as 20 years.

P Perhaps this is DOE's subtle way of admitting that no nuclear waste has as yet been disposed of and that, more than thirty years after we began generating it, we are still holding it without a method for disposal.

Q What we would like to see is some indication of the time limit on "temporary" storage, some indication of the content of "residue" presently being held, some detailed indication of the manner in which the "residue" is transported when it leaves the plant and the route it follows, and some indication of emergency provisions for transportation accidents--both on the way in and on the way out. We would like detailed information on training of emergency personnel in small communities along the way, e.g., in Vega or Adrian on I-40. We would like to know what provisions have been made for dealing with a long-burning high-temperature fire involving nuclear waste in one of those small communities. Are they simply written off because they are small?

R The Draft Environmental Impact Statement refers to epidemiological data but does not include it. This makes critical assessment more difficult for those who do not have access to documents listed in the reference section. There is no indication in the statement that there are differences of opinion among experts on the effects of radiation exposure, especially at low levels. Why does DOE not open its data to critical analysis by experts whose assumptions and biases differ from those of the government?

S From the perspective of a sparsely populated agricultural area such as the Texas Panhandle, DOE's use of expected cancer mortalities is also problematic. Worst case transportation accidents are assumed to be those that occur in major metropolitan areas (with 250,000 or more population). This amounts to an assertion that no accident in the Panhandle of Texas would be classfied as "worst case." The figure of 68 cancer deaths cited in consideration of credible accidents looks much worse when considered as a percentage of population in, e.g., Vega (where it would amount to approximately 7% of the population) than in Amarillo (where it is considerably less than 1%).
The Draft Environmental Impact Statement gives no clue as to whether those figures are equally applicable to accidents in small communities and those in larger metropolitan areas. We would like specific information on the degree to which reduced population corresponds to reduced population density in areas affected by accidents. An adequate analysis would include attention to the impact of accidents in specific communities of the Panhandle affected by the plant and associated transportation.

T What, e.g., would be the impact of a sustained high temperature fire involving a "safe-secure" rail car carrying nuclear weapons through Dumas or Stratford?

U What would be the impact of a fuel truck/rail car accident at the Santa Fe switching yards under I-40 in Amarillo? What about a similar accident in a residential area of North Amarillo?

V This document, like others produced by DOE, betrays an insensitivity to the fact that the Panhandle of Texas is an agricultural region. "Worst case" accidents are not necessarily those that occur in urban areas or when the wind is blowing toward Amarillo. It is incumbent on DOE to look at the impact of accidents in "isolated" agricultural areas. It is incumbent on DOE to specify whether cleanup costs include compensation to farmers for lost productivity and damage to crops or soil.

W The "overall annual chance of a plutonium releasing accident for Pantex is 1 in 5100."[8] That is assumed to be an "acceptable risk," but on what basis?

X Given the relatively high possibility of a plutonium releasing accident at Pantex, we are told that DOE is considering "mitigative" procedures involving aircraft flying over the plant. We are given no indication of the impact of changing flight patterns on safety at the Amarillo Airport, nor are we given any indication of the cost of the change and who will bear it.

Y It would be appropriate for Panhandle residents to ask why that high risk has been considered acceptable for so long and what implications that has for critical assessment of future DOE decisions. Are DOE standards acceptable from a Panhandle perspective, or do they tend to grow out of the perception of this area as a wasteland or an unpopulated area?

Z We are also told that DOE is considering "mitigative" procedures directed at accidents induced by tornados. It would be appropriate for Panhandle residents to ask for specific information on how DOE proposes to eliminate the possibility of tornado induced accidents.

IV. CONCLUSION: The Department of Energy's Draft Environmental Impact Statement relegates itself to irrelevance by refusing responsibility for results, by divorcing results from their effects, and by assuming and legitimating a commitment to nuclear weapons production. It serves only as an apologetic for an ongoing approach to nuclear weapons and national security.

What is needed is a critical assessment of the Pantex Plant and its environmental/medical implications undertaken by researchers who have no vested interest in continued operation, a careful assessment of economically viable alternatives, a critical reassessment of the meaning of "security" and the plant's impact on the security of people here and elsewhere, and finally a disciplined national and international reconsideration of the mandate that "justifies" the plant's operation.

Nothing less will suffice.

NOTES:

[1] Draft Environmental Impact Statement: Pantex Plant Site, Amarillo, Texas. U.S. Department of Energy, December, 1982.

[2] Ibid., p.ii [3] Ibid., p.S-6 [4] Ibid., p.4-20

[5] Cf. the work of Seymour Melman and Lloyd J. Dumas.

[6] Draft Environmental Impact Statement, p.S-5, S-6, S-7.

[7] Ibid., p.S-5,6 [8] Ibid., p.S-8

Prepared by:

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DOE Responses to Northwest Texas Clergy and Laity Concerned on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

The paragraphs in the written comments were lettered for ease of reference.

Paragraphs A, B, and C

No response required.

Paragraphs D, E, F, G, and J (Position statement that the Draft Environmental Impact Statement does not address the appropriate scope of alternatives and that the Draft Environmental Impact Statement is poorly documented)

This Environmental Impact Statement does not attempt to analyze and evaluate the possible alternatives to the Nation's nuclear defense policies; for example, the alternative of putting "a freeze on production, testing, and deployment of nuclear weapons." The statement does not assess the environmental impacts of the U.S. nuclear defense policy, but rather focuses on the site-specific environmental impacts of conducting nuclear weapons production, maintenance, modification, surveillance, and retirement operations at Pantex Plant and/or elsewhere.

U.S. defense policy and nuclear weapons requirements in support of that policy restrict alternatives as to Department of Energy's nuclear weapons operations. However, the converse is not true. The Department of Energy's production of nuclear weapons does not foreclose options with respect to the overall U.S. national defense program.

The assertion was made that the Draft Environmental Impact Statement was poorly documented. Supplemental reference documents were available to anyone on request and were available at the Amarillo Public Library during the entire review period.

Paragraph H (Statement that the use of the disclaimer is inappropriate)

The disclaimer that appeared on the inside of the front cover of the Draft Environmental Impact Statement is a routine patents and technical data type of provision that is not intended for inclusion in an environmental impact statement but was inadvertently incorporated during the printing and binding of the document. Its language is obviously inappropriate for an Environmental Impact Statement, whether on a draft or final issuance, and no such provision has been included in this Final Environmental Impact Statement.

Paragraphs I and K

No response required.

Paragraph L (Statement that economic instability exists because of the Pantex Plant)

The referenced Section IV-A-1 in the summary of the Environmental Impact Statement indicates that current payrolls and purchases of the Pantex Plant add about $106 million to the local economy, and that the projected increase in work force could contribute about 0.3 percent to retail sales. Moving these nuclear weapons operations to either the Iowa Army Ammunition Plant or the Hanford Site (as discussed in Section 4.1.9.4), would result in a total loss to the Amarillo Area economy of about 3 percent (discussed in Section 4.1.8.4), and would affect about 5 percent (4.7-5.5 percent) of the work force. These are moderate changes that would not devastate the economy; yet, they would have noticeable impact. Virtually any future use could be conducted at the Pantex Plant if nuclear weapons operations were moved elsewhere (Section 2.2.4). The conclusion of economic stability was based on information from the Texas Industrial Commission that showed about 8,000 jobs statewide traceable to the Pantex Plant operations. Details on this conclusion were given in Rapp 1982.*

Paragraph M (Statement that terms were not defined)

The statement is made that terms used in the Draft Environmental Impact Statement are not well defined. This statement is followed by a citation to the summary section of the Environmental Impact Statement. The summary section is used to present conclusions based on information presented in later chapters where terms are explicitly defined or quantitatively illustrated. In addition, Section 8.2 is a glossary of those terms considered unfamiliar to the public.

The term "credible" was defined in Sections 2.4.1 and 8.2 as meaning an event whose chance of occurrence is "at least one in a million of happening in a year of operation." The term "significant" in relation to accidents was also defined qualitatively in Section 2.4.1 and illustrated quantitatively throughout Sections 4.2.1 through 4.2.8. Judgments of significance or importance regarding both normal operational releases and accident consequences were illustrated quantitatively in summaries throughout Chapters 3 and 4. Additional detail and data on measurements were given in the 16 reports in the series "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant" prepared by the Los Alamos National Laboratory. Copies of the entire series were available throughout the public comment period in the Amarillo Public Library, and copies were sent to anyone requesting them. Specifically, the methods, data, evaluations of potential health effects, and cleanup costs of potential accidents were detailed in Elder 1982B**, Wenzel 1982B***, and Wenzel 1982D.+

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*Rapp 1982: D. Rapp, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Socioeconomic Assessment," Los Alamos National Laboratory report LA-9445-PNTX-J (1982).

**Elder 1982B: J. C. Elder, R. H. Olsher, and J. M. Graf, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Radiological Consequences of Immediate Inhalation of Plutonium Dispersed by Postulated Accidents," Los Alamos National Laboratory report LA-9445-PNTX-F (1982).

***Wenzel 1982B: W. J. Wenzel, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Decontamination Methods and Cost Estimates for Postulated Accidents," Los Alamos National Laboratory report LA-9445-PNTX-N (1982).

+Wenzel 1982D: W. J. Wenzel and A. F. Gallegos, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Long-Term Radiological Risk Assessment for Postulated Accidents," Los Alamos National Laboratory report LA-9445-PNTX-O (1982).

Paragraph N

No response required.

Paragraphs O, P, and Q (Statement that nuclear waste disposal is poorly defined and that transportation accidents in small towns is not discussed)

Some of the terminology may appear artificial because of the need to comply with certain regulations regarding the categorization of disposal. However, regardless of terminology, the important points of what now exists at the Pantex Plant are described in Section 3.2.6.1.

All previously stored operational radioactive waste has been removed from the Plant site and shipped to the Nevada Test Site. Currently, generated waste is accumulated for up to 1 year in about 25 208-liter (55-gallon) steel drums. The level of contamination on the operational wastes (paper towels, rubber gloves, filters, etc.) is comparable to what is generated by a hospital performing radioisotope diagnosis and treatment or a university radiochemical laboratory. Additional information has been incorporated into Sections 2.3.6, 3.2.6.1, 4.3.1, and 4.3.3.1 regarding the routine wastes and their transportation.

The residue from military nuclear weapons accidents was all removed from storage in 1981. After measurement of contents, about half was determined to be waste and was shipped to the Nevada Test Site. About 18 of the accident residue containers are still at Pantex Plant awaiting final decisions on whether some of those materials are recoverable or reusable. Additional information on the weapons accident residue, contaminated or potentially contaminated soil associated with retrieving the accident residue, methods of transportation and transportation risks have been added to Sections 2.3.6, 3.2.6.1, and 4.3.3.1.

In regard to emergency provisions for transportation accidents, Section 4.3.1 was expanded to cover the capabilities and resources available to respond to Department of Energy transportation incidents if required. Note that the Department of Energy does not rely on local agencies for emergency response. The Department of Energy couriers and Radiological Assistance Program personnel are trained and ready to respond to accidents involving radioactive materials. Appropriate notification and coordination with state and local emergency response organizations would be made depending on the location of any incident. These provisions are applicable regardless of location, so small communities would receive the appropriate aid, if needed.

Paragraph R (Statement that the epidemiologic data was not in the Draft Environmental Impact Statement)

The detailed data and description of the epidemiological study was presented in Wiggs 1982.* This report was placed in the Amarillo Public Library for public use during the comment period. In addition, copies of these documents were made available to anyone requesting them. The detailed epidemiologic

*Wiggs 1982A: L. D. Wiggs, G. S. Wilkinson, G. L. Tietjen, and J. F. Acquavella, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: A Comparison of County and State Cancer Mortality Rates," Los Alamos National Laboratory report LA-9445-PNTX-P (1982).

study on worker mortality has been completed (Acquavella 1982).* The results of this study show no increase in any cause of death (including all cancers, arteriosclerotic heart disease, and digestive diseases) from working at the Pantex Plant.

Paragraphs S and T (Concern about the dose models used, how the accident data was applied, and what the effects of an accident would be to small towns)

Section 3.2.6.1 referenced Appendix 8.1, where the issue is discussed. In the appendix (Section 8.1.5), those parts of the disagreement relevant to the kinds of doses related to Pantex Plant operations were pointed out. The appendix referenced Buhl 1982,** where the various models were discussed in detail. None of the conclusions regarding significance of doses discussed in the Environmental Impact Statement would change as a result of using any of the various dose-effect models.

Expected cancer mortality was calculated as only one indication of consequences that could occur from either transportation or Plant accidents dispersing plutonium. Other indicators were amount of land contaminated and estimated costs for cleanup and restoration. These evaluations were summarized in text and tables in Section 4.2.6, 4.2.7, 4.2.8, and 4.3.3.1.

The terminology "extreme case" was associated with "unfavorable dispersion" conditions as explained in Section 4.2.5. These conditions would expose the largest number of people and would result in the largest population dose or the largest number of potential cancer fatalities. This evaluation could be interpreted as the maximum consequence to society as a whole. As explained in Section 4.2.5, other dispersion conditions and locations (as in the case of potential transportation accidents) could result in larger consequences from other perspectives (such as maximum exposed individual). This is precisely the reason that different dispersion conditions were analyzed and summarized in the various tables in Sections 4.2.6, 4.2.7, and 4.2.8. Data in these tables show risks to individuals at different distances in the direction of Amarillo and in the direction of Borger, which includes both a lower total population and a lower population density. For the maximum release accident, for example (Table 4.2.6-1), a maximum estimate of 1 eventual cancer fatality for median dispersion compares with the estimate of 68 for unfavorable dispersion in the direction of Amarillo. As explained in Section 4.2.6, the estimate of cancer facilities is a product of the amount of plutonium inhaled, the number of people involved, and the quantitative relation between exposure and likelihood of cancer fatality. Thus, for other factors being held constant, the expected number of cancer fatalities is directly proportional to the number of people exposed.

In specific reference to the transportation accident analysis (Table 4.3.3.1-1), the ratio of the maximum number of cancer fatalities to the population is approximately 3 or 4 to 10,000 (3 to 4 one-hundredths of one percent) for either dispersion condition. As a first approximation, one can estimate that if such an accident (a long-burning high-temperature fire) occurred in a community of 10,000,

*Acquavella 1982: J. F. Acquavella, L. D. Wiggs, R. J. Waxweiler, D. G. Macdonell, and G. S.Wilkinson, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Occupational Work Force Mortality Study," Los Alamos National Laboratory report LA-9445-PNTX-Q (1982).

**Buhl 1982: T. Buhl, J. Dewart, T. Gunderson, D. Talley, J. Wenzel, R. Romero, J. Salazar, and D. Van Etten, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Radiation Monitoring and Radiological Assessment of Routine Releases," Los Alamos National Laboratory report LA-9445-PNTX-C (1982).

about 3 or 4 cancer fatalities might eventually result; in a population of 1,000, zero or one eventual cancer fatality would be expected. Much more detail on the risk calculation methodology was presented in the supplementary documents available in the Amarillo Public Library or from the Department of Energy's Amarillo Area Office.

Paragraph U (Concern over the effects of a transportation accident in Amarillo)

The expected number of cancer fatalities would be similar to what is shown in Table 4.3.3.1. Depending on the exact wind direction, considerable variation in the number of people exposed would be expected. As shown in Table 4.3.3.1, 25,000 to 100,000 exposed population could result in about 8 to 38 eventual cancer fatalities. If an accident occurred in Amarillo, this is the range of expected effects.

Paragraph V (Concern over the effects of an accident on agricultural areas)

As noted earlier, the term "extreme case" was associated in the Draft Environmental Impact Statement with maximum number of cancer fatalities as a measure of risk to society (see Section 4.2.5). The effect on agricultural land was considered in detail in terms of required decontamination and potential long-term health effects from residual contamination. These analyses were summarized in Sections 4.2.7 and 4.2.8. The detailed analyses including costs were presented in Wenzel 1982A* and Wenzel 1982B.** The fourth paragraph in Section 4.2.7 has been modified to indicate compensation for crops and was considered in the detailed analysis.

Paragraph W

No response required.

Paragraph X (Concern over the impacts of mitigation measures to the Amarillo International Airport)

As stated in the response to the Federal Aviation Administration letter, any mitigation measure that significantly reduces air traffic over or near the Pantex Plant is desirable. Potential mitigating measures have been restated in Section 2.6.2 in a more general way to provide for greater flexibility in selection of specific options and avoid major adverse [illegible]mitation on local airport operations.

Paragraph Y (Statement that "DOE standards" are not acceptable risks)

None of the likelihood of accident values are "DOE standards," nor are they given as acceptable or unacceptable. They are estimates prepared by a uniform methodology to permit comparison between alternatives and to provide a mechanism to compare between different hazards. Further, the likelihood of

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*Wenzel 1982A: W. J. Wenzel, K. M. Wallwork-Barber, J. M. Horton, L. C. Hollis, E. S. Gladney, D. L. Mayfield, A. F. Gallegos, J. C. Rogers, R. G. Thomas, and G. Trujillo, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Agricultural Food Chain Radiological Assessment," Los Alamos National Laboratory report LA-9445-PNTX-M (1982).

**Wenzel 1982B: W. J. Wenzel, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Decontamination Methods and Cost Estimates for Postulated Accidents," Los Alamos National Laboratory report LA-9445-PNTX-N (1982).

a plutonium-releasing accident is only part of the total evaluation of risk. Risk must also consider the magnitude of consequences.

In the Draft Environmental Impact Statement, two aspects of accident risk were evaluated: first, the likelihood that an accident would occur; and second, the magnitude of possible consequences should an accident occur. (See Section 2.4.3 for a comparative summary of accident risks.) The philosophy underlying this approach is that an accident with a low probability of occurrence but capable of causing highly significant environmental impacts is much more important than an accident that has a high probability of occurrence but has no environmental impact.

<u>Paragraph 7</u> (Concern about how tornado-induced accidents will be eliminated)

As stated in Section 2.4.3, the structures proposed under Options 2 or 3 would be built to withstand tornadoes and thereby eliminate tornadoes as a credible event leading to a plutonium-dispersing accident. Section 2.1.2 stresses the fact that current structure design criteria require both assembly cells and assembly bays to be built to withstand tornadoes. These design criteria are again stressed in Section 2.2.1.2, for Option 2 and 2.2.1.3 for Option 3.

Given the event of a tornado, the new structures would be strong enough to protect the interiors of the buildings and to prevent a detonation accident leading to the dispersal of plutonium. The wording in the summary and Section 2.4.3 was revised to emphasize structural protection from tornadoes and to avoid any implication that tornadoes themselves could be eliminated.

557 Sherman Hall
909 South Fifth Street
Champaign, Illinois
61820
March 10, 1983

Mr. Alex Griego, Environmental Engineer
Operational Safety Division
Department of Energy, Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87115

Dear Mr. Griego,

A I have recently read the Draft Environmental Impact Statement for the Pantex Plant Site in Armarillo, Texas. As a rather concerned and interested party, I wish to offer comments on the draft statement concerning the consideration of alternatives to improving the Pantex plant and the purpose and need for carrying out the project.

B The draft Environmental Impact Statement (EIS) appeared much too positive in discussing the Pantex alternatives on the present site. The draft EIS did not mention one serious environmental impact which would be caused by expanding the Pantex plant or choosing the "no action" alternative.

C However, the draft EIS seemed to go out of its way to mention serious environmental impacts at the Iowa and Hanford sites. Examples of these impacts included the release of particulate matter in the Columbia River at the Hanford site and the presense of explosive matter in groundwater at the Iowa plant. To its merit, the EIS does go into a fair amount of detail on how some of these problems will be mitigated. One example of this is the need for tile drainage and waterproofing at the Iowa site, given its shallow water table. The EIS does give fair mention of the fact that these improvements will add to the costs of relocating the Pantex workload to these sites.

D I wish to raise concern over the lack of information involving waste disposal of hazardous and non-hazardous waste materials in landfills at both alternate sites. There is no mention of landfill technologies in this EIS for the storage of these wastes. There is no mention of whether landfills will be monitered continuously for possible signs of leaks or groundwater contamination.

E At the Hanford site, the draft EIS mentions that toxic and non toxic wastes will be dumped on site with the toxic wastes being stored in chemical drums and the non-toxic wastes in a landfill. However, there is no mention of whether the two fills will be near each other or separate from each other. Given that there is no mention of monitering procedures in the draft EIS, I see a dangerous possibility of incompatible wastes from a leaking landfill mixing with toxic wastes from chemical drums. Last week's Newsweek magazine showed a photograph of chemical drums of nuclear waste being buried in the ground in Washington State without any protective cover. I hope this is not the way hazardous wastes will be buried at either of the alternative sites.

F Questions about monitering also arise in the discussion of the closing of the Pantex Plant.The draft EIS mentions that experiments were conducted on the site to determine radioactivity on land,vegetation and living things.Howevere,no mention is made of the possible continuation of these studies,should the Pantex plant be closed.The government should make such studies again,after the Pantex plant is closed in order to study lingering radioactive effects and avoid futher liabilities.

G The draft EIS mentions the need for studies on endangered species at the Iowa site and historic areas at the Iowa and Hanford sites.No mention is made that these studies will be completed before the preparation of the final EIS.Only the Pantex site has a complete inventory of these environmental impacts.Along with the lack of procedures for closing the Pantex Plant,these statements may lend credence to the fact that the alternative sites are not being seriously considered.

H This contention may be further substantiated by the fact that the draft EIS neglects the "boom town" impacts which may be caused by an increase in the labor force,especially the eight percent "one time" growth on the Iowa site.

I The first such impact is on the housing stock.The draft EIS goes into a fair amount of detail on the availability of temporary housing,especially for construction workers.No mention is made of the possibilities that an increase of such housing may be needed over a longer period of time than necessary due to possible cost overuns or construction delays.The draft EIS fails to mention the need for permanent housing for both basic and non-basic labor forces.Only temporary units received mention.

J The draft EIS does an adequate job of covering provision of water and electric power to an expanding labor force.I am pleased to see that it considers the impact on the school system.However,there is no mention of the additional need for police,fire protection,wastewater treatment and garbage collection in order to accommodate the new workers.The draft EIS also fails to mention whether or not local waste disposal sites can handle increased loads of residential waste.Given the nature of the project I am suprised that local security in the form of police and first aid was not given consideration.While the chances of accident appear to be minimal,given the data used in the draft EIS,I believe that the site should have increased security provisions.The risks of accident from plant traffic or overturned trailers shipping radioactive waste, justifies an increasing need for local security.

K For the Iowa site,there are problems resulting from the interaction of agricultural land use with transportation.Dust from roads has a negative impact on farmland productivity,because the dust may blow onto crops.Farm vehicles occupy the same roads as cars along highways surrounded by agricultural land.These vehicles are slow-moving,causing traffic delays and possible resentment between farmers and commuters.Given the magnitude of this social conflict,it is suggested that some sort of bus transit be provided for the workers.This would minimize the numbers of vehicles on the road and the areas for potential conflict.

L The draft EIS makes no mention of traffic impacts caused by the increased population inside and outside city limits for both alternatives. Given the nature of the materials being shipped from the Pantex plant to alternate sites, it would be good for the government to know the number of traffic fatalities on the roads leading to the plant, their condition and their traffic volume. The risk of accident on a bad road is greater than on a good one. This is especially true in the case of the Iowa plant. If the area has a drainage problem, as is mentioned in the draft EIS, then there is a strong possibility that water may remain on roads during the winter, causing them to ice. This increases the risk of accident for the Safe-Secure trailors which may be shipping radioactive materials to the plant.

M Given the lack of serious consideration for the alternatives, I question the need for the project in any form, other than the "no action" alternative. While the draft EIS mentions that the project is needed to comply with directives outlined in the Atomic Energy Act of 1954, it fails to mention that the Pantex plant will be receiving any new weapons for testing in the near future. The only statement made related to this is the discussion of the draft EIS for the MX missile prepared in 1980. Since the draft EIS shows no evidence of any other weapons system coming to Pantex in the near future, I fail to see any reason to expand beyond the present facilities. This may be furthered justified by the fact that the MX missile has not been approved by Congress. Further, I can see by reading the draft EIS that there are no serious environmental effects caused by the "no action" alternative. Finally, there is no evidence presented in the draft EIS that, given the present workload at the Pantex site, the government is not presently meeting its obligations under the Atomic Energy Act of 1954.

N In light of this information, I strongly suggest that the "no action" alternative is the best one, until it can be proven that there is a greater demand for the testing of nuclear weapons. In the mean time the present facilities are adequate for that purpose.

Sincerely,

Stuart L. Nachbar

DOE Response to Mr. Stuart Nachbar of Champaign, Illinois, on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

The paragraphs in the written comments were lettered for ease of reference.

Paragraphs A and B

No response required.

Paragraph C (Statement by the commentor that serious environmental impacts exist at the Iowa Army Ammunition Plant and Hanford Site)

The conditions referenced for the Iowa Army Ammunition Plant and Hanford Site are existing conditions caused by past and present operations at the two sites. The expected impacts from future nuclear weapons operations at any location would be small compared to the existing impacts at the Iowa Army Ammunition Plant or Hanford Site.

Paragraphs D and E (Concern over lack of information on hazardous and nonhazardous waste disposal)

Analyses of the waste management operations at the Pantex Plant have demonstrated that no hazardous wastes (as defined by 40 CFR 261) are disposed of at Pantex Plant from current operations. (See also the response to the Texas Department of Water Resources.) Similar waste management practices would be established if operations were moved, and therefore, no significant environmental impacts would be expected. Current management methodology for handling wastes is detailed in the 1980 waste management site plan for the Pantex Plant* and the Iowa Army Ammunition Plant Spill Prevention, Control, and Countermeasure Plan (IAAP 1980).**

Paragraph F (Concern over monitoring, especially if the Pantex Plant were closed)

In addition to the special studies undertaken for the Environmental Impact Statement to provide additional detail, routine monitoring for environmental conditions has been conducted for many years by the Plant's operating contractor and will continue in the future to assure compliance with environmental regulations. The decontamination and cleanup discussed in Section 2.2.4 would include appropriate monitoring and measurement to assure adequacy of the cleanup and document "as-left" conditions.

Paragraph G (Statement that additional studies would be needed at either the Iowa Army Ammunition Plant or Hanford Site if they were selected, and that procedures for closure of Pantex Plant are needed)

If either the Iowa Army Ammunition Plant or Hanford Site alternatives were selected, some additional detailed studies would be required of the exact construction sites selected.

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*"1980 Waste Management Site Plan," USDOE Amarillo Area Office, Pantex Plant, Mason and Hanger-Silas Mason Co., Inc., (October 1980).

**IAAP 1980: "Spill Prevention, Control, and Countermeasure Plan, ENG-13," Mason and Hanger-Silas Mason Co., Inc., Iowa Army Ammunition Plant, Middletown, Iowa, unnumbered report (December 10, 1980).

Section 2.2.4 indicates the types of actions that would be required to terminate Department of Energy Nuclear Weapons Operations at the Pantex Plant.

Paragraph H (Concern that "boom town" impacts are ignored)

While the term "boom town" was not used, the social and economic impact of rapid growth were evaluated in detail. This fact was indicated in the discussion in Section 4.1.8.2 and is discussed in more detail in the reference on the socioeconomic assessment performed for the Environmental Impact Statement (Rapp 1982).*

Paragraph I (Concern over possible impact on housing)

The construction periods were considered as ranges in the socioeconomic assessment. The results reported in the Environmental Impact Statement reflect maximum impacts generally associated with the shorter periods. Additional details of the evaluation are in Rapp (1982).

Permanent work force housing was not found to be a significant factor. As summarized in Section 2.3.8 and shown in Table 2.3.8-1 the operational work forces at any of the three alternatives would have negligible effects on population growth, and therefore, on any community resources including housing.

Paragraph J (Statement that police, fire protection, and utilities are ignored; also, that security was not addressed)

Police and fire protection needs are explicitly addressed in Sections 4.1.10.1, 4.1.10.2, and 4.1.10.3. Details on the evaluations are in Rapp 1982. Under the general context of utilities, such things as water supply, waste water treatment, and solid waste disposal are not expected to be significantly impacted at any of the three sites.

All appropriate measures would be taken at a new site to meet all required safeguards and security features as discussed in Section 1.5. All appropriate planning measures regarding emergency preparedness coordination would be undertaken at any new site as discussed in Section 4.2.9.

Paragraph K (Concern expressed over crop damage from excess commuter traffic, and the statement that car pooling or busing is needed)

The roads used by the commuters would be paved. This would mostly eliminate the problem of stomatal clogging in crops by road-traffic-created dust.

Rapp 1982 reports the findings of a socioeconomic assessment that indicates that carpooling or busing might be required to eliminate traffic problems.

*Rapp 1982: D. Rapp, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Socioeconomic Assessment," Los Alamos National Laboratory report LA-9445-PNTX-J (1982).

Paragraph L (Concern over increased traffic and the potential for accidents during transportation)

Impacts from related transportation operations, including those from normal operations and risks from potential accidents, were discussed in Section 4.3. Specific comparisons for the Iowa Army Ammunitions Plant site are in subsections 4.3.2.2 and 4.3.3.2.

Paragraph M (Concern expressed that the proposed facilities are not necessary, and the statement is made that the Environmental Impact Statement does not mention weapons testing at Pantex Plant)

The need for some increase and improvement in facilities is discussed in Section 1.1. Simply stated, there is an increase in work load that must be accommodated, and the Department of Energy also desires to provide greater reliability and safety with new facilities. The Pantex Plant does not do any weapons testing. It performs the types of operations discussed in Section 1.4, including subsections 1.4.1, 1.4.2, 1.4.3, and 1.4.4.

Paragraph N

No response required.

2100 S. 4th St.
Burlington, Iowa 5260
March 10, 1983

Alex Griego
Dept. of Energy
Albuquerque Operations Officer
Box 5400
Albuquerque, New Mexico 87115

Dr. Mr. Griego:

I am writing to express my views concerning the resumption of the production of nuclear weapons at the IAAP in Middletown, Iowa. Those of us living in the Burlington community are well aware of the fact that wherever there is a nuclear facility the cancer death rate is much higher. Also there are many of us who do not want to see nuclear weapons produced here — nor in Amarillo or out in Washington at the Hanford plant. We are opposed to nuclear weapons production anyplace.

Let us ~~move~~ in the direction of eliminating the production of nuclear weapons. We would ask you to do all in your power to prevent the manufacture of nuclear bombs at the IAAP.

Sincerely yours,

Clarence L. [illegible]

DOE Response to Mr. Clarence Adolph of Burlington, Iowa, on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

(Statement that wherever there is a nuclear facility the cancer rate is higher)

The findings of epidemiological studies carried out for the Pantex Plant Environmental Impact Statement contradict this contention. No elevated cancer mortality was found in the general population in counties near the Pantex Plant nor in the work force during the three decades since the Plant started operations. These studies are documented in Wiggs 1982A* and Acquavella 1982.**

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*Wiggs 1982A: L. D. Wiggs, G. S. Wilkinson, G. L. Tietjen, and J. F. Acquavella, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: A Comparison of County and State Cancer Mortality Rates," Los Alamos National Laboratory report LA-9445-PNTX-P (1982).

**Acquavella 1982: J. F. Acquavella, L. D. Wiggs, R. J. Waxweiler, D. G. Macdonell, and G. S. Wilkinson, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Occupational Work Force Mortality Study," Los Alamos National Laboratory report LA-9445-PNTX-Q (1982).

2332 Burlington Ave.
Burlington, Ia. 52601
February 21, 1983

Mr. Alex Griego
Dept. of Energy
Albuquerque Operations Officer
Box 5400
Albuquerque, N. M. 87115

Dear Mr. Griego:

This letter is written in behalf of the Citizens for Peace, Burlington, Iowa.

At a meeting of our group held on Tuesday, February 8, 1983 the environmental impact statement prepared by your office was reviewed and discussed. As a result a number of questions arose for which we had no answers. These questions have been asked again and again since that time with answers being sought from a variety of sources. However, no answers have been satisfactory as of this date. Thus, they are addressed to you. They are

1 - Is the IAAP at Middletown a real alternative or a routine entry to satisfy the requirements of such a study?

2 - Was the danger of the assembly of nuclear weapons considered at the Middletown site or is this outside the interest of the Department of Energy?

In regard to the latter, figures available from other parts of the country seem to indicate that nuclear installations of various degrees result in a definite increase in the occurrence of cancer and kindred ills. Though assurance is constantly given that the assembly of nuclear weapons present no such consequenees there remains considerable doubt in the minds of many people as to the validity of such assurance. When such doubt prevails a distrust arises among the citizenry which creates all sorts of additional fears.

Finally, our local concern is not only with the fact that the IAAP is being considered as an optional place for the assembly of nuclear weapons, but that all further increase of nuclear weapons be abandoned. We do not feel that nuclear arms superity assures peace!

Sincerely,

A. C. Koengeter

DOE Response to Citizens for Peace of Burlington, Iowa, on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

Question 1 (Question about whether or not the Iowa Army Ammunition Plant is a real alternative)

The Iowa Army Ammunition Plant Alternative, including Options 1 and 2 are both "reasonable" alternatives within the meaning of the National Environmental Policy Act, in the sense that they are possible and would meet the purpose and need for the Department of Energy's action. However, neither is at this time a preferred action on the part of the Department of Energy.

Option 1, which involves reusing the portion of the Iowa Army Ammunition Plant formerly used for nuclear weapons operations (until 1975), could provide the needed facilities for increasing work loads within the same time frame and at about the same total construction cost as the Pantex Plant Alternative Option 1. However, it would mean a larger proportion of operations would be carried out in older, existing structures. The operating costs would be higher because of the need for duplicating many support service jobs in Iowa and Texas, and the expense of utilities and maintenance for two plants.

Option 2 at the Iowa Army Ammunitions Plant is a reasonable alternative to the Pantex Plant Option 3 in that either would result in all-new facilities for most of the required nuclear weapons operations. The cost at Iowa would be higher, largely because of the need to build new support facilities in Iowa and the cost of some facilities already under construction in Texas. There would be no environmental advantages to moving to Iowa. For these and other reasons, the Department of Energy prefers to continue operations at the Pantex Plant.

Question 2 (Concern about the risk of an accident at the Iowa Army Ammunition Plant)

Detailed studies of both the likelihood and potential consequences of accidents at the various plant sites and in conjunction with related transportation operations were carried out for all options in the Draft Environmental Impact Statement. Their findings were summarized in Sections 2.4 and 2.5, discussed further in Sections 4.2 and 4.3, and explained in detail in several supplementary reports cited in those sections and available on request. Very briefly, the overall chance of a plutonium-releasing accident was found to be somewhat lower for either Iowa Army Ammunition Plant option than for the Pantex Plant Alternative, but the maximum consequences (indicated by eventual possible cancer mortality or cleanup costs) were similar for both locations.

Concern About Whether Nuclear Facilities Cause an Increase in Cancer Rates in Surrounding Populus

The findings of epidemiological studies carried out for the Pantex Plant Environmental Impact Statement contradict this contention. No elevated cancer mortality was found in the general population in counties near the Pantex Plant nor in the work force during the three decades since the Plant started operations. These studies are documented in Wiggs 1982A* and Acquavella 1982.**

*Wiggs 1982A: L. D. Wiggs, G. S. Wilkinson, G. L. Tietjen, and J. F. Acquavella, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: A Comparison of County and State Cancer Mortality Rates," Los Alamos National Laboratory report LA-9445-PNTX-P (1982).

**Acquavella 1982: J. F. Acquavella, L. D. Wiggs, R. J. Waxweiler, D. G. Macdonell, and G. S. Wilkinson, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Occupational Work Force Mortality Study," Los Alamos National Laboratory report LA-9445-PNTX-Q (1982).

March 10, 1983

Alex Griego
Dept. of Energy
Albuquerque Operations Officer
Box 5400
Albuquerque, NM 87115

Dear Mr. Griego:

It has recently come to the attention of citizens in the Burlington, Iowa area that the Department of Energy is considering bringing nuclear weapons production back to the Iowa Army Ammunition Plant at Middletown, Iowa. This, we understand, would be an alternative to expanding current weapons facilities at the Amarillo, Texas Pantex plant.

According to reports in our local paper, the Middletown option is being considered because many citizens in the Texas panhandle have protested expansion of the plant there. While, according to the environmental impact study being done by your department, the expansion to Middletown would bring thousands of jobs and probably millions of dollars to our area, there are many citizens here who don't want weapons production in their backyards, either.

Your environmental study assesses the social, economic and ecological impact of weapons production in each of the three sites under consideration. Environmentally, many area citizens do not want to be exposed to risk of radiation and cancer deaths so often associated with many forms of nuclear facilities. Socially, we feel it would be immoral and divisive to bring nuclear weapons production to our community. Economically, yes, we need more jobs, but we need useful, productive jobs that will return benefits to our community.

In short, I and many others feel opposed to nuclear weapons being built anywhere. We don't want our brothers and sisters in Texas or Washington to be exposed to the dangers or forced to compromise their consciences any more than we want to have to do that here.

Don't we have enough weapons to obliterate life on our planet many times over? When will enough be enough??

(P.S. The citizens of this area resent the fact that this environmental study was made known only to a select few in our community, none of whom would make the results public. We had to find out about it through a little investigative digging by a concerned citizen. It's our lives and property you're toying with, after all!!)

Sincerely,

Elaine Cale

Elaine Cale
602 Broadway
West Burlington, IA 52655

DOE Response to Ms. Elaine Cale of Burlington, Iowa, on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

(Statement regarding cancer rates near nuclear facilities)

The findings of epidemiological studies carried out for the Pantex Plant Environmental Impact Statement contradict this contention. No elevated cancer mortality was found in the general population in counties near the Pantex Plant nor in the work force during the three decades since the Plant started operations. These studies are documented in Wiggs 1982A* and Acquavella 1982.**

As noted in the February 9, 1983, issue of the Hawk Eye, the information was publicly available. Both the address and phone number were included in the article about where copies of the Draft Environmental Impact Statement and other reference documents could be obtained.

---

*Wiggs 1982A: L. D. Wiggs, G. S. Wilkinson, G. L. Tietjen, and J. F. Acquavella, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: A Comparison of County and State Cancer Mortality Rates," Los Alamos National Laboratory report LA-9445-PNTX-P (1982).

**Acquavella 1982: J. F. Acquavella, L. D. Wiggs, R. J. Waxweiler, D. G. Macdonell, and G. S. Wilkinson, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Occupational Work Force Mortality Study," Los Alamos National Laboratory report LA-9445-PNTX-Q (1982).

Rt. 4 Box 287
W. Burlington, Ia.
52655

Mr. Alex Griego
Dept. of Energy
Box 5400
Albuquerque, N.M.
87115

Dear Sir:

There has been talk that the Iowa Army Ammunition Plant at Middletown, Iowa, is being considered as a possible site for the production of atomic war-heads. As a concerned citizen, and a close neighbor of the IAAP, I strongly oppose such a move.

I do so for two reasons. First, the production of nuclear weapons, whose only purpose is to annihilate fellow human beings, is immoral. From all reports that I have gathered, our country already possess enough nuclear devices to exterminate the vast majority of the human population. Why do we need more?

Secondly, the cancer rates show a significant increase in the area that surround facilities which produce or use nuclear materials. As I live only two miles from the IAAP, I do not want to have to worry about the possible consequences of health and safety to me and my family.

I do hope you, and all others that are connected with the decision of making this move, will give it careful, careful consideration before doing so.

We have a clean, healthy neighborhood here. We want it left that way!

Yours very truly,

Mrs. Marvin L. Brown

Mrs. Marvin L. Brown

DOE Response to Mrs. Marvin L. Brown of Burlington, Iowa, on the
Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

(Statement regarding cancer rates near nuclear facilities)

The findings of epidemiological studies carried out for the Pantex Plant Environmental Impact Statement contradict this contention. No elevated cancer mortality was found in the general population in counties near the Pantex Plant nor in the work force during the three decades since the Plant started operations. These studies are documented in Wiggs 1982A* and Acquavella 1982.**

---

*Wiggs 1982A: L. D. Wiggs, G. S. Wilkinson, G. L. Tietjen, and J. F. Acquavella, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: A Comparison of County and State Cancer Mortality Rates," Los Alamos National Laboratory report LA-9445-PNTX-P (1982).

**Acquavella 1982: J. F. Acquavella, L. D. Wiggs, R. J. Waxweiler, D. G. Macdonell, and G. S. Wilkinson, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Occupational Work Force Mortality Study," Los Alamos National Laboratory report LA-9445-PNTX-Q (1982).

JOHN SPELLMAN
Governor

DONALD W. MOOS
Director

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Mail Stop PV-11 • Olympia, Washington 98504 • (206) 459-6000

March 15, 1983

Mr. Alex Griego
Environmental Engineer
Operational Safety Division
U.S. Department of Energy
Alburquerque Operations Office
P. O. Box 5400
Albuquerque, New Mexico 87115

Dear Mr. Griego:

Thank you for the opportunity to comment on the draft environmental impact statement (EIS) for alternative sites for the Pantex Plan, which is presently located in Amarillo, Texas. The Department of Ecology has no specific comments on this proposal. We did, however, coordinate the review of the EIS with the other state agencies and their comments are attached for your information.

If you have any questions, please contact the appropriate agency or Mr. Don Provost at 459-6023.

Sincerely,

Dennis L. Lundblad, Supervisor
Operations Management Division
Office of Field Operations

DLL:jpf

Enclosures

JOHN SPELLMAN
Governor

HUGH FOWLER
Director

STATE OF WASHINGTON
DEPARTMENT OF EMERGENCY SERVICES
4220 E Martin Way • Olympia, Washington 98504 • [redacted] 206.459.9191

February 28, 1983

RECEIVED
MAR - 2 1983
DEPARTMENT OF ECOLOGY
ENVIRONMENTAL REVIEW

Ms. Barbara Ritchie
NEPA Coordinator
Environmental Review Section
Department of Ecology
Mail Stop PV-11
Olympia, WA 98504

Dear Ms. Ritchie:

The Department of Emergency Services has reviewed the Draft Environmental Impact Statement for the Pantex Plant Site. If the Pantex operation were to be moved to the U.S. Department of Energy Hanford Reservation in Central Washington, the transport of materials to and from the plant site might increase the risk of exposure of the public to radioactive materials due to transportation accidents. Although the state does not have a plan that specifically addresses response to such transportation accidents, a general plan exists which, if implemented, should provide adequate governmental response to protect the health and lives of state citizens.

The draft impact statement does not clearly address the potential risk to populations surrounding the Hanford Reservation due to an accident at the plant site. In the past, fires and/or explosions at the Amarillo plant could have resulted in some radioactive contamination downwind of the accident site. If the plant were to be built on the Hanford site, the state Fixed Nuclear Facility Response Plan would have to be expanded to include consideration of the Pantex Plant. Sufficient funds would need to be provided for such expansion of the plan, and these funds would need to be provided by either the federal government or the plant contractor.

Please include these concerns in your consolidated response regarding this draft environmental impact statement.

Sincerely,

James M. Thomas
Assistant Director
Plans and Preparedness Division

JMT:bf

DOE Response to the State of Washington Department of Emergency Services on the Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

(Concern expressed over potential risk from accidents, and statement that fires and/or explosions at Pantex Plant could have resulted in contamination)

Both normal transportation operations and potential accidents were considered in Section 4.3. As indicated there, the nationwide likelihood of a transportation accident resulting in dispersal of plutonium was estimated to be about 2 chances in a million per year if the Hanford Site Alternative were implemented. The chance of such an accident occurring within the State of Washington would be a fraction of the nationwide probability.

The major concern expressed by this comment was related to defining the location of the proposed plant site within the Hanford Site, according to a telephone communication with James Thomas in March 1983. The proposed location in the north-central part of the Hanford Site is indicated as the center of the population distribution map in Figure 3.2.8-3. It is at least 12 kilometers (7 miles), and for the most likely wind directions 16 kilometers (10 miles) or farther, from the site boundary. This location was used for all of the detailed calculations on health effects, decontamination, and long-term effects summarized in Sections 4.2.6, 4.2.7, and 4.2.9 and detailed in Elder 1982B,* Wenzel 1982B,** and Wenzel 1982D.***

None of the fire or explosion accidents that have occurred in the past at the Pantex Plant have resulted in any dispersal of plutonium or any radioactive contamination.

If the Hanford Site Alternative were selected, site-specific emergency planning would be carried out as is discussed in Section 4.2.9.

---

*Elder 1982B: J. C. Elder, R. H. Olsher, and J. M. Graf, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Radiological Consequences of Immediate Inhalation of Plutonium Dispersed by Postulated Accidents," Los Alamos National Laboratory report LA 9445-PNTX-F (1982).

**Wenzel 1982B: W. J. Wenzel, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Decontamination Methods and Cost Estimates for Postulated Accidents," Los Alamos National Laboratory report LA-9445-PNTX-N (1982).

***Wenzel 1982D: W. J. Wenzel and A. F. Gallegos, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Long-Term Radiological Risk Assessment for Postulated Accidents," Los Alamos National Laboratory report LA-9445-PNTX-O (1982).

JOHN SPELLMAN
Governor

DUANE BERENTSON
Secretary

STATE OF WASHINGTON
DEPARTMENT OF TRANSPORTATION
Office of District Administrator • 2809 N Main St., Union Gap, P.O Box 52 • Yakima, Washington 98907

January 27, 1983

Barbara Ritchie
NEPA Coordinator
Department of Ecology
Mail Stop PV-11
Olympia, WA 98504

Pantex Plant Site
Amarillo, Texas
Draft EIS

Dear Ms. Ritchie:

As a follow-up to your conversation with Larry Rus of my office, we offer the following comments regarding the proposed Hanford alternative to relocate the Pantex plant.

Should the proposed plant be located near or require use of a state highway for access, definite impacts would result.

As indicated, the plant would employ 2,400 workers. Traffic generated by this number of vehicles, in addition to other anticipated increases, would have a significant impact. Without additional details of where the plant is to be located, it would be impossible to determine specifically what these may be.

The proponent should provide adequate information to address these impacts.

Very truly yours,

ROBERT C. SCHUSTER, P.E.
District Administrator

By: R. M. MacNEIL, P.E.
District Design Engineer

RCS
RMM
LHR/era

DOE Response to the State of Washington Department of Transportation on the Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas DOE/EIS-0098-D

(Concern expressed that the anticipated vehicular traffic would have a significant impact)

The proposed plant site is in the north-central part of the Hanford Site as noted in responses to other State of Washington Agency comments. The precise location in relation to existing on-site roads is shown in Figure A-14 in Wenzel 1982B.* It was assumed that access would be by the same entrance points and in about the same proportion as presently used by employees on the Hanford Site. Information provided by the State of Washington Employment Security Department during preparation of the draft Environmental Impact Statement (included in detail in Rapp 1982)** indicated that anticipated declines in employment at the Washington Public Power Supply System (a drop of more than 9,000 from the peak in 1981 to expected 1986 levels) would more than offset any increase associated with constructing a nuclear weapons operations facility on the Hanford Site. Thus, our evaluation concluded there would be a net decrease of work force (considering both construction and permanent employees) and a subsequent decrease in any associated impacts on community resources.

---

* Wenzel 1982B: W. J. Wenzel, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Decontamination Methods and Cost Estimates for Postulated Accidents," Los Alamos National Laboratory report LA-9445-PNTX-N (1982).

**Rapp 1982: D. Rapp, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Socioeconomic Assessment," Los Alamos National Laboratory report LA-9445-PNTX-J (1982).

JOHN SPELLMAN
Governor

ALAN J. GIBBS
Secretary

STATE OF WASHINGTON

DEPARTMENT OF SOCIAL AND HEALTH SERVICES

Olympia, Washington 98504

January 28, 1983

RECEIVED
FEB - 1 1983
DEPARTMENT OF ECOLOGY
ENVIRONMENTAL REVIEW

TO: Barbara Ritchie
NEPA Coordinator
Department of Ecology
Mail Stop PV-11

FROM: Nancy P. Kirner, Supervisor
Radioactvie Materials Unit

SUBJECT: PANTEX PLANT SITE, AMARILLO, TEXAS, DRAFT EIS

Thank you for the opportunity of reviewing this environmental impact statement. My cursory review of the draft EIS indicates that combined impacts from the Hanford site alternative would be relatively high. For this reason the choice of the Hanford site does not appear to be a viable one. Certainly, radiological impacts from location of the Pantex plant on the Hanford reservation appear to be the lowest of all proposed alternatives. If Hanford were to become a more attractive alternative, additional information would be needed on the proposed location of the Pantex plant within the Hanford reservation in order to assess its impact on existing state regulated operations.

If you need additional information, please do not hesitate to call me at 3-3459.

NPK/db

cc: John Aden, LD-11
Dick Watson, ER-11

DOE Response to the State of Washington Department of Social and Health Services on the Draft Environmental Impact Statement for the Pantex Plant Site, Carson County, Texas
DOE/EIS-0098-D

(Concern expressed over selection of the Hanford Site Alternative, and that the exact location of the proposed site was not well defined)

As clarified in a telephone communication with Nancy Kirner in March 1983, the combined construction cost and other economic impacts of relocation to the Hanford Site would be the largest of the alternatives considered. This is part of the reason that the Hanford Site Alternative is not the preferred action by the Department of Energy.

The proposed plant location considered in evaluating the Hanford Site Alternative is indicated as the center of the population distribution map in Figure 3.2.8-3. Larger scale maps appeared in the reference documents; Figure A-14 in Wenzel 1982B* precisely locates the plant in relation to existing roads.

---

*Wenzel 1982B: W. J. Wenzel, "Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant: Decontamination Methods and Cost Estimates for Postulated Accidents," Los Alamos National Laboratory report LA-9445-PNTX-N (1982).

U.S. Department
of Transportation
Federal Aviation Administration

800 Independence Ave., S.W.
Washington, D.C. 20591

MAR 4 1983

Colonel John T. Weathers
Director, Division of Safety, Environment,
and Emergency Actions
Office of Military Application
Department of Energy
Washington, D.C. 20545

Dear Colonel Weathers:

This is in response to your December 30, 1982, letter to Mr. Raymond Van Vuren, Director, Air Traffic Service, regarding the Draft Environmental Impact Statement (DEIS) for the Pantex Plant Site.

The Federal Aviation Administration (FAA) has previously responded to you concerning your data for the aircraft crash assessments and is in the process of resolving these matters with the preparers of the DEIS. The outcome of these discussions will be considered to be FAA's comments for the DEIS. We, therefore, have no other comments to offer at this time.

Sincerely,

John E. Wesler
Director of Environment and Energy

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Ecological Services
9A33 Fritz Lanham Building
819 Taylor Street
Fort Worth, Texas 76102

February 14, 1983

Colonel John T. Weathers, USA
Director, Division of Safety Environment and
Emergency Actions
Office of Military Application
Department of Energy
Washington, DC 20545

Dear Colonel Weathers:

This responds to your letter of December 30, 1982, transmitting a copy of the Department of Energy's draft environmental impact statement for the Pantex Plant Site, DOE/EIS-0098-D, for our comments.

We have reviewed the document and believe that continuing the operations or constructing additional facilities at the Pantex Plant near Amarillo, Texas, will have insignificant or minimal adverse impacts to fish, wildlife, or their habitats.

Our comments only address the Pantex operations in the Texas area. Alternatives discussed concerning the Iowa and Washington locations are out of the geographical area of responsibility of this field office and were not considered in our evaluation.

The opportunity to comment is appreciated.

Sincerely,

Jerome L. Johnson

Jerome L. Johnson
Field Supervisor

City of Amarillo

OFFICE OF
CITY MANAGER

March 3, 1983

Mr. Alex Griego
Environmental Engineer
Operational Safety Division
Department of Energy
Albuquerque Operations Office
P. O. Box 5400
Albuquerque, New Mexico 87115

Dear Mr. Griego:

The City of Amarillo has reviewed the draft Environmental Impact Statement for the Pantex Plant site in Amarillo, Texas, and the proposed expansion of the Pantex facility will have no negative impact on the City of Amarillo. The Pantex Plant is a large employer of personnel in Amarillo and they contribute significantly to the economy. The vast majority of the citizens of Amarillo are seemingly supportive of Pantex and are proud to have Pantex as a part of our community.

If you have any questions concerning our review or if we may be of any assistance in the future expansion of the Pantex site, please do not hesitate to contact me.

Sincerely,

John S. Stiff
City Manager

JDS/JSS/kk

P.O. BOX 1971 • PHONE (806) 378-3000 • AMARILLO, TEXAS • 79186

Garry Mauro
Commissioner
General Land Office

RECEIVED
MAR 11 1983
OFFICE OF THE GOVERNOR
O.M.B./O.P.I.R.

March 1, 1983

Mr. Harden Wiedemann, Director
Governor's Office of Planning and
Intergovernmental Relations
P.O. Box 13561
Austin, Texas 78711

RE: Plantex Plant Site - Amarillo, Texas
Draft Environmental Impact Statement

Dear Mr. Wiedemann:

The General Land Office appreciates the opportunity to comment on the above document. The EIS states that there will be no impact on land use, agriculture, or terrestrial resources in Texas.

The existing plant site, which is to be expanded, is located in Carson County near Amarillo, Texas. The nearest state land is located in Potter County approximately 20 miles from the existing plant. No impact on state-owned lands is anticipated from the proposed expansion of the plant.

Sincerely,

Mike Hightower

Mike Hightower, Program Manager
Land Resources Program
(512) 475-1166

MH:SD:mlg

Stephen F. Austin Building
1700 North Congress Avenue
Austin, Texas 78701
(512) 475-2071

FEB 25 [illegible] -

COMMISSION

ROBERT H. DEDMAN, CHAIRMAN
A. SAM WALDROP
JOHN R. BUTLER, JR.

STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION
DEWITT C. GREER STATE HIGHWAY BLDG.
AUSTIN, TEXAS 78701

ENGINEER-DIRECTOR
MARK G. GOODE

February 21, 1983

RECEIVED
FEB 25 1983
OFFICE OF THE GOVERNOR
O.M.B./O.P.I.R.

IN REPLY REFER TO
FILE NO.
D8-E 854

Pantex Plant Site (EIS # 3-01-50-005)

Mr. Harden Wiedeman, Director
Governor's Office of Planning & Intergovernmental Relations
P.O. Box 13561
Austin, Texas 78711

Dear Mr. Wiedeman:

Thank you for the opportunity to review the draft environmental statement covering the Pantex Plant Site.

Neither the preferred plan nor any of the alternate plans would significantly affect the State highway system.

Sincerely yours,

M. G. Goode
Engineer-Director

By: Marcus L. Yancey Jr.

Marcus L. Yancey, Jr.
Deputy Engineer-Director

Texas Department of Health

Robert Bernstein, M.D., F.A.C.P.
Commissioner

1100 West 49th Street
Austin, Texas 78756
(512) 458-7111

Robert A. MacLean, M.D.
Deputy Commissioner
Professional Services

Hermas L. Miller
Deputy Commissioner
Management and Administration

February 22, 1983

Colonel John T. Weathers, USA
Director, Division of Safety,
Environment, and Emergency Actions
Office of Military Application
U.S. Department of Energy
Washington, D.C. 20545

Dear Colonel Weathers:

Thank you very much for your letter of December 30, 1982, and the enclosed DEIS on the Pantex Plant Site (DOE/EIS-0098-D).

My comments, if any, on the document will be included in the compilation of comments from the Bureau of Radiation Control, Texas Department of Health.

Sincerely,

Edgar D. Bailey, P.E., Director
Division of Licensing, Registration
and Standards
Bureau of Radiation Control

Suggested Questions to be Considered by Reviewing Agencies:

1. Does the proposed project impact upon and is it consistent with the plans, programs and statutory responsibilities of your agency?

2. What additional specific effects should be assessed?

3. What additional alternatives should be considered?

4. What better or more appropriate measures and standards should be used to evaluate environmental effects?

5. What additional control measures should be applied to reduce adverse environmental effects or to avoid or minimize the irreversible or irretrievable commitment of resources?

6. How serious would the environmental damage from this project be, using the best alternative and control measures?

7. What specific issues require further discussion or resolution?

8. Does your agency concur with the implementation of this project?

As a part of the environmental impact statement review process, the Budget and Planning Office forwards to the originating agency all substantive comments which are formally submitted. If, after analyzing this document, you conclude that substantive comments are unnecessary, you may wish to so indicate by checking the box below and forwarding the form to this office. This type of response will indicate receipt of this document by your agency and that no formal response will be prepared.

[X] No Comment.

Edward Ellis, Executive Assistant
Name and Title of Reviewing Official

[illegible] Advisory Council
Agency

ELIZABETH LAMB
Apartment 417
2909 Woodland Avenue
Des Moines, IA 50312

Re: DOE/EIS-0098-D

Please understand that the people of Iowa do not want the Pantex plant moved to Burlington.

Elizabeth Lamb

3·7·83

DOE/EIS-0098-D

Mr Weathers — We Iowans are anxious that the Pantex plant NOT be moved to Iowa.

M. D. Alexander
845 – 40th St
Des Moines 50312

Rec'd SEEA 3/15/8

426 E. Wheeler
W. Burlington, Ia
52655
March 13, 1983

Alex Griego
Dept. of Energy
Albuquerque Operations Officer
Box 5400
Albuquerque, N.M. 87115

Dear Mr. Griego:

I wish to state that I am completely against nuclear weapons being produced at the Burlington IAAP plant. I am against nuclear weapons being produced anywhere. But producing them five miles from my home + family, extremely disturbs me. I, many of my friends, and my church are strongly opposed to bringing nuclear weapons here. We will take action to fight such a move to Burlington.

Sincerely,

Sandra Walters

Box 294
Burlington, Iowa
52601

3/11/83

Dear Mr Griego:

Though I feel our comments will be mainly ignored, I want to assure you that there is already strong opposition among Iowans against any plans for production of nuclear weapons in our state.

I urge you to consider that Iowans will not meekly accept any plan to begin nuclear weapon production. Iowa. I want to be informed of any hearings, plans, or reports that refer to this subject.

Most Sincerely
Charlotte Walker

Dear Sir:

I was the Mayor when your office made a request for information regarding the nuclear project. I thought it was a mistake to 'put all the eggs' in one basket', when AEC Burlington was moved and think as a minimum you should put part of it back. I would appreciate any information you can send me, so I can promote Burlington again. From an economic standpoint, it can all return just to here.

R. F. Uffelman
2504 Amelia
[redacted]ton, Iowa 52601

March 9, 1983

Mr. Alex R. Griego, Environmental Engineer
Operational Safety Division
Department of Energy
Albuquerque Operations Office,
P. O. Box 5400
Albuquerque, New Mexico, 87115

Dear Mr. Griego:

Thank you for your response to my request for a copy of the draft EIS, and for placing my name on the mailing list. At one time, I worked part time at the AEC Plant when it was here.

As a comment on the matter to be decided, I felt it was a mistake to " put all our 'eggs' in one basket" by consolidating the Burlington operation with Pantex.

Since the Burlington plant physical facilities are still essentially in place, it is logical they should be re-used. The US should have two or more places for its nuclear weapons development, an important deterrent to any attempt by a foreign power to start an offensive against us.

The impact on Burlington should be positive, since we have been suffering from considerable unemployment (14.6) since the removal of the operation.

R F Uffelman

R. F. Uffelman
2504 Amelia
Burlington,
Iowa, 52601

2/10/83

Alex Griego:

This article was written by Col Nelson Sweet son who was in Charge of the IAAP for a number of years.

I never knew of any objection to the Plant when it was running full force. It played a big part in the economy in this area for many years. Where ever it is located there will be Citizens for Peace who will object to the location.

Safety records of the pass should be a big factor here. The location in the center of the U.S. must have a bearing. Our country has to have weapons - where it can be done with the least cost to the goverment

should be the finally decision.
We have to pull in our horns
and save in any way we can.
The article stated - The
IAAP option has local opposition -
about 30 people — big deal
How many people knew
about any of this untill they
read the article in paper.

NAME REMOVED BY REQUEST

I have "1" request - I do not want to get
involved in what-ever. To hear my name
mentioned or see in print. I believe others
feel the same way. Some people glow on being
on a side of a issue - not me my health
could not handle it.

121 Crestview Dr.
Burlington, Iowa 52601
February 10, 1983

Mr. Alex Griego
Dept. of Energy
Box 5400
Albuquerque, N. M. 87115

Dear Sir,

The Board of Directors of the United Nations Association, Burlington Chapter, is shocked about the possibility of the expansion of the Pantex nuclear weapons plant in Middletown, Iowa. This community is our next door neighbor.

We are opposed to this type of installation anywhere and, in particular, in Middletown.

Our board consists of twenty-four concerned civic leaders of this area.

Sincerely,

Avis I. Long

Avis I. Long, President, Burlington Chapter
U.N.A.-U.S.A.

February 11, 1983

Operations Officer Alex Griego
Department of Energy
Box 5400
Albuquerque, New Mexico 87115

Dear Officer Griego,

In view of the fact that the Defense Department is contemplating moving the manufacture of Atomic Weapons from Pantex in Ammarillo, Texas back to Iowa Army Ammunition Plant in Middletown, Iowa we and our neighbors are very much concerned.

We are fearful of the effect this will have upon the citizens of this area. This poses a number of dangers:

1. The imput of environmental radiation to those of us living "down wind" from the I.A.A.P. which includes Burlington.

2. The possibility of a "nuclear accident" which would literally destroy southeastern Iowa.

3. The money that would be spent in the manufacturing of weapons of destruction could be spent in a more constructive manner.

Therefore, we beg of you to use all the influence in your power to block this move. We believe it is your duty to work for the preservation of our health and safety at all times.

Be it also understood that we are not trying to push this off on people of other areas of our country - as we believe they should <u>not be manufactured</u> at all anywhere, but first we must do what we can in our area.

Can we rely on your help? We hope so.

Signed:

Paul J. Hemann - 1719 Madison Ave - Burlington IA 52601
Frieda J. Hemann 1719 Mad. Ave Burl. Ia
c.c. Robert L Van Duwater 1911 Mad. Ave Burl.
Betty Van Duwater 1911 Madison Ave Burl.

February 11, 1983

Operations Officer Alex Griego
Department of Energy
Box 5400
Albuquerque, New Mexico 87115

Dear Officer Griego,

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Can we rely on your help? We hope so.

Signed:

Tom Thomas 633 So 6th Burlington Ia
Mrs. Tom Thomas 633 S. 6th Burlington, Ia
c.c.
Wendell G. Burcham 1007 Sumner St.

1102 S. 15th
Burlington, Iowa 52601
Feb. 12, 1983

Mr. Alex Griego
Department of Energy Operations Office
Box 5400
Albuquerque, N. Mex. 87115

Dear Mr. Griego:

I want to protest the possibility of moving nuclear arms production from Texas to the Iowa Army Ammunition Plant at Middletown, Ia.

We have only very recently become aware of this possibility, and I understand that the comment period closes on March 15. This certainly doesn't give enough time for public reaction.

I believe that statistics show that the incidence of cancer in the population increases greatly near a nuclear power plant or where nuclear arms are produced. We need to stop nuclear weapons production, rather than increase it. We have more than enough to destroy the world. This is madness! The possibility of an accident at a nuclear arms plant is too awful to contemplate.

Sincerely yours,
Edna A. Den Hartog

Citizens for Education on Nuclear Arms
c/o 1014 Grand Park
Fairfield, IA 52556
February 28, 1983

Alex Griego
D.O.E. Box 5400
Albuquerque, NM 87115
RE: hearings on possibility of construction of nuclear weapons components in Burlington, IA

Dear Mr. Griego,

CENA, Citizens for Education on Nuclear Arms, a group concerned about the possibility of nuclear weapons components being built in Burlington, Iowa, wish to go on record as vigorously opposed to any efforts to link our state to a defense strategy that, at its core, accepts the loss of millions of non-combatants as nuclear war is being fought.

Citizens of our country have been steadily losing control of our defense policies. Citizens of the state of Iowa may be reminded of that very graphically if Burlington is made a site for manufacture of components for nuclear weapons. The citizens in our locality, if questioned, would have second thoughts about having a potential target so close to us in the event of nuclear war. The citizens in CENA would like any plans for an obscenity such as what we hear proposed to be stopped cold.

We recognize the lure of defense industries for areas of low unemployment, and reject such myopic plans to remedy that. We recognize the need for national defense, but question strongly the reasoning behind weapons that would only result in the genocide of the world's population. We recognize the need for a strong nation, but we affirm that a strong nation is built on policies that are based on sound moral principles. Nuclear war is merely expedient. It is not creative. It is not humane. It is not necessary. It is suicidal.

During these hearings, please keep in mind the welfare of our country's, as well as other countries', civilians. Please allow us options in our lives. A nuclear weapons plant in Burlington limits our liberty excessively. The people of the world, the United States, Iowa, Burlington, Fairfield and its environs deserve better.

Sincerely,

Doug Calsbeek

Doug Calsbeek for CENA

TWENTY-SEVEN HUNDRED SOUTH MAIN STREET, BURLINGTON, IOWA 52601

February 28, 1983

Alex Griego
Department of Energy
Albuquerque Operations Officer
Box 5400,
Albuquerque, New Mexico 87115

Dear Mr. Griego,

This letter is written so that my view as an individual plus that of many citizens likewise concerned over the build-up of nuclear weapons in general and in Burlington particularly be recorded. It is my understanding that all such communications will be a matter of permanent record.

When the IAAP was originally founded here, I was deeply involved in this community's adjustment to the war preparation, discussing with Iowa's Governor, at the request of our mayor, a State Enabling Act to allow federal housing built here, helping families of construction and other workers to become a part of the city's social fabric, helping those whose family farms were confiscated to make way for the plant to understand the national necessity requiring this action. Moreover, I lobbied intensively for rescinding the Neutrality Act to enable direct aid to those opposing the agressor nations.

All of this and more I would do again with enthusiasm, given the same circumstances. These, however, will never exist again. Nuclear weapons have permanently changed the scenario. Though I have neither turned pacifist nor isolationist and because I believe in a strong defense, I can not condone the current escalation of ~~the~~ nuclear arms, for it endangers rather than strenthens our national security.

Locating a nuclear weapons industry in Burlington, Iowa would be repugnant to a large segment of our citizens here who hold essentially the same opinion — as do, according to national polls, over 60% of the American public.

In addition to the above rationale, the plant location here — whether as a supplement to the Pantex operation or to take its place — would turn this community into a prime military target, as it was in the forties and fifties — number four in the nation, if my information is correct!

If environmental impact studies touch not only on the effect of a new operation on the community, but also the impact of reaction on the operation, itself, you will find that — contrary to the plant's original welcome — such a nuclear operation in the 1980s would find a hostile environment, indeed.

With appreciation for your attention,

Sincerely,

Dorothy Schramm

Dorothy Schramm

DS/ka

Mar '83

Mr. Alex Griego

Dear Mr. Griego

I am told you head the decision Committee concerning possible moving of the nuclear production facility from Amarillo, Tex. to Burlington (Middletown) Iowa.

Of course we could then rent our apartments and have some extra jobs, but what good would ~~that~~ do if we had just one accident!? and we are already high on the "hit list" and don't want to move up! The horrors are unthinkable.

There is a citizens peace group here who do not want this move and sincerely wish all nuclear production would halt, so please do not plan to move here!

Thank you.

Mrs. H.H. Morgan
1038 S. Leebrick
Burlington - 52601

1825 Vogt Street
Burlington, Iowa 52601
March 4, 1983

Mr. Alex Griego
D.O.E. Box 5400
Albuquerque NM 87115

Dear Mr. Griego:

I am writing to express my strong opposition to the production of nuclear weapons in Burlington, Iowa; Amarillo, Texas; or any place else.

Production of these weapons is a threat to all humanity, and the more that are made the less secure we must feel. I believe the time has come to stop this cooperation with a policy of terrorism and start using our talentsand resources to find other ways of securing peace in the world.

I vigorously object to the use of my tax dollars to produce these weapons of destruction and I urge the Department of Energy to turn its attention to constructive activities in the use of energy, any of which would provide more jobs and more prosperity for our country than the dangerous and immoral directions that you are following.

We in Burlington challenge you to come up with other pursuits that you, the management of Silas-Hangar, the work force, and the community can be proud to participate in, and which will add to the betterment of the people in the communities where you are a factor, not threaten them with health, safety, and moral problems -- along with ultimate destruction.

Sincerely,

Sally McMillan
(Mrs. Eugene J.)

Alex Grigo
Dept. of Energy
Box 5400
Albequerque New Mexico 87115

9 March 1983

Dear Mr. Grigo,

I appreciate the opportunity to make comments for consideration in the Environmental Impact Statement for proposed Pantex expansion: Please: not-in-my-backyard-Burlington-Iowa, please: not anywhere. The impact on our local and global environment and our economy and our future can be only destructive, finally, despite the illusion of international security and jobs-creation that the arms race gives.

Be advised to issue an Environmental Impact Statement with concern for the effect of the expansion of nuclear armament. Please act responsibly.

Sincerely,

Terri Parrish McGaffin

Terri McGaffin
1347 West 12th Street
Davenport, Iowa 52804

JOHN SPELLMAN
Governor

JAN TVETEN
Director

STATE OF WASHINGTON

WASHINGTON STATE PARKS AND RECREATION COMMISSION

7150 Cleanwater Lane, KY-11 • Olympia, Washington 98504 • (206) 753-5755

January 26, 1983

RECEIVED
JAN 2 1983

TO: Barbara Ritchie, NEPA Coordinator

FROM: David W. Heiser, E.P.
Chief, Environmental Coordination

RE: Pantex Plant Site, Amarillo, Texas - DEIS (E-2500)

The staff of the Washington State Parks and Recreation Commission has reviewed the above-noted document and does not wish to make any comment.

Thank you for the opportunity to review and comment.

bh

United States
Department of Energy
Washington, DC 20545

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