DOE/EIS-0050

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Final Environmental Impact Statement

RESIDENTIAL CONSERVATION SERVICE PROGRAM

NOVEMBER 1979

U.S. DEPARTMENT OF ENERGY

WASHINGTON, D.C. 20585

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FINAL ENVIRONMENTAL IMPACT STATEMENT
THE RESIDENTIAL CONSERVATION SERVICE PROGRAM

November 1979

The Department of Energy

COVER SHEET
FINAL ENVIRONMENTAL IMPACT STATEMENT
DOE/EIS-0050

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(b) Proposed Action: Residential Conservation Service Program

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(d) Designation: Final EIS

(e) Abstract: Proposed is the establishment of the Residential Conservation Service (RCS) Program to implement Part 1 of Title II of the National Energy Conservation Policy Act (NECPA) (P.L. 95-619). The proposed program would require large regulated and nonregulated utilities with specified residential sales to prepare and administer programs of consumer information and services, including home energy audits, designed to promote the installation of energy conservation and renewable resource measures in residential buildings. Among the energy conservation measures currently included in the RCS Program are caulking and weatherstripping; certain furnace efficiency modifications; insulation of ceilings, walls, floors, pipes, ducts and water heaters; storm windows and doors; thermal windows and doors; and clock thermostats. Among the renewable resource measures currently included are active solar space heating and hot water systems; passive solar space heating and cooling systems; and wind energy devices. The range of alternatives considered for the program includes the scope and duration of post-installation inspections, the scope of installation standards for loose-fill insulation, and a material standard for attic insulation.

(f) The RCS Program will not go into effect for 30 days after the availability of this Final EIS is announced in the *Federal Register*.

PREFACE

This Environmental Impact Statement (EIS) of the proposed implementation of the Residential Conservation Service (RCS) Program has been prepared in accordance with the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. Section 4321 *et seq.*). The EIS follows the applicable policies and procedures for compliance with NEPA, as set forth in 10 CFR Part 208 (41 FR 4274; January 30, 1976). Cognizance was also taken of the action by the Council on Environmental Quality in issuing final regulations establishing uniform procedures for implementing the procedural provisions of NEPA (43 FR 5579; November 29, 1978).

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SUMMARY

This environmental impact statement (EIS) analyzes the potential environmental impacts which could result from the implementation of the Residential Conservation Service (RCS) Program authorized by Title II of the National Energy Conservation Policy Act (NECPA) (Public Law 95-619).

1. The Residential Conservation Service Program

The RCS Program is a Congressionally mandated program to encourage the installation of residential energy conservation and renewable resource measures in the homes of customers of large gas and electric utilities and home heating suppliers. Large regulated and nonregulated public utilities with specified annual residential sales (covered utilities) are required to prepare and administer programs of consumer information and services designed to promote the installation of such measures. State governments may prepare a State Residential Conservation Service Plan (State Plan) governing the development and administration of utility programs by covered regulated utilities operating within their states. States may include nonregulated utilities and any home heating supplier which volunteers to prepare a program for its heating fuel customers. If a State elects not to prepare a State Plan, covered utilities in that State must implement programs under a Plan promulgated by DOE.

The residential energy conservation measures included in the RCS Program are:

- Caulking and weatherstripping
- Specified furnace efficiency modifications (e.g., vent dampers, and electrical and mechanical ignition systems)
- Insulation of ceilings, walls, floors, pipes, ducts, and water heaters
- Storm windows and doors
- Thermal windows and doors
- Heat reflective and heat absorbing window and door material
- Electric load management devices
- Clock thermostats
- Replacement central air conditioners.

Residential renewable resource measures included are:

- Solar domestic hot water systems
- Active solar space heating systems

- Combined active solar space heating-hot water systems

- Passive solar space heating and cooling systems

- Wind energy devices

- Replacement solar swimming pool heaters.

Under the Program, eligible customers of covered utilities and participating home heating suppliers could receive the following services:

- Information about estimated savings on energy costs for selected energy conservation and renewable resource measures

- Energy audits upon request

- Arrangements upon request for the purchase, installation, and financing of the selected energy conservation and renewable resource measures

- Lists, upon request, of suppliers, contractors, and lenders who have agreed to comply with the Program's standards and procedures

- Post-installation inspections.

Because of the national nature of the RCS Program, its consumer education aspects and its other benefits, DOE estimates that a response rate of 7 percent per year could be achieved for the projected five-year life of the program (through 1985) where audits are free or at minimal cost. For purposes of the EIS, DOE has assumed this 7 percent annual response rate nationwide, based on experience gained with existing utility-offered energy audit programs. This assumption is probably an optimistic projection given the likelihood that some State Regulatory Authorities may allow more than minimal audit fees. DOE estimates that 75 percent of the persons who receive an audit may purchase at least one energy conservation measure addressed in the audit. To assess the maximum likely effect of the RCS Program, DOE has assumed, for purposes of the EIS, a 75 percent purchase rate by residential customers receiving audits under the Program.

2. Impact of Program Measures

For both energy conservation and renewable resource measures, there are only a few measures included in the Program which, even when improperly manufactured or installed, have potential to cause a significant environmental impact. For these, Program standards minimize the potential that improper installation or the installation of faulty equipment will occur. These measures and the mitigating standards are discussed in detail in Section 4 below.

A substantial effort was made to quantitatively analyze the potential environmental impacts of the total RCS Program. The use of a quantitative approach required that estimates be determined of the numbers of conservation and renewable resource measures that would be installed as a direct consequence of the RCS Program. For many measures, and in particular for renewable resource measures, valid estimates of RCS Program-stimulated market penetration could not be established. For those national or site-specific impacts which could be treated through quantitative analysis, the analytical technique and resultant data are discussed in the EIS. For those measures where DOE has been unable to identify an appropriate quantitative treatment, a qualitative analysis of known or potential impacts is presented in the EIS.

In preparing the quantitative analysis, occasionally a choice had to be made among competing assumptions. Wherever such a choice was required, the assumption chosen was that which would produce a projection of the most adverse or worst case environmental impact.

More specifically, the EIS analyzes the environmental impacts of the conservation and renewable resource measures that can be installed under the RCS Program in the following manner:

- The national pollutant emissions impacts due to the following three measures are estimated quantitatively: ceiling insulation, wall insulation, and water heater insulation.

- The national pollutant emission impacts due to all other measures are analyzed qualitatively. These measures include floor insulation, duct and pipe insulation, storm doors, storm windows, clock thermostats, caulking, weatherstripping, thermal windows, reflective and absorptive window films, furnace modifications (including vent dampers, electric or mechanical ignition devices, oil burner replacement, and replacement furnaces and boilers), energy usage display meters, load management devices, active solar heating, small wind energy conversion systems, passive solar devices, and solar pool heaters.

- The potential site-specific effects of all measures are assessed qualitatively.

3. National Impacts

Ceiling, wall, and water heater insulation are expected to account for a large portion of any pollution emission increases due to increased production of measures as well as emission decreases due to energy generation savings under the Program.

It is estimated that the RCS Program will reduce residential energy demand and will also cause decreases in the air and water pollutants necessary to generate energy for residential buidings. The estimated reduction in residential energy usage for the Program is 11.04 quads. Three measures -- ceiling, wall and water heater insulation -- will account for about 71 percent (about 7.86 quads) of this total. The average annual reduction in energy usage due to these three measures will be between 0.31 and 1.57 quads.* This average represents from 2.6 to 12.9 percent of the projected residential energy consumption projected for 1985 and from 0.4 to 2.2 percent of the projected national energy consumption for that year.

National pollutant emission changes were calculated on the basis of the current distribution of fuel sources for electricity generation. Based upon the assumed 75 percent purchase rate for the three major measures (ceiling, wall, and water heater insulation), air and water pollutant emissions due to the Program were estimated. The largest estimated reductions for air pollutants were for nitrogen oxides and sulfur oxides. The largest reductions for water pollutants were for dissolved solids and chemical oxygen demand. The only two pollutants for which net increases might occur are fluorides and arsenic; in both cases, the estimated net increases would be small. Finally, although almost all of the estimated net pollutant changes are beneficial, none of the changes is major on a national scale. For example, the projected net reduction for nitrogen oxides would be equivalent to from 0.14 to 0.68 percent of the projected 1985 nitrogen oxide emissions from energy-related activities.

4. Site-Specific Impacts

The energy conservation and renewable resource measures included in the RCS Program were examined for potential site-specific health and safety impacts. For each of the measures, the potential adverse impacts were related to

**The range is the result of using the lives of the shortest and longest lived Program measures as the base period for calculating the average net change.*

potential faulty manufacturing or improper installation. None of the energy conservation or renewable resource measures should constitute a safety or health hazard when properly manufactured, installed, and operated. Analysis showed that there are three categories of measures with different levels of potential adverse impacts.

For certain measures, even improper manufacture and/or installation has a very low probability of producing an adverse health or safety impact because of either the lack of inherent danger or the limited scope of problems that improper manufacture or installation could cause. The measures in this category include caulking, weatherstripping, replacement air conditioners, passive solar measures, duct and pipe insulation, clock thermostats, heat reflective and heat absorbing window or door material, devices associated with electric load management techniques, and energy conserving practices.

For other measures with a higher probability for producing an adverse health or safety impact, the Program includes safety and effectiveness standards. These standards are intended to reduce to an insignificant level the potential for any adverse impacts occurring in connection with these measures. These measures include ceiling insulation, wall insulation (other than urea-formaldehyde foam), floor insulation, water heater insulation, storm and thermal windows, storm and thermal doors, replacement furnaces or boilers, oil furnace replacement burners, active solar heating, active solar water heating, and solar pool heaters.

Although there is a somewhat higher probability of potential adverse health and safety impacts regarding the measures in this second category, the potential risks can be minimized. The primary potential risk regarding storm and thermal windows and doors is glass breakage. This potential risk can be mitigated through the use of shatter-resistant materials. The primary risk related to ceiling, wall, floor, and water heater insulation (other than urea-formaldehyde foam) concerns potential fires. This risk can be minimized through appropriate installation procedures and the use of fire-resistant materials. The primary concern regarding replacement furnaces and burners concerns potential explosion, fire and carbon monoxide emissions. These potential risks can be minimized through appropriate installation procedures, material standards, and maintenance. Primary concerns regarding active solar systems concern potential outgassing and water contamination. These risks can be mitigated by appropriate installation procedures, material standards, and maintenance. Increased homeowner education and awareness in connection with this Program should also help to further eliminate potential problems regarding these measures.

The third category of measures -- with the greatest level of potential adverse health and safety impacts -- involves (1) the three energy conservation measures and the one renewable resource measure specified below whose adverse impact, in the event of improper performance, are potentially significant, and (2) concerns regarding the reduction in air exchange rate resulting from the installation of certain energy conservation measures. These five concerns are:

(a) Wall insulation: urea-formaldehyde foam

(b) Flue opening modification: vent dampers

(c) Electric and mechanical ignition systems

(d) Small wind energy conversion systems

(e) The increased concentration of certain indoor air pollutants within a residential building, caused by reduction in the air exchange rate in the building, from the installation of energy conservation measures such as caulking, weatherstripping, and storm doors and windows.

Each of these major areas of concern is discussed below.

a. Wall Insulation: Urea-Formaldehyde Foam. There are several health and safety concerns associated with the use of urea-formaldehyde foam as an insulating material in residences. Formaldehyde gas is present in the components of the foam and may be released during the foaming operation at the time of installation, and after installation by decomposition of the foam. Improper installation can cause such releases of formaldehyde gas into homes.

Potentially, formaldehyde gas can cause health problems ranging from temporary irritation to death in extreme circumstances. Health symptoms resulting from exposure may include eye and upper respiratory irritation, shortness of breath, nasal congestion, and skin rash. Individual responses to concentration levels vary widely. The most commonly reported symptom is irritation of the upper respiratory tract. The severity of the incidents reported also reflect wide variation. Prolonged exposure or higher concentrations of formaldehyde vapor can lead to pulmonary edema, pneumonitis, and, in extreme circumstances, death.

The Program is developing an interim material standard and an installation standard for urea-formaldehyde foam. Installations of UF foam insulation will not be permitted under the Program until standards have been formally adopted. Because of concerns about potential problems related to this measure, the Program also requires four inspections in the first 10 installations of UF foam by each contractor and random 10 percent post-installation inspections thereafter. An alternative to require post-installation inspections of all UF foam installations performed under the Program might reduce potential problems even further. However, it is believed that the post-installation inspections proposed will accomplish the desired objectives effectively since contractors will know that their work will be checked and that they will be held accountable for improper installations.

b. Flue Opening Modification: Vent Dampers. There are three potential hazards associated with the use of vent dampers. For all types of vent dampers, failure to open upon burner ignition, or closure during burner firing could result in venting combustion products into a residence, possibly leading to carbon monoxide poisoning. Secondly, for dampers on gas heating systems, failure of the dampers to open in the event that the pilot is extinguished could result in venting unburned gas into the residence, creating a fire or explosion risk. Finally, for electrically activated dampers, failure could also result in electrical shock.

DOE addressed these concerns through a material standard in the Program. DOE is also developing an installation standard for vent dampers. Installations of vent dampers will not be permitted under the Program until installation standards have been formally adopted.

The Program requires a post-installation inspection of every installation of vent dampers occurring under the Program. An alternative was considered to require inspection of 100 percent of the first 10 installations by each contractor and a random 20 percent thereafter. This option would reduce the associated costs of post-installation inspection. The magnitude of increased safety hazard that would be associated with this alternative is uncertain. In view of the potential hazard associated with vent dampers, the original proposal was considered preferable.

c. Electric and Mechanical Ignition Systems. The primary health and safety concerns associated with electric and mechanical ignition systems are potential fire hazards and the possibility of asphyxiation. Most ignition systems are equipped with safety features which are designed to shut off the gas supply in the event of pilot or main burner ignition failure. If these safety features fail to operate properly, unburned gas could vent into the residence, causing a fire or explosion hazard from other sources of ignition. Unburned gas could also cause asphyxiation of residents.

DOE addressed these concerns through a Program material standard and is also developing an installation standard. Installations of electric or mechanical ignition devices will not be permitted until installation standards have been formally adopted.

Because of the potential health impacts associated with improperly installed or malfunctioning electric and mechanical ignition systems, the Program requires a post-installation inspection of installations occurring under the Program. As with vent dampers, it was concluded that safety and health considerations outweighed cost considerations. Because of this priority, options for fewer post-installation inspections were rejected. The same preferences were reached regarding post-installation inspections of small wind energy conversion systems, which are discussed below.

d. Small Wind Energy Conversion Systems. The primary potential safety concerns associated with the residential use of small wind energy conversion systems are structural failures of the tower supports and rotor subsystems. Tower collapse due to wind loads is a highly unlikely but potential hazard where exceptionally high winds, gusts, tornadoes, or hurricanes exceed design limits. Tower collapse due to foundation failure from flooding, settlement, or earthquake represents a potential but avoidable hazard. Fracture and breakup of rotor blades have been extremely rare, but still represent a potential hazard to life and property.

Additional potential health and safety concerns associated with small wind energy systems relate to the safety of utility line maintenance personnel. Multiple electric generation sources increase the potential safety hazard in utility grids by increasing the difficulty of isolating transmission lines for repair. Noise from normal operation is not considered an adverse impact, but a potential nuisance could exist where maintenance is not adequate to keep up with normal wear and tear or where close proximity is not appropriate for sensitive adjoining land uses.

DOE addressed these concerns through the development of Program material and installation standards. No evidence currently exists as to what, if any, siting requirements should be established in order to minimize personal injury or property damage if a small wind tower, mechanical components, or electrical components (such as controls or interface equipment) fail to meet design specifications. There is also little historical data regarding potential noise impacts in the residential context.

e. Indoor Air Pollution. Infiltration of outside air contributes substantially to heating and cooling requirements in many (if not most) houses. The application of various energy conservation measures will tighten up homes, reducing the air exchange rate from infiltration and exfiltration. Thus, while applying these measures may help conserve energy, they may also contribute to potential indoor air quality problems in certain circumstances.

Measures used to eliminate air leaks in homes include caulking and weatherstripping, storm windows and storm doors. There are several air pollutants (e.g., radon gas, carbon monoxide, nitrogen dioxide, and formaldehyde gas) which have been found in homes which adversely affect health if their concentrations are high for an extended period of time. To the extent that energy conservation measures reduce air exchange rates and increase the concentration of these pollutants, the health of building occupants may be affected adversely. Pre-existing health problems, in particular, may be aggravated. However, with the possible exception of potential problems associated with radon (see below), it is not believed that the health impacts will be significant. Potential adverse impacts due to indoor combustion of fuel will exist only in homes with natural or liquid propane gas appliances or gas and oil heating equipment.

or kerosene heaters

A major concern involves the accumulation of radon gas caused by reduced air exchange rates in homes applying these energy conservation measures. Radon can enter a home from radium-bearing soil underlying or in the vicinity of the building, groundwater seepage or well water passing through radon-bearing rock formations, construction materials composed of radium-bearing soil or rock, and certain types of rock used in solar heat storage systems. The potential health hazard associated with exposure to radon gas and radon daughter products is the emission of short range alpha particle radiation. Though the amount of radiation energy and material released is low, alpha particles can be very damaging to human tissue cells. Prolonged exposure to high radon gas concentrations or accumulated concentrations of respirable radon daughters may increase the risk of lung cancer; however, this has not been adequately quantified and documented for low level, long term exposures.

While the potential radon problem was first identified in states where mining operations uncovered materials with greater than average concentrations of uranium, evidence of the potential radon problem has been found to be more widespread than initially assumed. A growing recognition of possible high levels of radon and its daughter products in many parts of the United States suggests more information is needed on building materials, water and soil characteristics at the residential site, and air exchange rates. Health concerns may lead to future monitoring of building material supplies and construction sites, as well as determination of air exchange rate standards. However, in the absence of a generally accepted standard for maximum permissible concentrations of these radioactive elements, and the lack of source-strength data in residences, it is difficult to set ventilation standards. DOE is conducting research in this area and heads a task force on indoor air quality that includes CPSC, HUD, EPA, and NBS.

Another major concern involves indoor-generated air pollutants from improperly vented gas appliances or gas or oil heating equipment. The gas stove emits carbon monoxide, nitric oxide, nitrogen dioxide, formaldehyde, and respirable aerosols in sufficient quantitites to exceed recommended health standards if ventilation is reduced. The health consequences could potentially include carbon monoxide poisoning, increased respiratory illness, and death. DOE is conducting research on potential mitigating measures, including recommended air exchange rates to reduce these pollutant concentrations.

In view of the uncertainty about the magnitude of these health hazards, an alternative was considered to delay the inclusion of measures which may increase potential indoor air quality hazards. However, the delay of inclusion of caulking, weatherstripping, storm windows, and storm doors, could affect the success of the RCS Program significantly. The reduction of air infiltration has been found to be an important recommendation for energy saving. Moreover, these measures are probably the most well known. Because of the increasing cost of energy, it is likely that increasing numbers of residential building owners will utilize these measures, with or without the services of the Program. In the latter case, they might not benefit from information the

Program might otherwise communicate to them. Delay regarding inclusion of these measures would seem to serve little purpose. The Program focus should be, rather, on ensuring communication of practical knowledge to minimize or eliminate potential problems while encouraging the conservation of energy in residential buildings and at the same time encouraging further research on those areas of potential health and safety concern.

5. Alternatives

a. No-Action Alternative. There is some likelihood that many of the consumer conservation actions that will be promoted by the RCS Program will eventually occur even in the absence of the Program. If energy-related expenses continue to increase as a proportion of household budgets, residential customers who would have installed measures under the impetus of the RCS Program are likely to eventually do so anyway. As a consequence, some of the reduction in energy usage and corresponding pollutant emission changes that are projected to result from the Program might occur even without the Program. These reductions and changes would be realized without the costs associated with implementing the Program.

On the other hand, the cumulative reduction in energy usage would be less than that which can be realized with the RCS Program, and much of any near term beneficial effect on energy imports produced by the RCS Program would be lost. Furthermore, since the RCS Program provides for consumer information programs and specifies installation and materials standards, the no-action alternative is likely to result in a more poorly informed public and a reduction in the benefits that would have been obtained by compliance with the standards. Finally, some of the people who would have installed measures regardless of the existence of the RCS Program can be expected to take advantage of its services, and will thus be more likely to have safe and effective products installed than had there been no Program.

b. Program Alternatives

(1) Installation Standards Alternatives

(a) Post-Installation Inspections. In order to promote the training of installers as well as safety and effectiveness of installations under the Program, post-installation inspections are required for certain measures. The State Plans must provide for post-installation inspections of all installations of vent dampers, electric or mechanical ignition devices, and wind energy systems. Installations of insulation and other measures must be inspected on a random basis with four of a contractor's first ten installations of insulation and 10 percent of all other suggested measures over the life of the Program being inspected. The State may reduce or eliminate the 10 percent random inspection requirement if it can demonstrate that it is not necessary in order to ensure the safety and effectiveness of the covered installations.

DOE did not consider alternatives to the mandatory post-installation inspection requirement for vent dampers, wind energy devices, or ignition devices because of its concern over the potential health and safety impacts if any of these measures were installed improperly.

Regarding the other measures, three alternatives were proposed for the required scope of the random post-installation inspections:

(1) No inspection requirement

(2) Require distribution of self-inspection materials to all audited homes and offer post-installation inspections on request

(3) Require inspection of all installed measures.

Two additional alternatives were proposed regarding the duration of the requirement for post-installation inspections:

(4) The inspections are required for the duration of the Program

(5) After an unspecified initial period, States may, at their discretion, remove the inspection requirement.

DOE determined, on the basis of experience gathered by utilities, that some measures for which random inspections have been prescribed are occasionally installed improperly. Eliminating the random inspections altogether would decrease the effectiveness and increase the safety risk associated with some of these measures. This finding applied, in particular, to urea-formaldehyde foam and active solar systems. The increased safety risk and potential reduction in effectiveness associated with eliminating all random post-installation inspections were considered unacceptable in spite of the increased Program cost that inspections will impose.

DOE recognized the potential cost savings in the second alternative, and considered the use of inspection guides. However, the difficulty of obtaining meaningful self-inspection by many homeowners made this alternative less attractive.

Alternatives (3) and (4) would be both the most expensive approaches and the most likely to reduce safety hazards to a minimum. However, the added costs were considered too high in relation to the potential improvement in benefits. Alternative (5) would allow a State to end its inspection program without having to demonstrate that it was no longer needed. It was not considered reasonable to permit inspections to end without a demonstrable factual basis.

(b) Loose-fill Insulation. Several requirements were proposed to govern the installation of loose-fill insulation. These requirements were combined into three alternatives for consideration by DOE:

(1) The first alternative would require the use of several precautionary measures intended to ensure adequate ventilation, moisture protection, and fire safety. Of the latter, wire guards would be required where needed to prevent electrical wiring from being covered by insulation.

(2) The second alternative would include all of the provisions specified for (1) except the requirement for wireguards.

(3) The third alternative would include all of the provisions specified for (1) except substitute a restriction that all loose-fill insulation be below the level of any wiring in place of the wire guard provision.

The first alternative would result in the lowest potential health and safety hazard since no wiring could be covered with insulation. However, this alternative poses a serious drawback. The wire guard provision would significantly increase the average cost of an installation of loose-fill insulation and reduce the demand for such installations under the Program. The cost increase would be likely to affect the competitive position of any contractor, and especially small business contractors, attempting to do business under the Program.

The second alternative would have a potentially higher safety risk than the first alternative since attic wiring would probably be covered during many installations. The magnitude of this safety risk is not known, however. The Program believes this potential risk is minimal since meaningful field data do not seem to support laboratory indications of it. DOE is presently conducting research that will help to evaluate this potential impact.

The third alternative would have approximately the same impact as the first since no wiring would be covered with insulation. However, insulation levels could be substantially reduced in some attics to avoid covering wiring under this alternative, and the resulting energy-usage reduction benefit would be less.

Alternative (2) is considered preferable because of the lack of data concerning the actual, as opposed to potential, fire risk associated with covering attic wiring with insulation and the relatively high costs and other drawbacks of alternatives (1) and (3).

(2) Material Standards Alternatives

(a) Enforcement Provisions. The rule does not require any enforcement of the material standards. Although contractors must use standard products for all installations performed under the Program, with one exception no check of these products is required. The exception covers a customer or any other person who alleges injury because a contractor used substandard products. Such persons shall be entitled to redress under appropriate procedures. These procedures might include testing for compliance.

Three alternatives to this decision that were considered would have required:

(1) That all materials used in the Program be tested by an independent laboratory for compliance with the safety-related sections of the material standards. Laboratories testing insulation would have to be accredited under the National Voluntary Laboratory Accreditation Program (NAVLAP) of the Department of Commerce.

(2) That all materials used in the Program be labeled or give other evidence of compliance with DOE material standards. An alternative to labeling is the distribution of specification sheets (containing test results) to all retailers or contractors to be given to the ultimate user of the product.

(3) That both of the above alternatives be adopted.

The first alternative is likely to have the greatest effect on reducing the potential for health and safety hazards arising from improperly made material since actual testing would be required. The disadvantage of this alternative is that it might be costly for many manufacturers to comply with it. Prices for their products might rise, and as a result some manufacturers might not participate in the Program.

The second alternative is likely to be less effective than the first option since some manufacturers may label their products incorrectly. The alternative would provide more information to consumers under the Program, but might increase some product costs and might cause some manufacturers to keep their products out of the Program.

The third alternative would reduce the potential for hazards and provide more information to the ultimate users. It would, however, increase costs and possibly reduce manufacturer participation. An intermediate approach considered would be to require that either of these alternatives be used. This alternative, while less costly than requiring both proposals, would also be subject to the same objections as noted above.

(b) Mineral Fiber Batt Insulation. The materials standard for mineral fiber batt insulation requires that a warning label be placed on kraft paper vapor barrier coverings to warn the installer to place the insulation in such a manner that the kraft paper vapor barrier is not exposed. This warning is specified because the risk of rapid flame spread is greater if the kraft paper vapor barrier is installed facing an open space where fire might originate. DOE has accepted the Consumer Product Safety Commission's (CPSC) position that installing the vapor barrier as specified in the warning will control the risk of injury from fire associated with the paper.

One alternative to the warning label that DOE considered would have required all kraft paper vapor barriers to pass the fire safety tests. This alternative would have virtually eliminated insulation using kraft paper vapor barriers from the Program because of the large expense involved in treating it to pass the fire safety tests; however, it also would have virtually eliminated the fire hazard.

(3) <u>Additional Measures</u>. The question of permitting additional measures to be added to the Program while retaining an assurance that these measures would be environmentally acceptable was given careful consideration by DOE. Section 212(b) of NECPA requires that when measures are added to the Program by rule, the Secretary must promulgate necessary safety, effectiveness, and installation standards. In the Program, DOE requires a subsequently proposed measure to meet several energy, economic, and environmental criteria before it can be added to the Program. The environmental criterion requires that the measure not present a significant safety, fire, or health hazard when properly installed. A more stringent criterion would require that for any measure for which evidence exists that the measure creates a potential health, safety, or fire

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hazard when improperly installed, material and installation standards which prevent those hazards must be developed and followed.

The latter criterion, while possibly more expensive and time-consuming, avoids the potentially difficult problems of determining what constitutes the proper installation of a given measure. That is, a "proper" installation could be, by definition, one that does not create a significant safety, fire, or health hazard. The alternative criterion would require, instead, that necessary material and installation standards be established before proceeding with any measure under the Program whenever there is any evidence whatsoever of a potential health, safety, or fire hazard.

Another alternative considered would have precluded adding any measure for which evidence exists of potential health problems resulting from improper installation. This alternative would maximize the reduction of potential health or safety problems; however, it might also eliminate additional measures that have significant energy saving potential and whose potential problems could be minimized or eliminated through appropriate material and installation standards.

Another alternative considered would establish an appropriate mechanism for permitting States to add measures for use in their own jurisdiction (State measures) pursuant to some form of State agency certification and DOE review. This alternative would necessitate the commitment of State resources to ensure that any proposed State measure was subjected to an adequate environmental analysis and review and that adequate oversight activities were undertaken. Adoption of this alternative would allow States the flexibility to adopt measures appropriate to their specific needs. While this alternative would probably increase the Program burden on some States, it also might increase State agency interest and participation, improve the quality of research evaluation and dissemination, and accelerate the potential Program success.

(4) Indoor Air Quality. DOE considered several alternative methods for dealing with potential indoor air quality concerns. These options would have required that some account be taken of indoor air quality during the audit.

In one alternative, the auditor would check the home for sources of indoor air pollution and discuss the possible effects of weatherizing the home with the homeowner. While this alternative would provide the homeowner with additional information, it would increase the cost of the audit which might discourage some participation. On the other hand, if the information conveyed is specific and focused, it would probably be of value in contributing to an informed decision by the homeowner. no longer ...

Another alternative considered would be to monitor the residences of customers of covered utilities in areas known or suspected to have large concentrations of radon. With the exception of the increased cost of monitoring homes, this would affect Program effectiveness in the same manner as the preceding alternative. Implementation of this alternative would be limited to areas where radon is known or expected to be present in large concentrations.

In a third alternative, outside air for combustion in a heating furnace would be required as a Program measure. While such a measure might reduce the buildup of indoor-generated pollutants in some homes, research has also shown that adoption of this option frequently would not reduce energy consumption in houses. Therefore, the inclusion of outside combustion air in the Program would not seem to be appropriate or necessary.

(5) Delay Case Alternative. The potential site-specific health and safety hazards from the installation of the energy conservation and renewable resource measures vary in nature. Potentially serious hazards with uncertain probabilities of occurrence exist in connection with the installation of some measures. For some other measures and the indoor air quality problem, the magnitude of the potential impacts ~~are~~ is not known with certainty. Recognizing these uncertainties, DOE considered whether to include measures for which potentially serious or uncertain hazards exist or delay them until better information was developed regarding the nature of their hazards. On balance, after evaluating the factors summarized below, it was deemed in the public interest to include such measures.

The primary measures in question were vent dampers, electric or mechanical ignition devices, wind energy devices, urea-formaldehyde foam insulation, and the measures that can contribute to indoor air quality problems, i.e., storm windows, storm doors, caulking, and/or weatherstripping. The alternatives to including these measures in the Program were:

(a) Delaying their inclusion until research on all of them was concluded and potential hazards and mitigating strategies were better understood

(b) Delaying inclusion of each measure until potential hazards were assessed more definitively and mitigating strategies were developed.

The anticipated total delay for the first alternative would be two years. During this time, none of the affected measures could be installed under the Program. The anticipated delay for the second alternative would vary for each measure. For vent dampers and electric or mechanical ignition devices, the delay would be approximately six months. For urea-formaldehyde foam, the delay would be about 18 months. For wind devices, the delay would be about 18 months. For measures affecting general indoor air quality, the delay would be 18 months or more.

Either alternative could be expected to further minimize or eliminate potential hazards. The delay of vent dampers, electric or mechanical ignition devices, and wind energy systems would probably not have a significant effect on the Program because fewer of these measures are expected to be purchased and installed under the Program than other measures. The delay of inclusion of urea-formaldehyde foam insulation would also probably not affect the Program significantly since there are other wall insulation products which can be substituted. However, NECPA includes these items within the statutory definition of residential energy conservation measures and requires DOE to promulgate necessary safety, effectiveness, and installation standards for them.

The delay of inclusion of caulking, weatherstripping, storm windows, and storm doors, which may cause potential indoor air quality hazards, could affect the Program significantly, however. The reduction of air infiltration has been found to be an important recommendation for reducing energy usage. The delayed inclusion of these measures may inhibit the success of the Program significantly. If, nonetheless, the increasing cost of energy caused large numbers of residential building owners to utilize these measures, with or without the benefits of the Program, then delaying their inclusion would be counterproductive and not in the public interest.

(6) Legislative Alternatives

(a) Time-of-Transfer Program. A legislative alternative that would promote the same objective as the RCS Program, i.e., improve the energy efficiency of America's homes, would be a requirement that all existing residences meet specified energy efficiency standards. This requirement could be imposed, for example, at the time they are sold. Such a proposal, generally called a "time-of-transfer" requirement, would require new legislation. The standards would be analogous to the lists of suggested measures contained in the RCS Program rule.

The results of such a program by 1985 might be approximately the same as those of a moderately successful RCS Program. The national pollution effects could therefore be expected to be about the same as those projected for the RCS Program. Many of the potential adverse site-specific effects might be reduced below those for the RCS Program since a time-of-transfer program would probably include 100 percent inspection of all required conservation measures, thereby ensuring a higher degree of compliance with safety and effectiveness standards. Indoor air quality would still be a potential problem under this alternative since storm windows and doors, caulking, and weatherstripping might be installed in a large number of houses.

(b) Increased Tax Incentives. The Energy Tax Act of 1978 included tax credits for certain conservation and renewable resource measures installed in residences. Increased tax credits would probably substantially increase the purchases of both conservation and solar measures. In particular, increased credits for those taxpayers who participated in the RCS Program would probably substantially increase the effectiveness of the Program.

If additional tax credits were related to the RCS Program and increased the participation in it, the potentially positive and adverse impacts of the Program would be increased proportionately. If such credits were not tied in any way to the RCS Program, however, then certain adverse impacts might increase more than the positive impacts since no safety standards are required for measures currently eligible for tax credits. Thus, increased tax credits independent of the RCS Program could increase potential site-specific hazards associated with such devices or products as vent dampers and urea-formaldehyde foam insulation.

(c) NECPA Amendment Providing for Increased Funding for Promotion and Training. Increased funding would probably help increase the number of homeowners participating in the RCS Program and the number who eventually will reduce energy consumption as a result of the Program. Increased funding to DOE and to States and utilities should increase Program effectiveness thereby making it more attractive to eligible customers. The funds could pay for increased (or higher quality) promotion for the

Program and for increased training for auditors, inspectors, and installers. The principal effect of such an alternative probably would be to magnify both the potential positive and adverse effects of the Program.

(d) NECPA Amendment Providing for Increased Funding for Enforcement. Funds could be appropriated to assist State listing of contractors and lenders and State enforcement programs. As NECPA and the Program currently envision, States and utilities must generate adequate funds for listing and enforcement from their own revenues. Some part of those funds probably will come from utility revenues authorized by State Regulatory Authorities. Many States, however, may be unwilling or unable to find adequate revenues for their listing and enforcement programs. Inadequate funding will aggravate the safety and effectiveness problems arising from the improper installation of measures. Federal funding would help mitigate this problem.

(7) Policy Alternatives

(a) Exemptions and Waivers. Section 216 of NECPA generally prohibits utilities from either installing or financing the installation of any energy conservation or renewable resource measure. This prohibition is reflected in the Program. Certain exemptions are allowed by the law and the Program, particularly for small loans and for furnace modifications. The Secretary is also given the discretion to waive the prohibition, based on certain findings about prices, interest rates, and competition.

Several existing utility programs which offer financing at low interest rates appear to stimulate increased purchases of conservation measures. As an alternative, therefore, DOE might further encourage such programs by establishing specific criteria for exemptions, by waiving the statutory prohibition on financing, and by persuading utilities and States to begin or accelerate such activities. Each of the positive and adverse effects of the existing Program would be proportionately increased to the extent such a policy is successful. It is not believed such programs would either increase or decrease the relative magnitude of any particular environmental effect.

(b) CPSC Standards. Any product covered by a CPSC standard must be produced and/or installed according to such standard in every situation regardless of its relationship to any Federal program. With the exception of cellulose insulation, no energy conservation or renewable resource measure is covered by a CPSC mandatory product standard.

A possible Program alternative would be to recommend to the CPSC that it establish mandatory product standards for those measures which DOE believes have substantial health and safety risks.* There is a risk that the RCS Program will both increase the installation of certain potentially hazardous materials and

This action would occur after consultation with the Secretary of Commerce, acting through the National Bureau of Standards, and the Federal Trade Commission regarding product or material standards pursuant to Section 222 of NECPA.

devices and at the same time provide inadequate procedures to reduce those hazards. For example, although the Program will promulgate material and installation standards for vent dampers, many homeowners may purchase them outside the coverage of the RCS Program inspection program. CPSC standards for the sale and installation of such devices would cover installation outside the RCS Program and would thus reduce even further any associated potential health and safety hazards. It is likely that this alternative would entail some extra costs, however.

(c) State Standards. The RCS Program requires as a minimum that a participating State establish a system of post-installation inspections for measures installed "under the RCS Program." The Program requires that such inspections be required at least for those products whose installation is "arranged" by the utility. The definition of "arrange" is left to the States, within certain limits. Those installations which take place "outside" the RCS Program are not required to meet Program standards (or perhaps any standards) even though they may occur in connection with knowledge of RCS Program information and activities. However, to the extent that States adopt standards similar to or the same as Program standards, potential health and safety hazards associated with such measures might be further reduced. Such State standards could be expected to place additional cost and enforcement responsibilities upon the States and, for these reasons, may not be adequately enforced.

6. Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

It is likely that the implementation of the RCS Program will have beneficial impacts upon the environment and thus upon the maintenance and enhancement of the long-term productivity of land, water, and other environmental resources. On the national level, it is believed that the pollutant emission increases and decreases attributable to increased demand for energy conservation and renewable resource measures as a result of the Program will represent a small percentage of nationwide emissions and will be insignificant. It is concluded that the net changes in projected pollutant emissions, while small, would be beneficial. Thus, it is highly unlikely that this Program will constrain the diversity and range of potential uses of the environment. The RCS Program does not involve trade-offs between short-term environmental gains at the expense of long-term losses or vice versa and would not foreclose future options. It is far more likely that the Program will help broaden the diversity and range of potential environmental uses through information dissemination, education, and practical applications of energy conserving measures.

Regarding estimated increases in production for selected energy conservation measures, the analysis showed that there might be some associated increases in air and water pollutants but that such increases would not be significant on a nationwide basis or at the industry level. Any incremental increase in pollutants associated with the remaining energy conservation devices was estimated to be even more minimal. The pollution analysis showed a reduction in air and water pollutant emissions associated with the estimated decreased demand for energy. Similar conclusions were reached, on a more qualitative basis, regarding estimated air and water pollution impacts attributable to renewable resource measures. It was estimated that the net change in emissions in both categories of measures would be beneficial but also small when analyzed on a national basis. Increased production might also cause some increase in the use of human resources.

7. Irreversible or Irretrievable Commitments of Resources

Apart from the previous summary of potential air and water pollution impacts, the environmental analysis did not disclose any basis in fact to conclude that implementation of the Program will result in the commitment, consumption, destruction, or transformation of any scarce or nonrenewable resources or in the curtailment of the range of potential uses of the environment.

1.0 INTRODUCTION

This Final Environmental Impact Statement (EIS) analyzes the environmental impacts of the Residential Conservation Service (RCS) Program and its reasonable alternatives.*

Description of the RCS Program

Through Part 1 of Title II of the National Energy Conservation Policy Act (NECPA) (P.L. 95-619),** Congress mandated the U.S. Department of Energy (DOE) to implement a national residential energy conservation program. The Program is designed to facilitate and encourage the installation of energy conservation and renewable resource measures in the homes of customers of large gas and electric utilities and home heating suppliers.

In preparing this EIS, DOE has made a thorough review of relevant information available in published sources, including previous environmental studies, as well as unpublished documents bearing on the issues involved which DOE has been able to identify. In addition, DOE has attempted to obtain informally information relative to already existing utility programs as it bears upon the RCS Program. In certain instances, which are identified, DOE was unable to obtain reliable quantitative data. In these cases, DOE had to utilize qualitative analyses.

The purposes of NECPA, as declared by Congress, are to provide for the regulation of interstate commerce, to reduce the growth in demand for energy in the United States, and to conserve nonrenewable resources produced in the U.S. and elsewhere without inhibiting beneficial economic growth. NECPA, Section 102(b).

As required by NECPA, the RCS Program will require large regulated and nonregulated public utilities with specified residential sales* to prepare and administer programs of consumer information and services designed to promote the installation of energy conservation and renewable resource measures in residential buildings.** State governments may prepare a State Residential Conservation Service Plan (State Plan) governing the development and administration of the utility programs within their states. If a State elects to prepare such a State Plan, it must govern participation by all covered regulated utilities operating within its borders. It may, at its discretion, include covered nonregulated utilities and any home heating supplier*** which volunteers to prepare a program for its heating fuel customers. The Tennessee Valley Authority may prepare a State Plan governing participation by covered utilities within its jurisdiction. If a State elects not to prepare a State Plan, covered utilities in that State must implement programs under a Plan promulgated by DOE.

**Utilities with annual sales for purposes other than resale in excess of 10 billion cubic feet of natural gas or 750 million kilowatt-hours of electricity. For program purposes these are called "covered utilities." NECPA, Section 211.*

***A "residential building" is defined as having one to four dwelling units, having a system for heating or cooling, and not being subject to the final Building Energy Performance Standards under Sections 304(a) and 305 of the Energy Conservation and Production Act. NECPA, Section 210(9).*

****"Home heating suppliers" are persons selling or supplying home heating fuel (including No. 2 heating oil, butane, propane, and kerosene) to residential customers for consumption in a residential building. NECPA, Section 210(20).*

The residential energy conservation measures* currently included in the RCS Program are:

- Caulking and weatherstripping
- Specified furnace efficiency modifications
- Insulation of ceilings, walls, floors, pipes, ducts, and water heaters
- Storm windows and doors
- Thermal windows and doors
- Heat reflective and heat absorbing window and door material
- Electric load management devices
- Clock thermostats
- Replacement central air conditioners.

Residential renewable resource measures currently included are:

- Solar domestic hot water systems
- Active solar space heating systems

**NECPA, Section 210 (11) defines residential energy conservation measures. Section 210(11)(I) authorizes DOE to identify other measures through rulemaking. The content of the rules is governed by criteria set forth in Section 212(b).*

- Combined active solar space heating-hot water systems

- Passive solar space heating and cooling systems

- Wind energy devices

- Replacement solar swimming pool heaters.

Definitions of these and other terms are set forth in the Glossary.

Under the Program, eligible customers of covered utilities and participating home heating suppliers could receive the following services:

- Information about estimated savings on energy costs for selected energy conservation and renewable resource measures

- Energy audits upon request

- Arrangements upon request for the purchase, installation, and financing of the selected energy conservation and renewable resource measures

- Lists, upon request, of suppliers, contractors, and lenders who have agreed to comply with the Program's standards and procedures

- Post-installation inspections.

Under the Program, the following benefits would be available to customers who have the installation of the selected measures arranged by a covered utility or participating home heating supplier:

- The measures purchased by the customer would be covered by a three-year manufacturer's warranty.

- The measures installed would meet any applicable DOE installation or materials standards.

- The installation would be included in a pool of installations from which random inspections of compliance would be made.

- A post-installation safety inspection would be mandatory in connection with the installation of certain measures with potential health or safety risks (vent dampers, electric ignition systems, and wind energy systems).

- The customer would be eligible for the billing and repayment services of the participating energy supplier.

- Complaints lodged by the customer against the installer, supplier, or lender would be handled through a resolution procedure.*

**A State could at its option expand the class of eligible customers for these benefits beyond those who have the selected measures arranged to be installed by a covered utility.*

DOE is required by NECPA to promulgate standards which the Secretary determines to be necessary for the general safety and effectiveness and installation of any residential energy conservation or renewable resource measure. DOE reviewed existing standards from government and industry sources, as discussed in Chapter 3. Existing standards were either adopted in whole or in part or were expanded as necessary to assure adequate safety and effectiveness. In some cases, inclusion of a standard in DOE's Program was found unnecessary because existing material and installation practices are adequate. In general, State and local codes relating to these measures must be followed in the absence of a conflict.*

In the case of some measures having the potential for adverse health and safety impacts, DOE found the preparation of adequate standards to be a lengthy process. These measures, such as vent dampers, electric ignition devices, and urea-formaldehyde foam insulation, have the potential to reduce energy usage and pay for themselves within their lifetime. DOE determined that rather than postpone the benefits achievable through the Program until adequate standards could be prepared for these measures or exclude these measures entirely from the Program,** their inclusion in the Program should be reserved pending the adoption of adequate standards promoting their safe and effective usage.*** The measures will be included in the Program when adequate

**In Section 220 of NECPA, Congress declared that no State or local law shall be superseded except under certain conditions as specified therein. See also Section 456.102 of the rule regarding petitions concerning conflicts of laws.*

***Some of these measures are required by NECPA, Section 210.*

****This decision is discussed in Section 6.2.7, the delay case.*

health, safety, and effectiveness standards have been adopted through a formal rule-making process. A reserved measure will be withdrawn if adequate health, safety, and effectiveness standards have not been adopted by the time of approval of the first State Plan.

Under the Program, suppliers, financers, and installers of energy conservation measures and renewable resource measures would be listed on a State-developed and utility-distributed list if they agree to comply with certain requirements. Among these are requirements for contractors to install measures in accordance with DOE standards which would be enforced through post-installation inspections. The Program would require mandatory post-installation inspections of all vent dampers, electric ignition systems, and wind energy systems where a covered utility or participating home heating supplier arranges* installation of a suggested energy conservation measure. Specified random inspections shall be required for the other measures installed in a residential building pursuant to an arrangement. The Program requires any State which submits a Plan to assign responsibility for these post-installation inspections (see Section 456.313 of the rule).

As may be seen from this summary description of the RCS Program, it is primarily informational in nature. That is, utilities will, in program announcements, inform their residential customers of the desirability (in terms of energy cost savings) of installing certain suggested energy conservation and renewable resource measures. In this

**NECPA Section 215 requires that each utility program include procedures to inform residential customers of the availablity of arrangements and to offer to arrange for the installation of suggested energy conservation measures.*

regard, the RCS Program will complement other Federal, State, and private informational sources with respect to energy conservation and renewable resource measures by providing additional accurate and useful information and by reaching a larger number of people. In addition, by offering energy audits of residential buildings, the RCS Program will improve the information delivery system by enabling the auditor to provide more site-specific information concerning the likely costs and savings of installing certain energy conservation and renewable resource measures. Finally, the RCS Program also provides an opportunity for the eligible customers of the utilities to receive lists of contractors, suppliers, and lenders in their area who install, supply, and finance the measures involved.

The program announcements will reach the largest potential number of residential customers.* The number of persons who might actually request audits for this Program cannot be accurately ascertained at this time. Data available to DOE suggests that, as the cost of an audit increases, the response rate decreases rapidly. Under the terms of NECPA, the cost of an audit is left to the sole discretion of the State Regulatory Authority or to the nonregulated utility.** If a substantial percent of the actual cost of an audit is charged to the customers who request it, DOE believes response rates will be minimal (that is, 1 percent per year or less). Available empirical data show that free

**One estimate, in DOE's Regulatory Analysis, is that the program announcement could potentially reach 65.4 million households. The methodology for this estimate, based on census data for housing stock, as opposed to customers of covered utilities, suggests that the estimated potential figure represents the maximum situation. Since many utilities do not come within the minimum required sales criteria of NECPA, their customers might not be included within this Program.*

***NECPA, Section 215(c).*

or minimal charge audits have received response rates on the order of 4 to 5 percent per year. Given the national nature of the RCS Program, rising fuel prices, increased consumer education, and other benefits of the RCS Program, DOE estimates that a response rate of 7 percent per year could be achieved for the projected five-year life of the Program (through 1985) where audits are free or at minimal cost. For purposes of this analysis, DOE has assumed a 7 percent annual response rate nationwide, realizing that it is probably an optimistic projection given the likelihood that some State Regulatory Authorities may allow more than minimal audit fees.

DOE's Regulatory Analysis estimates that 75 percent of the persons who receive an audit will purchase at least one energy conservation measure addressed in the audit.* To assess the maximum likely effect of the RCS Program, DOE has assumed, for purposes of this analysis, a 75 percent purchase rate by residential customers receiving audits under the Program.

In addition to the informational aspects of the RCS Program, there are essentially two other separable aspects of the Program. The first is the requirement, noted previously, that utilities offer to "arrange" for the installation, supply, or financing of suggested measures. This does not, except in limited circumstances, mean that the utilities themselves must install, finance, or supply measures; only

*This estimate assumed that a customer, upon receiving an audit, would purchase at least one measure he did not already have which would pay back its cost in six years. Experience in existing utility programs suggests that this assumption is highly optimistic and represents a maximum potential response rate. The data and model used to determine what measures were already present, the costs, and the savings for measures, while the best available at the time for nationwide modeling purposes, are necessarily subject to re-evaluation should more complete empirical data become available.

that they facilitate the installation, supply, or financing of residential energy conservation and renewable resource measures. The RCS Program will allow States broad discretion in implementing the required "arranging" function so long as some activity is required in addition to the mere distribution of lists of suppliers, contractors, and lenders.

The second aspect of the Program that goes beyond the information function concerns the benefits, described previously, which residential customers receive in connection with "arranged" installations--primarily the assurance that measures will be installed according to the Program's installation and material standards.*

The environmental effects of these noninformational aspects of the Program are difficult to gauge because of the discretionary ability of States to change the nature and scope of these functions. Based on the types of measures most likely to be installed after an audit (and especially their relatively low cost and ease of installation for do-it-yourself residential customers), DOE believes that a substantial percent, if not a majority, of the measures installed will not be "arranged" by a utility, however "arranging" may be implemented by a State. Moreover, DOE does not have any evidence indicating how States may expand the class of beneficiaries for the benefits beyond those who have installations "arranged."

Programs to inform homeowners of the potential benefits--both to themselves and to the nation as a whole--of installing energy conservation and renewable resource mea-

**States have discretion to expand the class of beneficiaries for these benefits beyond those receiving "arranged" installations. For instance, a State could provide these benefits to any installation following a program audit.*

sures are not unique. The RCS Program is unique, however, in the potential scope and nature of its information program as well as in the integral relationship of the informational, arrangement, and benefits aspects of the Program.

2.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

There are essentially two levels at which the environment may be affected by the RCS Program: the national/regional level and the site-specific residential building level.

On the national/regional level, the RCS Program potentially could affect air and water quality positively. This could occur primarily from a reduction in certain air and water pollutants associated with the production of electricity and the burning of heating oil and natural gas in homes. To the extent that the RCS Program is successful in encouraging the installation of energy conservation and renewable resource measures in residential buildings, there should be a reduction in the use of energy from what otherwise would have been used. On the other hand, an assumed increase in the manufacturing of these energy conservation and renewable resource measures might increase certain air and water pollutants beyond that which otherwise would have been the case. These potential impacts are addressed in more detail in Chapter 3. There is no present factual basis for the Program to project more success in one region rather than another. Moreover, production of energy conservation and renewable resource measures is for the most part geographically diffuse. Therefore, as a general matter, DOE believes evaluation of the RCS Program's potential impact on the nation's air and water quality is the most appropriate methodology to follow since it seems probable that any likely environmental impacts, especially regarding air and water quality, are likely to be spread rather evenly across the country. Where there is a factual basis to discern regional differences, they will be addressed.*

The second level at which the environment may be affected is the site-specific household environment. A primary focus will be upon potential health and safety issues related to various energy conservation measures. Air quality within residential buildings is also addressed because this can be potentially affected by the installation of certain energy conservation measures. Water quality at the site of the household and its immediate vicinity is likewise addressed because certain renewable resource measures potentially could affect water quality.

In assessing the national/regional impacts on the environment by the RCS Program, the number of installations considered is significant since the greater the number of installations, the greater the potential impact. To be absolutely precise, the assessment should be limited to the impacts actually caused by the RCS Program: that is, where the Program creates an incentive for installation of measures as opposed to those instances where installations occur solely as a result of information concerning those measures and from installations that would occur in the absence of the RCS Program. As noted before, however, there are no present data with which one can accurately separate the effect of the information aspects of the RCS Program from the noninformational aspects. Consequently, this EIS addresses the impacts on the national/regional environment of all installations projected to occur after an audit has been conducted, recognizing that this includes a large percentage of installations which would not have been "arranged."

3.0 ASSESSMENT OF POTENTIAL IMPACTS

3.1 Introduction

This chapter assesses the potential aggregate pollutant emission* changes nationwide, the potential health and safety impacts associated with the installation of RCS Program energy conservation measures and renewable resource (e.g., solar and wind) measures in residential buildings, and other potential impacts attributable to the RCS Program activities.

For both energy conservation and renewable resource measures, there are only a few measures included in the Program which, even when improperly manufactured and installed, have the potential to cause a significant environmental impact. This EIS analyzes the potential environmental impacts of those measures and mitigation measures to reduce the potentiality that improper installation or the installation of faulty equipment will occur.

3.1.1 Analytical Approach

In addressing potential environmental impacts associated with implementation of the RCS Program, it has been necessary to utilize a variety of analytical techniques. For those national or site-specific impacts which could be treated

**The terms "pollutant emissions" and "emissions" as used in this EIS encompass emissions of air pollutants and the discharge of water pollutants.*

through quantitative analysis, the analytical technique and resultant data are discussed in this chapter. For those measures where DOE has been unable to identify an appropriate quantitative treatment, a qualitative analysis of known or potential impacts is presented.

A substantial effort was made to quantitatively analyze the potential environmental impacts of the total RCS Program. The use of a quantitative approach required that estimates be determined of the numbers of conservation and renewable resource measures that would be installed as a direct consequence of the RCS Program. For many measures, and in particular for renewable resource measures, valid estimates of RCS Program-stimulated market penetration could not be established.

For renewable resource measures in general, quantitative analysis is available in the literature setting forth the aggregate impacts due to the penetration estimates for active solar systems. These impacts and estimates are presented in the Domestic Policy Review of Solar Energy (DPR) for the National Energy Plan (NEP) anticipated for the period through 2020 [Science Applications, Inc., and JRB, September 1978]. The estimates for the DPR encompassed the entire national solar program as then projected. The residential solar application projections, in particular, were for a composite program including tax credits and solar loan programs in addition to the RCS Program. Although this analysis indicated that the use of renewable resources resulted in a net reduction of pollution, it was not considered valid data for the RCS Program evaluation since the portion of the projected renewable resource penetrations that would be stimulated by the RCS Program cannot be separated. Accordingly, the impacts of the renewable resource measures under the RCS Program have been analyzed qualitatively at both the national and the site-specific levels. In any event, it is likely that the impacts associated with renewable resource measures under the RCS Program, for the reasons discussed later (relative costs and payback periods), will be considerably less than the impacts attributable to the energy conservation measures under consideration.

DOE also was unable to quantify the estimates of penetration of several conservation measures. However, three energy conservation measures which are expected to account for a large part of any pollutant emission increases resulting from the production of energy conservation measures under the Program were identified and analyzed quantitatively. These measures are ceiling, wall and water heater insulation.

In preparing the quantitative analysis, occasionally a choice had to be made among competing assumptions. Wherever such a choice was required, the assumption chosen was that which would produce a projection of the most adverse or worst case environmental impact.

The assessment of the environmental impacts of the conservation and renewable resource measures that can be installed under the RCS Program consists of the following analyses:

- The national pollutant emissions impacts due to the following three measures are estimated quantitatively: ceiling insulation, wall insulation, and water heater insulation.

- The national pollutant emission impacts due to all other measures are analyzed qualitatively. These measures include floor insulation, duct and pipe insulation, storm doors, storm windows, clock thermostats, caulking, weatherstripping, thermal windows, reflective and absorptive window films, furnace modifications (including vent dampers, electric or mechanical ignition devices, oil burner replacement, and replacement furnaces and boilers), energy usage display meters, load management devices, active solar heating, active solar water heating, wind energy systems, passive solar devices, and solar pool heaters.

- The potential site-specific effects of all measures are assessed qualitatively including the three measures which were assessed quantitatively.

Where the possible extent of potential impacts is not fully known or where the determination cannot be made that a potential impact does not represent a genuine health or safety problem, a qualitative description of the potential risk is given together with a statement of activities undertaken to acquire the information necessary to make such determinations. The effect of delaying the incorporation of measures for which the nature of the potential risk is uncertain is discussed in Chapter 6, section 6.2.7, "Delay Case."

3.1.2 Provisions to Minimize Adverse Health and Safety Impacts

DOE is required by NECPA to promulgate standards which the Secretary determines to be necessary for the general safety and effectiveness of any residential energy conservation or renewable resource measure installed under the Program. In accordance with this mandate, DOE proposed standards whose purpose it is to promote the safe and effective installation of properly designed and manufactured measures. DOE intends that these standards (which are discussed in Sections 3.2 and 3.3) should minimize the risk of adverse health or safety impacts occurring as a result of Program installations.

Under conditions of low compliance with these standards, however, a worst case risk situation might be created in which the chance of an adverse impact would approach that existing for an installation without the Program standards.

In order to reduce the probability of realizing this worst case or low compliance situation, DOE has prescribed that post-installation inspections be performed on certain installations under the Program. All installations of vent dampers, electric ignition systems and wind energy systems must be inspected. Random inspections are required for installations of ceiling, wall, and floor insulation; active domestic solar water heating systems and solar active heating systems. For these measures, four of the first ten installations by a contractor must be inspected. Additionally, these measures would be inspected on a random percentage basis.

3.2 Impacts Attributable to Energy Conservation Measures

3.2.1 Aggregate Pollution Impacts

The total annual emissions of several air and water pollutants will be affected by the Program rules for the installation of energy conservation measures. The pollutant emissions affected will be those resulting from the generation of electricity and heating energy for residential use and those resulting from the production of the energy conservation measures. The net effect of the Program on the total annual emissions for most of these pollutants will be to decrease them through decreasing the residential demand for energy. For some pollutants, increases associated with the production of conservation measures will outweigh decreases from the reduction in energy usage and the net effect will be to increase the total annual emission level. In either case, however, the expected net change in pollutant emissions will be a small fraction of the national total annual emissions for each pollutant.

These changes in pollutant emissions are assessed through both a quantitative and qualitative analysis. Three energy conservation measures were selected for quantitative analysis (see the following section) in order to provide an estimate of the changes that can reasonably be expected as a result of the Program. The changes in pollutant emissions due to the other energy conservation measures are assessed qualitatively.

3.2.1.1 Pollutant Emission Increases

Quantitative Analysis

The RCS Program is expected to increase the demand for energy conservation measures during the Program period.* Associated with these demand increases will be air and water pollutant emission increases due to the manufacture of the energy conservation measures and related materials.

These pollutant emission increases are assessed through a quantitative estimate of the increases due to the incremental demand (as a result of the RCS Program) for three energy conservation measures. The three energy conservation measures analyzed are ceiling insulation, wall insulation, and water heater insulation. These measures were chosen for quantitative analysis because of:

- The magnitude of the estimated increase in pollutant emissions generated as a result of the production of these measures in comparison to the estimated increase as a result of the production of other measures.

- The availability of data needed to estimate the demand for the materials used in these measures and the resulting pollutant emission increases.

**NECPA, Section 215, requires that program announcements be sent to residential customers until January 1, 1985. DOE has assumed that the first program announcements will be sent during 1980. Therefore, for the purpose of estimating pollutant changes associated with the RCS Program, a period of five years has been used for the duration of the Program-induced demand for energy conservation measures.*

The production of these measures is expected to generate a large portion of all of the pollutant emission increases resulting from the production of energy conservation measures under the Program because of: (1) the expected greater demand for these measures primarily as a result of their shorter payback period relative to most of the other measures,* and/or (2) their higher raw materials requirement per home than many of the other conservation materials. The following assessments of the measures that are not analyzed quantitatively support this estimate:

- The demand for floor, duct, and pipe insulation is not expected to be as great as that for ceiling insulation and water heater insulation because of (1) longer payback periods, (2) installation problems associated with putting floor insulation in existing residences, and (3) the smaller amount of insulation needed for ducts and pipes.

- The demand for storm and thermal doors and windows is not expected to be great because of longer payback periods.

- Clock thermostats, electric or mechanical ignition systems, flue opening modifications, furnace replacement burners, replacement furnaces or boilers, caulking, weatherstripping, energy usage

*The estimated payback period for each energy conservation measure was calculated by the National Bureau of Standards NBS, April 1979 . They may be found in DOE's RCS Program Regulatory Analysis [DOE, October 1979].

display meters, heat reflective and heat absorbing window or door material, and devices associated with electric load management techniques will (1) probably not be subject to great demand as a result of the RCS Program because of longer payback periods (e.g., flue opening modifications), and/or (2) have a smaller materials requirement per home (e.g., clock thermostats) than the measures quantitatively analyzed.

The estimation of pollutant emissions from any industrial activity depends upon the availability of air emission factors, water effluent guidelines/data, production factors, and the level of production activity. All of these data were available for the three measures analyzed.

In quantitatively estimating the pollutant emission increases due to the incremental demand for the three energy conservation measures, focus was placed on the production of the materials used to make the measures. For example, in assessing the pollutant emission increases due to the incremental demand for insulation, the production of fiberglass, rock wool, cellulose, and boric acid was analyzed. This focus bypassed the extraction and transportation of the raw materials, such as silica, used in the production of the materials and the fabrication of the fiberglass itself. The added pollutant emission impact due to these additional industrial activities is not expected to significantly change the overall assessment. The percentage change in annual pollutant emissions that has been estimated for the production of the analyzed materials is so small that an increase by several times in these estimates will still not constitute a large change. Such levels of increase are not expected from the other industrial activities associated with the production of the three energy conservation measures.

Although these pollutant emissions associated with the materials extraction, transportation and measures-fabrication activities for ceiling insulation, wall insulation, and water heater insulation were not assessed quantitatively, they are identified and discussed qualitatively as part of this assessment of the pollutant emission increases attributable to the three energy conservation measures.

The materials manufacturing activities examined quantitatively were for:*

- Fiberglass insulation
- Cellulose insulation
- Rock wool insulation
- Boric acid

In order to guard against overstating the beneficial impacts of the Program and thereby provide an analysis unduly slanted toward Program benefits, wherever it was feasible analytical assumptions were selected that would present a liberal estimate of the pollutant emission increases due to the Program. This approach resulted in the following "worst case" assumptions regarding the assessment of pollutant emission increases:

*Boric acid is applied to cellulose insulation for flame retardant purposes. Fiberglass is used for ceiling, wall, and water heater insulation. Cellulose and rock wool insulation are used in ceilings and walls.

- If more than one production process was relevant, the most polluting was used. This assumption results in higher estimates of the pollutant emission increases due to the production of energy conservation measures.

- Effluent guidelines based on Best Practicable Control Technology Currently Available were used in preference to guidelines based on Best Available Technology Economically Achievable. Since the latter guidelines are more restrictive, this assumption results in higher estimates of pollutant emission increases.

As a result of this approach, the estimates of pollution emission increases represent, for the activities analyzed, the greatest potential increases due to the increased demand for the three conservation measures.

For the purpose of estimating the demand for energy conservation measures, the analysis assumed a 7 percent per year rate of household response to the offer of an energy audit. It was further assumed that 75 percent of the households requesting an audit would actually purchase and install one or more energy conservation measures.*

**The response and investment rate assumptions are based on a small sample of utilities offering energy audits DOE, October 1979 . Currently, there is no precise method of estimating what the rates of response and investment will be for the RCS Program; therefore, these estimates should be used with caution. It is likely that the rates of response to the offer of an audit and subsequent investment actually will be less. If so, all gross estimates reported herein will decrease proportionately.*

The assumed response rate to the audit offer and assumed investment rate are considered the maximum expected for the Program. This, in combination with the conservative approach to selecting assumptions discussed above, maximizes the estimates of pollutant emission increases that are likely to be experienced for the measures analyzed.

The pollutant emissions associated with production of the electricity that must be purchased for use in the manufacture of the three materials have not been included in these quantitative estimates. The energy needed to manufacture the materials for ceiling insulation, water heater jackets, and wall insulation needed to accommodate the RCS Program demand has been estimated to be 0.13 quads.* There will be pollutant emission increases associated with this manufacturing energy usage. The air pollutant emission factors which were used in estimating these emissions take into account most of the energy conversion activities within the manufacturing facilities (e.g. the burning of gas or oil in a fiberglass furnace). They do not, however, include the emissions associated with energy conversion activities outside of the manufacturing facilities. The most significant of these is the generation of the electric energy purchased by the facility. These emissions were not included in the quantitative estimates because the requisite data were not available for all of the materials manufacturing activities analyzed.

**See Appendix A.*

Table 3-1 presents the results of the quantitative analysis. The assumptions and methodology used are presented in Appendix A. The emission increases will occur over the five-year Program period.

TABLE 3-1. ESTIMATED TOTAL AIR AND WATER POLLUTANT EMISSION INCREASES DUE TO INCREASES IN THE PRODUCTION OF SELECTED ENERGY CONSERVATION MEASURES AS A RESULT OF THE RCS PROGRAM

Air Pollutants	Emission Increases (Tons)	Water Pollutants	Emission Increases (Tons)
Particulates	66,210	Suspended solids	42
Nitrogen oxides	3,763	Biological oxygen demand	7
Sulfur oxides	5,979	Chemical oxygen demand	99
Carbon monoxide	1,284	Phenol	1
Fluorides	72	Arsenic	7

The magnitude of these estimated pollutant emission increases is not large on a national scale. For example, the total particulate emissions over the five year Program period are estimated at 66,210 tons (or 13,424 tons per year). This yearly average represents only about 0.12 percent of the projected 1985 particulate emissions from energy-related activities which constitutes a substantial portion of the total particulate emissions from all sources* [See Appendix A].

**Energy-related activities are defined as exploration, development, extraction, processing, transportation, conversion, and combustion for all sectors (i.e., utility, industrial, residential, commercial, transportation) [DOE, November 1979]. For a discussion of the reasons for and implications of using energy-related emissions as a base for calculating percentage changes, see pp. 3-36 to 3-37.*

The increases in total annual production needed to produce the materials analyzed are presented in Table 3-2. These increases correspond to the maximum industry-wide production increase needed to accommodate the assumed customer response to the Program. If, as is likely, customer response is lower, the expected increases will also be lower.

In estimating the pollutant emission and production increases associated with wall insulation, it was assumed that all installations would be either fiberglass, rock wool, or cellulose. This assumption is not representative of actual conditions because the use of urea-formaldehyde for retrofit wall insulation has captured a substantial portion of the market. It was not possible, however, to quantitatively analyze the pollutant emissions associated with the production of the ingredients contained in urea-formaldehyde because a representative mix of ingredients could not be obtained. The ingredients in urea-formaldehyde vary with manufacturers and the quantitative proportions of the ingredients is proprietary information. Because of this limitation, the production increases presented in Table 3-2 are somewhat greater than those which can be realistically expected, and as such, represent a worst case for production increases for the materials listed.

TABLE 3-2. ESTIMATED MAXIMUM ANNUAL PRODUCTION INCREASE IN MATERIALS USED FOR SELECTED ENERGY CONSERVATION MEASURES AS A RESULT OF THE RCS PROGRAM

Industry	Maximum Estimated Increase
Fiberglass	12.5%
Cellulose	49%
Rock wool	18%
Boric acid	24.5%

Note: See Appendix A, Section A.2, for assumptions used in the derivation of these numbers.

Most of the percentage increases in pollutant emissions for each industry should be similar to the estimated percentage increases in production for the industry. This is because the pollutant emission factors and effluent limitations are given primarily in pounds of pollutant per unit weight of material produced. Although a large increase in cellulose production is projected, this process is essentially pollution free. Cellulose insulation is made by shredding newspaper and applying a chemical, primarily boric acid, for flame retardant purposes. The increase in cellulose production should not, therefore, produce a large increase in pollutant emissions. A large increase was also estimated for boric acid production. This increase was estimated assuming total use of boric acid to control the flammability of cellulose insulation. It is possible, however, that boric acid will not be the only flame retardant used; consequently, the maximum estimated increase of 24.5 percent should be considered an extreme worst-case production increase.

The other industrial activities that contribute to the production of ceiling insulation, water heater jackets, and wall insulation also emit pollutants. As noted earlier, the additional pollutant emissions associated with these other activities are examined qualitatively.

Fiberglass is made primarily out of silica (sand) with smaller amounts of other materials including sodium, calcium, magnesium, aluminum, titanium, boron, and zirconium. Mining and/or quarrying these materials generate the following water pollutants: total suspended solids, iron, nickel, and zinc. These activities also generate the following air pollutants: particulates, nitrogen oxides, carbon monoxide, and free silica [EPA, June 1976; Battelle, June 1976]. Fiberglass manufacture generates the water pollutants: chemical oxygen demand, biological oxygen demand, total suspended solids, and phenols. The manufacture of fiberglass produces as air pollutants: particulates, sulfur dioxide, carbon monoxide, nitrogen dioxide, and fluorides [EPA, April 1973; EPA, January 1974(a)].

The RCS Program is expected to require a maximum increase of 12.5 percent in fiberglass production activities. Since the raw materials contained in fiberglass have a variety of other uses, the increase in mining and quarrying activities to obtain these materials to meet the RCS Program demand for fiberglass and the resultant percentage increases in total national pollutant emissions are expected to be considerably less than 12.5 percent.

Cellulose insulation is normally produced from waste newsprint; therefore, there are no raw material extraction or other industrial activities to be considered beyond the production of the insulation material itself.

The boric acid used to treat the cellulose is discussed below.

The major ingredients in rock wool are rock and coke [BNL, June 1978]. Stone quarrying and processing and coke production activities generate the following air pollutants: particulates, sulfur dioxide, carbon monoxide, hydrocarbons, nitrogen oxides, and ammonia. The water pollutants associated with these activities include: cyanide, phenol, ammonia, oil and grease, and total suspended solids [EPA, June 1976; Battelle, June 1976].

The increase in rock wool production activities needed to accommodate the program market are estimated to be no greater than 18 percent. Since rock and coke are used in many other processes, the increase in stone quarrying and coke production needed to accommodate the RCS Program market for rock wool and the resultant percentage increase in total industry-wide pollutant emissions should be considerably less than 18 percent.

Boric acid is produced by reacting borax with sulfuric acid. Sulfuric acid is produced by oxidizing sulfur. Sulfur and borax are obtained through mining activities. The water pollutants associated with the production processes for boric acid include arsenic, suspended solids, dissolved solids, and sulfides. The air pollutants include particulates and sulfur oxides.

The RCS Program market for boric acid is expected to require a maximum increase of 24.5 percent in boric acid production. Since sulfur, borax, and sulfuric acid are used for other purposes than producing boric acid, the percentage increases needed in sulfur and borax mining, sulfuric acid production, and the associated pollutant emissions, as a result of the RCS Program should be considerably less than 24.5 percent.

Transporting any of the materials for the energy conservation measures from the raw material sources to the processing facility and from the processing facility to the measures fabrication plants and retail establishments will generate additional air pollutants. These air pollutants will include hydrocarbons, carbon monoxide, nitrogen oxides, particulates, sulfur oxides, aldehydes, and organic acids [EPA, April 1973].

Qualitative Analysis

The incremental demand for the energy conservation measures that were not assessed quantitatively is expected to generate only a small proportion of the total increase in pollutant emissions resulting from the Program. As was noted earlier, this is because of the small demand for these measures and/or the very small quantity of material used in manufacturing them. These emissions have been examined qualitatively. The results of this examination are discussed below.

Urea-formaldehyde for wall insulation is generated onsite with the use of an air compressor and a mixing or foaming gun. The constituents in urea-formaldehyde consist of: urea-formaldehyde resin; a surfactant, or foaming agent, which contains a catalyst, or hardening agent; and air. The chemicals and their proportionate mix in urea-formaldehyde vary with different manufacturers and are proprietary information [Long, 1979].

Some foaming agents which have been used are naphthalene sulfonic acid and dodecyl benzene sulfonic acid. Some of the hardening agents which have been used include phosphoric, oxalic, citric, malic, and tartaric acids [Long, 1979].

The production of many of these chemicals is based on the conversion of petroleum, natural gas, and coal for the raw materials source, and on reactions with other chemicals. The water pollutants associated with these activities include biological oxygen demand, chemical oxygen demand, total suspended solids, oil and grease, phenolic compounds, ammonia, sulfide, chromium, iron, aluminum, manganese, cyanide, nickel, zinc, phosphorus, and fluoride [EPA, April 1974 (a); EPA, April 1974 (b); EPA, June 1974; EPA, October 1975; EPA, January 1975; EPA, March 1974 (b); EPA, September 1974; Lowenheim, 1975]. The air pollutants associated with these activities include particulates, carbon monoxide, hydrocarbon, sulfur oxides, nitrogen oxides, methanol, ammonia, carbon dioxide, aldehydes, and fluorides [EPA, August 1977; EPA, May 1978 (b); EPA, March 1979].

Floor, duct, and pipe insulation will also increase the demand for fiberglass, rock wool, cellulose, and other insulation materials. The water pollutants associated with producing insulation materials are the same as for ceiling insulation. They include chemical oxygen demand, biological oxygen demand, total suspended solids, phenols, and arsenic. The air pollutants associated with insulation production include particulates, sulfur oxides, carbon monoxide, nitrogen oxides, and fluorides [EPA, January 1974(a); EPA, May 1975]. As noted earlier, the RCS Program demand for these types of insulation is expected to be considerably less than the program demand for ceiling, wall, and water heater insulation. The associated production and pollutant emission increases should also be considerably less.

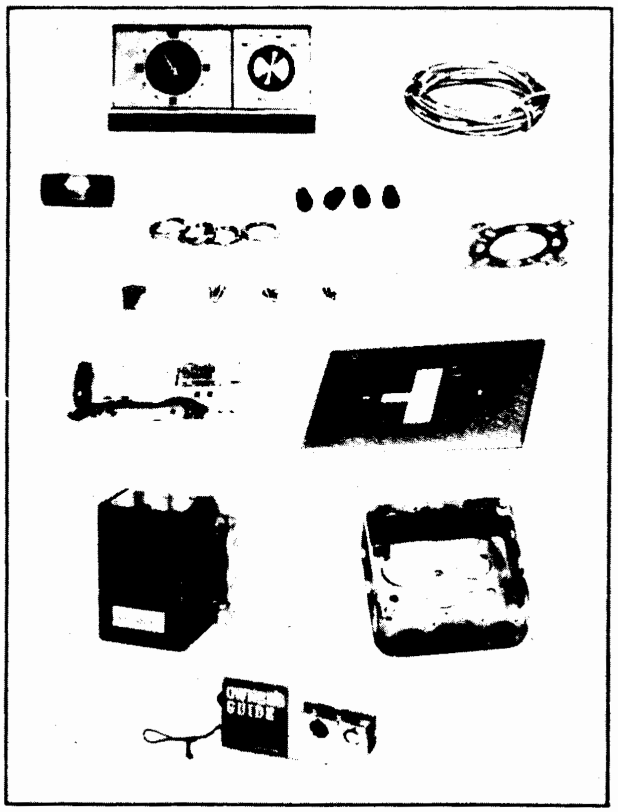
Storm and thermal doors and windows are fabricated primarily from aluminum and glass. The production of these measures involves bauxite mining, titanium mining, crushed stone mining and processing, salt mining, sand quarrying, glass manufacturing, and aluminum smelting. The air pollutants associated with producing aluminum and glass are fluorides, particulates, sulfur oxides, nitrogen oxides and carbon monoxide. The water pollutants include total suspended solids, oil, phosphorus, fluoride, iron, nickel and zinc [EPA, January 1974(b); EPA, January 26, 1976; EPA, March 1974 (a); EPA, April 1973; EPA, May 1978 (a); Battelle Columbus Laboratories, June 1976].

A broad variety of caulking materials are available commercially. Polyurethane rubber, polysulfide rubber, acrylic latex and silicone rubber, and linseed-oil putties are among the common materials available. Hydrocarbons and particulates are emitted to the atmosphere during the manufacture of rubber. Wastewater pollutants from the manufacture of rubber include soluble organics [Monsanto, March 1978]. Caulking manufacture represents a very small portion of the rubber industry; consequently, the percentage production increase and pollutant emission increases potentially caused by the RCS Program demand for caulking are not expected to be large.

Various types of weatherstripping are available for retrofitting. The most widely used are felt strips, adhesive back foam strips (rubber), vinyl foam strips, hollow vinyl cord and metal strips for door bottoms.

Weatherstripping materials do not represent a significant portion of the rubber, plastics, and metals industries. Therefore, it is not expected that the potential RCS Program demand for weatherstripping will cause a major production or pollutant emission increase.

A clock thermostat comprises a number of small parts (Figure 3-1). These parts include a top cover plate, wall plate, cable, rings, and screws. The materials used for these parts include plastic, aluminum, rubber, steel and copper. Primary raw materials are refinery products (or crude oil), bauxite, copper ore, iron ore, and coal.



Source: [Honeywell, n.d.]

Figure 3-1. Components of a Clock Thermostat

The RCS Program is not expected to noticeably affect the industries involved with producing and assembling the materials used in clock thermostats. The total weight of a clock thermostat is less than 2 pounds. Although the total number of homeowners who install clock thermostats as a result of the RCS Program may be large relative to the number that install some of the other measures [see DOE, October 1979], the amount of materials needed to produce the thermostats is not expected to be significant in relation to the already large production of these materials for other uses.*

For the same reasons, the pollutant emissions which will be generated by producing and assembling these clock thermostats are not expected to noticeably increase the pollutant emissions associated with the industries involved. The air pollutants associated with producing the materials used in clock thermostats include hydrocarbons, particulates, nitrogen oxides, sulfur oxides, carbon monoxide, aldehydes and hydrogen fluoride [EPA, January 1976; EPA, April 1973]. The water pollutants include nondegradable organics, suspended and dissolved solids, fluoride,

**This qualitative assessment may be supported by an analysis of the material that would be required if clock thermostats were constructed completely of aluminum or steel. It has been estimated that 10,984,000 households might install thermostats as a result of the RCS Program [DOE, October 1979]. Multiplying the weight of a clock thermostat (2 lbs.) by this number of households produces a total materials requirement of approximately 22 million pounds, or 11,000 tons, needed to produce the clock thermostats to accommodate the Program market. Assuming that clock thermostats consist totally of aluminum, the materials requirement of 11,000 tons, or 2,200 tons/year over the five-year program period, represents 0.057% of the 1978 gross shipments of aluminum in the U.S. If the clock thermostats consisted totally of steel, this percentage would be even less since steel production is much higher than aluminum production. The materials other than aluminum or steel needed to produce a clock thermostat are similarly expected to constitute a very small percent of the total annual demand for each nationwide.*

bases and sulfides [EPA, March 1974 (a); EPA, June 1974]. The water pollutants associated with the assembly operations for clock thermostats include cadmium, chrome, copper, cyanide, fluoride, iron, lead, mercury, nickel, oil and grease, phosphates, silver, total suspended solids, and zinc [EPA, June 1975].

An electric ignition system (Figure 3-2) consists of a number of small parts. The materials used for these parts include aluminum, copper, steel, iron, and rubber. Primary raw materials are refinery products (crude oil), bauxite, copper ore, iron ore, and coal. The RCS Program is not expected to noticeably affect the industries involved with producing and assembling the materials used in electric ignition systems. The total weight of an electric ignition system is approximately three pounds. The amount

Source: [Robertshaw, n.d.]

Figure 3-2. Components of an Electric Ignition System of materials needed to produce these systems is not expected to be significant in relation to the already large production of these materials for other uses.*

For the same reasons, the pollutant emissions which will be generated by producing and assembling the electric ignition systems to accommodate the RCS Program demand are not expected to noticeably increase the pollutant emissions associated with the industries involved. The air pollutants associated with producing the materials used in electric ignition systems include hydrocarbons, particulates, nitrogen oxides, sulfur oxides, carbon monoxide, aldehydes, and hydrogen fluorides [EPA, January 1976; EPA, April 1973]. The water pollutants include nondegradable organics, suspended and dissolved solids, fluorides, bases, and sulfides [EPA, March 1974 (a); EPA, June 1974]. The water pollutants associated with the assembly operations for electric ignition systems include cadmium, chrome, copper, cyanide, fluoride, iron, lead, mercury, nickel, oil and grease, phosphates, silver, total suspended solids, and zinc [EPA, June 1975].

As with clock thermostats and electric ignition systems, electric load management devices and energy usage display meters are small devices consisting of a number of smaller components. The production of these components will require the same type of materials and will involve the same type of air and water pollutants as electric

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**A supporting analysis similar to that performed for clock thermostats (p. 3-22) indicates that, if electric or mechanical ignition systems were made entirely of aluminum, the annual increase in aluminum production required to meet the Program demand would be 0.007% of the 1978 gross shipments of aluminum in the U.S. If the devices were made entirely of steel, the required percentage increase in national steel production would be smaller.*

ignition systems. The pollutant emission increases will be even less than with electric ignition systems because of the anticipated much smaller homeowner demand for electric load management devices and energy usage display meters.

Replacement furnaces and boilers, flue opening modifications, and replacement burners are made primarily out of steel. The production of steel involves coal mining, iron ore mining, pig iron manufacturing, coke production, and steel manufacturing. The water pollutants associated with these activities include cyanide, phenol, ammonia, oil and grease, suspended solids, sulfide, manganese, fluoride, nitrate, zinc, iron and lead [EPA, June 1974]. The air pollutants include particulates, carbon monoxide, fluorides, sulfur dioxide, hydrocarbons, nitrogen oxides, and ammonia [EPA, April 1973]. The water pollutants associated with manufacturing furnaces include cadmium, chemical oxygen demand, chrome, copper, cyanide, fluoride, iron, lead, nickel, mercury, oil and grease, phosphates, silver, total suspended solids, and zinc [EPA, June 1975].

Considering that steel is one of the largest industries in the United States and that the demand for replacement furnaces or boilers, flue opening modifications, and replacement burners as a result of the Program is not expected to be large, it is not likely that the RCS Program will have a noticeable impact on the steel production industry or on the associated pollutant emissions.*

**A supporting analysis similar to that performed for clock thermostats (p. 3-22) indicates that, if every house that has been projected to install some energy conservation measure DOE, October 1979 were to install a 500 lb. replacement steel furnace, the annual increase in steel production needed to meet the Program demand would be 0.63 percent of the 1978 steel production in the U.S.*

Central air conditioners are made primarily from steel with small amounts of copper, aluminum, and iron [EPA, June 1975]. The production of steel, copper, aluminum, and iron involves coal mining, iron ore mining, bauxite mining, copper ore mining, pig iron manufacturing, coke production, steel manufacturing, copper smelting, and aluminum smelting. The air pollutants associated with these activities include: particulates, sulfur oxides, carbon monoxide, hydrocarbons, nitrogen oxides, ammonia, fluorides, aldehydes, and organic acids [EPA, April 1973]. The water pollutants associated with these activities include suspended solids, cyanide, phenol, oil and grease, ammonia, sulfide, fluoride, manganese, zinc, nitrate, lead, iron, copper, cadmium, aluminum, mercury, arsenic, and selenium [EPA, March 1974 (a); EPA, June 1974; EPA, June 1976; EPA, February 1975; EPA, May 1976]. The water pollutants associated with assembly operations include chemical oxygen demand, cadmium, chrome, copper, fluoride, iron, lead, mercury, nickel, oil and grease, phosphates, silver, total suspended solids, zinc, and cyanide [EPA, June 1975].

Since air conditioners require much less material than furnaces, the RCS Program demand for air conditioners will have a lesser impact on materials production activities than will the RCS Program demand for furnaces. This impact is not expected to be noticeable.

3.2.1.2 Pollutant Emission Reductions

The RCS Program is expected to reduce the residential demand for energy for space heating and cooling and water heating. Associated with this demand reduction will be decreases in the quantities of air and water pollutant emissions released when energy is generated for use in residential buildings.

For the purpose of estimating the reduction in residential energy usage, a seven percent rate of response to the offer of a Program audit and a 75 percent follow-up investment rate were assumed. These are the same assumptions as were used for estimating the incremental demand for energy conservation measures.*

In estimating the pollutant emissions reductions due to the reduced demand for residential energy, focus was placed on the energy-generating activity. For example, in assessing the emissions decreases due to the incremental reduction in the use of oil for residential heating, the burning of oil in the residential building was analyzed rather than the extraction or refining of the crude oil from which it was produced. This focus provides an assessment of pollutant emission reductions that is considered more valid for the purposes of comparison with the increases from the production of energy conservation measures than would be the case if some other stage or the entire process of energy production had been examined.

**See pages 3-11 and 3-12. If the response and investment rates are smaller, as is likely, then the energy savings and resulting reductions in pollutant emissions will be smaller.*

The added pollution reduction due to the additional activities associated with energy production and use is not expected to significantly change the overall assessment. The additional activities not examined quantitatively include coal production, natural gas extraction, oil production, natural gas processing, oil refining, coal transport (railroad, barge), oil transport, and natural gas transport (pipeline). The air pollutants associated with these activities include particulates, nitrogen oxides, sulfur oxides, hydrocarbons, carbon monoxide, and aldehydes; the water pollutants include total dissolved solids, total suspended solids, bases, and nondegradable organics [Mendis, July 1976].

For the assumed response rate and the three energy conservation measures analyzed, the estimated reduction in residential energy usage will be about 7.86 quads.* This represents about 71.2 percent of the 11.04 quads reduction estimated for the installation of energy conservation measures under the Program [DOE, October 1979].

These energy savings will accumulate gradually over a period of many years beginning with the first installation of an energy conservation measure under the proposed

**See Appendix A. This figure for the reduction in residential energy usage represents the gross reduction in energy usage due to the installation of the three measures that are quantitatively analyzed. The pollutant emission reductions are calculated using this gross estimate rather than the net energy reduction realized after subtracting the energy used in manufacturing the materials for the three energy conservation measures. As noted earlier, approximately 0.13 quads of energy are used in the manufacture of the materials for the three measures. This results in a net Program energy reduction due to these measures of approximately 7.73 quads.*

Program and ending at the end of the useful life of the longest-lasting measure.* Thus, the reduction in energy usage in any given year due to the three measures will be considerably less than 7.86 quads.** The average annual reduction in residential energy usage will be between a high average based on the duration of the effectiveness of the shortest-lived energy conservation measure and a low average based on the duration of the effectiveness of the longest-lived energy conservation measure. The assumed useful life of the measures ranges from five years for water heater jackets to twenty years for ceiling insulation. Adding an additional five years to the twenty to account for the duration of the Program, the average annual reduction in energy usage due to the three measures analyzed quantitatively will be between 0.31 and 1.57 quads.*** This average represents between 0.4 percent and 2.2 percent of the projected national energy consumption for 1985 [DOE, April 1979(a)] and 2.6 to 12.9 percent of the projected residential energy consumption for that year.

**The useful life of the energy conservation measures was taken from U.S. Department of Commerce, National Bureau of Standards, April 1979 .*

***The discussion of average annual reduction in energy usage is presented in terms of the 7.86 quads that will not be used because of the installation of the three energy conservation measures analyzed rather than the 11.04 quads not used due to the installation of energy conservation measures in general. This facilitates making a reasonable comparison of the pollutant emission reductions and the pollutant emission increases for the three measures.*

****Five years is added to the assumed twenty-year life of ceiling installation to calculate the lower limit of the possible average annual reduction in energy usage. The energy savings attributable to the proposed Program will begin to accumulate with the first installation of any measure at the beginning of the Program period and could continue to accumulate through the twenty-year life of an installation of the longest lasting measure, i.e., ceiling installation, performed five years later at the end of the Program period.*

In estimating pollutant emission reductions resulting from this reduced demand for energy, it was estimated that the residential energy used for space heating and cooling and water heating is supplied from fuels/electricity in the following proportions.*

- Gas - 67.3%
- Oil - 21.8%
- Electricity - 10.9%

Gas and oil are used in the home for space and water heating. Electricity is used for space heating and cooling and water heating. It was assumed that the fuels that would have been used to generate the electricity not required because of the reduced residential demand would have been in the same proportions as the fuels presently used to generate electricity for all demands nationwide [DOE, April 1979(a)]:**

**The basis for these estimates is described in DOE's Regulatory Analysis for the RCS Program* [*DOE, October 1979*].

***These figures represent the current (January 1979) distribution of fuel sources for electricity generation. Several DOE projections of the future distribution indicate a greater reliance on coal and less reliance on oil and gas than these figures show. The use of coal is projected to constitute from 52 to 58 percent of the fuel consumption by electric utilities in 1990. The corresponding ranges for oil and gas are 7 to 12 percent and 1 to 2 percent, respectively* [*DOE, April 1979(d)*].

If any of these projected future distributions of fuel sources were used in this analysis instead of the current distribution, the magnitude of the pollutant emission reductions associated with the reduced demand for energy is likely to be somewhat greater than those presented. The future distributions show that a greater percentage of the electricity demand in coming years will be met by coal than is the case at present. Coal-fired power plants typically generate more pollutant emissions than oil-fired or gas-fired power plants. Therefore, in the future, the gross pollutant emissions due to electricity generation are likely to increase more than they would if the fuel source distribution remained as it is at present. Any reduction in the need for electricity realized as a result of the RCS Program will mean a greater proportionate reduction in the need for coal-fired generating capacity (at least for residential purposes) than is the case in this analysis where the current fuel source distribution is used. Therefore, the absolute magnitude of the pollutant reductions due to the RCS Program are likely to be greater also.

- Coal - 44.4%
- Oil - 16.5%
- Gas - 13.8%
- Nuclear - 12.5%.

Hydro resources (12.8%) were not considered in estimating these reductions because effluent limitations guidelines were not available for these plants. However, it is assumed that the pollutant emission changes from hydroelectric plants would be considerably lower than those associated with coal, oil, gas, and nuclear power plants. The effect of including the emission changes associated with hydroelectric power plants would be to slightly increase the estimate of pollutant emission reductions resulting from the RCS Program.

The pollutant emission reductions resulting from the reduced residential demand for energy are summarized in Table 3-3.

The assumptions and methodology used in estimating these reductions are described in detail in Appendix A. These pollutant emission reductions will be realized over the same time period as the energy savings (i.e., from installation of the first measure to the end of the useful life of the longest-lasting measure).

The pollutant emission reductions presented in Table 3-3 are the result of the reduction in residential energy usage anticipated if the three energy conservation measures that are analyzed quantitatively are purchased in the numbers estimated for the maximum likely response rates to the Program. Should these response rates be less, the reductions will also be less. As it is, these emission reductions are small when compared to the estimated national total for each pollutant. They are also small when compared

TABLE 3-3. ESTIMATED TOTAL AIR AND WATER POLLUTANT EMISSION REDUCTIONS DUE TO THE REDUCED USAGE OF RESIDENTIAL ENERGY ATTRIBUTABLE TO THE INSTALLATION OF SELECTED ENERGY CONSERVATION MEASURES UNDER THE RCS PROGRAM

Air Pollutants	Emission Reductions (Tons)	Water Pollutants	Emission Reductions (Tons)
Particulates	120,374	Total Suspended Solids	2,459
Nitrogen Oxides	813,995	Total Dissolved Solids	396,922
Sulfur Oxides	571,479	Biological Oxygen Demand (BOD)	608
Hydrocarbons	46,637	Chemical Oxygen Demand (COD)	58,093
Carbon Monoxide	106,721	Organics	312
Aldehydes	12,211	Oil and Grease	4,278
Arsenic	3	Chlorine	127
Beryllium	<1	Phosphorus	72
Cadmium	<1	Phosphate	197
Fluorine	229	Boron	1,562
Lead	21	Chromates	11
Mercury	2	Chromium	4
Selenium	17	Aluminum	127
Manganese	59	Acids	390
Chromates	97	Non-Ferrous Metals	46,917
Zinc	18	Zinc	21
Chlorides	1	Sulfates	17,405
		Nickel	1,533
		Surfactants	165
		Ammonia	25
		Nitrates	771

to the total production of each pollutant resulting from just energy-related activities.* The maximum total nitrogen oxide emission reductions, for instance, are estimated at 813,995 tons over the entire period during which energy savings are assumed to occur. This results in an average annual reduction between 32,560 and 162,799 tons for the 5- and 25-year periods, respectively. This average annual reduction will be between 0.14 percent and 0.68 percent of the projected nitrogen oxide emissions in 1985 due to energy related activities [DOE, November 1978]. A similar examination of the sulfur oxides reduction (the second largest reduction on the list) indicates that the average annual reduction will be between 0.08 percent and 0.38 percent of the total annual sulfur oxide emissions for energy related activities in 1985 [DOE, November 1978].

In addition to the pollutant emissions reductions presented in Table 3-3, there will be reductions in air and water radiation residuals associated with the reduced need for nuclear power generation. These reductions are estimated to be:

Air Residuals	Reduction (Curies)	Water Residuals	Reduction (Curies)
Kr-85	429	H-3	1,207
I-131	0.6	Co-60	0.002
Xe-133	251,560	Sr-90	0.003
Fission Products	71,534	Ru-106	0.0007
H-3	150	I-131	0.04
		Cs-134	0.15
		Cs-137	0.11
		Ce-144	0.002
		Fission Products	10

**Energy-related activities are defined as exploration, development, extraction, processing, transportation, conversion, and combustion for all sectors (i.e., utility, industrial, residential, commercial, transportation) [DOE, November 1978]. For a discussion of the reason for and implications of using energy-related emissions as the basis for calculating percentage changes, see pp. 3-36 to 3-37.*

3.2.1.3 Net Pollution Impact

The RCS Program will result in a reduction in pollutant emissions associated with the decrease in demand for residential energy and an increase in pollutant emissions associated with the increase in demand for energy conservation materials. Estimates of the net emission changes resulting from these reductions and increases have been calculated and are presented in Table 3-4. Column 1 contains the pollutants for which the aggregate impacts were calculated. Column 2 presents the estimated pollutant emission reductions due to reduced energy conversion activities. These reductions will occur over a long period of time (i.e., from installation of the first RCS Program measure to the end of the useful life of the longest-lasting measure). The useful life of the measures analyzed ranges from 5 to 20 years. These reductions are derived from the reduction in residential energy usage attributable to ceiling insulation, water heater jackets, and wall insulation. The reduction in energy usage attributable to other activities in the energy production process and to other energy conservation measures would increase the pollutant emission reductions.

Column 3 presents the estimated pollutant emission increases from manufacturing the materials for the same three energy conservation measures (i.e., for ceiling insulation, water heater jackets, and wall insulation. These pollutant emission increases will occur over the five-year Program period. In addition to the estimated increases presented in this column, there will be additional pollutant emissions from the other industrial activities associated with the production of these measures and from the production of the conservation measures that were not analyzed quantitatively.

TABLE 3-4. POLLUTANT EMISSION CHANGES (TONS) DUE TO CHANGES IN THE DEMAND FOR SELECTED ENERGY CONSERVATION MEASURES AS A RESULT OF THE RCS PROGRAM

Pollutant (1)	Energy (2)	Conservation Materials (3)	Net Difference (4)	% Decrease in Energy-Related Pollutant Emissions* (5)
Air:				
Particulates	-120,374	66,210	-54,164	0.02 - 0.10
Nitrogen Oxides	-813,995	3,763	-810,232	0.14 - 0.68
Sulfur Oxides	-571,479	5,979	-565,500	0.08 - 0.38
Hydrocarbons	-46,637		-46,637	0.009 - 0.04
Carbon Monoxide	-106,721	1,284	-105,437	0.01 - 0.05
Aldehydes	-12,211		-12,211	ND
Fluorides		72	+72	ND
Arsenic	-3		-3	ND
Beryllium	-<1		-<1	ND
Cadmium	-<1		-<1	ND
Fluorine	-229		-229	ND
Lead	-21		-21	ND
Mercury	-2		-2	ND
Selenium	-17		-17	ND
Manganese	-59		-59	ND
Chromates	-97		-97	ND
Zinc	-18		-18	ND
Chlorides	<1		-<1	ND
Water:				
Total Suspended Solids	-2,459	42	-2,417	ND
Total Dissolved Solids	-369,922		-369,922	0.4 - 2.0
Biological Oxygen Demand	-608	7	-601	ND
Chemical Oxygen Demand	-58,093	99	-57,994	ND
Organics	-312		-312	ND
Oil and Grease	-4,278		-4,278	ND
Chlorine	-127		-127	ND
Phorphorus	-72		-72	ND
Phosphate	-197		-197	ND
Arsenic		7	+7	ND
Phenols		<1	+<1	ND
Boron	-1,562		-1,562	ND
Chromates	-11		-11	ND
Chromium	-4		-4	ND
Aluminum	-127		-127	ND
Acids	-390		-390	ND
Non-Ferrous Metals	-46,917		-46,917	ND
Zinc	-21		-21	ND
Sulfates	-17,405		-17,405	ND
Nickel	-1,533		-1,533	ND
Surfactants	-165		-165	ND
Ammonia	-25		-25	ND
Nitrates	-771		-771	ND

Notes:

- indicates a reduction
+ indicates an increase
ND indicates that the percentage increases or decreases have not been determined because of the lack of data concerning nationwide pollutant emissions due to energy-related activities.

Column 4 presents the net difference between Columns 2 and 3 and the net emission change attributable to the incremental demand for the measures analyzed. The methodology used in conducting the comparisons is described in Appendix A.

Column 5 presents the percentage change that the net pollutant emission impact represents when compared to the estimated annual national emissions due to all energy-related activities.* Two percentages are presented: one represents the lowest estimated percentage change in annual energy-related emissions expected whereas the other represents the highest estimated percentage change in annual energy-related emissions expected. The percentages were calculated by averaging the net aggregate pollutant changes in Column 4 over five and twenty-five year periods** and dividing these averages by the projected 1985 annual emissions from energy-related activities for each pollutant [BNL, June 1978]. The actual percentage change should lie between the two figures presented.

The total projected 1985 energy-related emissions for air pollutants include the emissions from exploration, development, extraction, processing, transportation, conversion, and combustion activities for all sectors (i.e., utility, industrial, residential, commercial and transportation) [DOE, April 1978]. These emissions will constitute a major portion of the nationwide air emissions because of the dominant nature of energy-related air emissions in relation to other air emission sources. The percentage decreases

*Pollutant emissions due to energy-related activities were chosen as the basis for comparison rather than total annual national emissions because more data was available for this category than for the national aggregate category. The implications of this choice are discussed on pages

**See page 3-29 for an explanation of these baseline periods.

presented in Column 5 for the air pollutants should therefore be roughly comparable to the percentage decreases in nationwide emissions. Any correction for this error will make the percentage decrease less.

The total projection for 1985 energy-related pollutant emissions for total dissolved solids includes only the emissions from stationary combustion sources [DOE & EPA, March 1978]. Water pollutant emissions from stationary combustion sources do not constitute the major portion of nationwide water pollutant emissions; consequently, the actual percentage decrease resulting from the net suspended solids change should be considerably less than that presented in Column 5.

As can be seen from Columns 4 and 5, none of the net reductions or increases is major on a national scale. The largest net reduction is 810,232 tons for nitrogen oxides. This reduction over a 5- to 25-year period would average between 32,409 and 162,046 tons per year. This corresponds to 0.14 to 0.68 percent of the projected 1985 nitrogen oxide emissions from energy-related activities [BNL, June 1978]. The net reduction of sulfur oxides, 565,500 tons, corresponds to an average annual reduction between 22,620 and 113,100 tons. This represents 0.08 to 0.38 percent of the projected 1985 sulfur oxide emissions from energy-related activities [BNL, June 1978].

Columns 4 and 5 indicate that the RCS Program will promote a net increase in three pollutants which are associated with fiberglass and boric acid production activities. These pollutants are fluoride emissions to the air and phenol emissions to the water (both from fiberglass production) and arsenic emissions to the water (from boric acid production). The net increases, however, are not expected to be significant in relation to the nationwide baseline emissions of these pollutants. Since the air and water pollutant coefficients are given in terms of pounds of pollutant per ton of product, the percentages for production increases resulting from the RCS Program, presented previously, will also be the percentage increases in pollutant emissions. That is, the maximum percentage increase of these pollutant emissions within the fiberglass and boric acid industries is estimated to be 12.5 percent and 24.5 percent, respectively. On a national scale, these percentage increases are expected to be much lower. Many other industries discharge these pollutants (e.g., textile industry, iron and steel manufacturing, ferroalloy manufacturing, and organic chemicals for phenols; zinc manufacturing, phosphate manufacturing, and copper smelting for arsenic; and hydrofluoric acid manufacturing, aluminum production, iron and steel manufacturing, and glass manufacturing for fluoride); therefore, the increase in nationwide emissions of these pollutants as a result of the RCS Program is not expected to be significant [EPA, April 1963; EPA, March 1979; EPA, August 1974].

These net changes, annual averages and percentages should not be interpreted as indicating the magnitude of the net impact that will be experienced in particular localities. The energy conservation measures portion of the Program will have its greatest beneficial effect on residential energy usage devoted to heating and cooling; therefore, most of the beneficial environmental impact will be spread over areas where homes are heated by oil and gas and over the localities around electric generating stations in regions having high residential cooling requirements.

It is likely that the Northeastern United States, where a relatively high percentage of residences are heated by oil, will realize a higher total environmental benefit from the reduction in residential oil usage than other regions of the country where oil is used less frequently for heating. Similarly, the environmental benefits experienced due to the reduced demand for electricity for cooling will be greater in the South than in the North.

The estimated pollutant emission reductions resulting from the reduced demand for energy may permit additional growth in those areas where growth is presently limited because of air quality constraints. The magnitude of this growth opportunity is not expected to be large because of the proportionately small net emission reductions expected to result from the RCS Program and the dispersed nature of these reductions. There may be some areas, however, where the RCS Program, in conjunction with other air emission control measures, could improve the air quality enough to provide a considerable amount of new growth opportunity.

Those areas where energy conservation materials manufacturing facilities are located may experience a temporary net increase in pollutant emissions during the Program period. This net increase is not expected to be large, however. After the Program ends these areas will experience a decrease in pollutant emissions as a result of the reduced manufacturing demand and the continuing reduction in energy usage due to the installations of energy conservation measures.

3.2.2 Site-Specific Impacts

3.2.2.1 Potential Health and Safety Impacts

The energy conservation measures proposed for inclusion in the RCS Program were examined for potential adverse health and safety impacts. For each of the measures, this potential depends on defective material or defective installation. It is believed that none of the energy conservation measures present a safety or health hazard when properly manufactured, installed, and operated. For certain measures (listed on page 3-42) even improper manufacture and/or installation creates only a small probability of adverse health or safety impacts. For certain other measures, however, improper manufacture and/or installation can create a higher probability of adverse health or safety impacts (these measures are specified on pages 3-43 and 3-44).

To evaluate any potential adverse safety or health impacts, each energy conservation measure proposed for inclusion in the Program was examined for the potential adverse impacts associated with its use. The magnitude of these impacts in the absence of the Program was judged assuming the existence of industry and community standards and codes. The effect of the Program health and safety standards on these impacts was then assessed assuming, first, full compliance, and second, less than full compliance.

Installations of the RCS Program energy conservation measures would continue to occur in the absence of the Program. Some adverse health impacts are likely to occur as a result of these installations and in spite of industry and community standards designed to prevent them. The Program, to the extent that it generates more of these installations, may increase the total number of these adverse health impacts. However, because the Program contains standards affecting the quality of energy conservation measures and their installation under the Program, it is reasonable to believe that any such increase will be less than it would be if the same number of additional installations were to occur in the absence of the Program.

The extent of the reduction in the expected number of additional adverse health impacts will depend upon the degree of compliance with the Program standards and upon meaningful enforcement. If both factors occur, there should be a lower probability of adverse health impacts in connection with Program installations than in connection with non-Program installations. On the other hand, if there is poor compliance or if enforcement of the standards is inadequate, the probability of adverse health and safety impacts in connection with Program installations should approximate the probability associated with non-Program installations. However, it is believed that the probability of adverse health impacts in these cases would still be somewhat less than that expected in the absence of any standards because some installers could be expected to comply with the Program standards even if they are not effectively enforced. Assuming the existence of the Program and its standards, the situation created by low compliance and a lack of adequate standards enforcement constitutes the worst case for the purposes of assessing the potential health and safety impacts associated with the RCS Program.

For certain measures, even improper manufacture and/or installation have a very small probability of producing an adverse health or safety impact because of either the lack of inherent danger or the limited scope of problems that improper manufacture or installation could cause. For example, improper manufacture or installation of caulking would reduce its effectiveness but would not create genuine health or safety problems. The same would be true of all of the other measures in this category. These measures in this category would include:

- Caulking
- Weatherstripping
- Duct and pipe insulation
- Clock thermostats
- Heat reflective and heat absorbing window or door material
- Energy usage display meters
- Devices associated with electric load management techniques.
- Replacement air conditioners

For other energy conservation measures with a higher probability for producing an adverse health or safety impact, the Program proposes specific safety and effectiveness standards.* These standards are intended to reduce to an insignificant level the potential for any adverse impacts occurring in connection with these energy conservation measures. Enforcement procedures have been proposed in the Program to promote compliance with these standards (see Chapters 1 and 6). The measures so covered include:

- Ceiling insulation
- Wall insulation
- Floor insulation
- Water heater insulation
- Storm and thermal windows
- Storm and thermal doors
- Replacement furnaces or boilers
- Oil furnace replacement burners.

The most significant potential problems involve (a) three energy conservation measures whose adverse impact,

NECPA, Sections 212(b)(2)(A) and 212(b)(2)(B) require the Secretary of Energy to prescribe such standards as are determined to be necessary for the general safety and effectiveness and for the installation of any residential energy conservation measure.

in event of improper performance, is potentially large, and (b) the infiltration reduction from the installation of certain energy conservation measures. These four concerns include:

- Wall insulation: urea-formaldehyde foam
- Flue opening modification: vent damper
- Electric or mechanical ignition system
- The increased concentration of certain pollutants within a building, caused by reduction in the air exchange rate through a residential building from the installation of energy conservation measures such as caulking, weatherstripping, and storm doors and windows.

For the three measures noted above, as discussed subsequently, DOE has proposed or is in the process of developing standards to help ensure that they will not endanger the occupants of the residence.

The measures for which there is a somewhat greater potential for producing an adverse health and safety impact and the three measures and conditions which have the potential to cause a significant adverse health or safety impact are discussed in the remaining sections of this chapter. For each measure the principal health and safety impacts are identified; the standards proposed to mitigate these impacts are described; and, in order to assess the site-specific effects of the worst case situation, the likely health and safety impacts resulting from low compliance and inadequate enforcement of the standards are discussed.

3.2.2.1.1 Ceiling, Wall, and Floor Insulation: Organic and Mineral Fiber Loose-Fill

The primary potential health and safety concern associated with organic and mineral fiber loose-fill thermal insulation is a potential fire hazard. There is also a potential hazard created by overloading the ceilings of the rooms under the attic with loose-fill insulation. This potential hazard is identical to that discussed for mineral cellular loose-fill insulation (Section 3.2.2.1.4) and is not discussed further here. The potential fire hazard may result from the improper installation of this material. Several potential sources of fire ignition have been identified. They include:

- Fire sources, such as lighted cigarettes, introduced at the time of installation.
- Overheating of heat-producing devices such as recessed ceiling lights which were covered by insulation.
- Overheating of wiring which was covered by thermal insulation resulting in the deterioration of the wiring electrical insulation.

The National Bureau of Standards (NBS) Center for Fire Research conducted a preliminary survey of fire incidence data in which thermal insulation was a significant factor. This survey did not have access to nationwide data on fire incidents; therefore, its findings are only suggestive of the potential fire hazards associated with this type of insulation [NBS, July 1978]. The NBS report included findings from three sources:

- The National Fire Incident Reporting System contains data from California and Ohio for the year 1975. The data covers a total of 491 house fires where thermal insulation was the first material ignited. (Nearly 60,000 house fires were reported in California and Ohio in 1975). Cellulose insulation was the most frequently cited material in the 491 incident reports.

- The Michigan Department of Public Safety has assembled data on 207 house fires over a one-year period (1975-76) in which cellulose loose-fill was the first material ignited. Approximately half of these fires involved cellulose which supposedly had been treated to reduce its flammability.

- Oklahoma City listed 24 cases over an eight-month period in which thermal insulation was the first material ignited.

NBS also found that the two most commonly cited ignition sources in these insulation fires were:

- Covered electrical or heating devices causing smoldering ignition of the insulation, and

- Open flame from a plumbers torch or spark from an appliance igniting exposed insulation.

In compliance with its Congressional mandate for the RCS Program, DOE determined that the existing standards and guidelines for the material used in organic and mineral fiber loose-fill insulation do not adequately address the possible hazards and that little enforcement of such guidelines is carried out. Special safety standards governing the fire-resistant quality and installation of this type of thermal insulation have therefore been included in the Program. These standards are intended to assure that adding insulation to an existing building will not decrease the overall fire safety level of the building. Therefore, the effect of compliance with these standards will be to avoid any increase in the incidence of fire due specifically to the increased quantities of organic and mineral-fiber loose-fill insulation that will be installed under the RCS Program.

Material Standards

The Program material standards relevant to fire safety that are proposed for organic and mineral fiber loose-fill thermal insulation require that:

- Critical radiant flux must be at least 0.12 W/cm^2, as measured using the Attic Floor Radiant Panel Test. Critical radiant flux is a quantitative measure of the ease with which flame propagation may occur on the surface of exposed insulation on an attic floor when subjected to radiant heat from the attic roof.

- When tested by the Smoldering Combustion Test, weight loss will be less than 15 percent of the initial weight with no evidence of flaming combustion. This test method is intended to provide a reliable index of the tendency of insulation to smolder when it is installed directly over a heat producing object, such as a recessed light fixture.

The critical radiant flux standard and the smoldering combustion requirement were developed by the NBS Center for Fire Research. These fire safety requirements and test methods have already been adopted by both the General Services Administration (GSA)* and the Consumer Product Safety Commission (CPSC)** as the fire safety requirements for cellulose loose-fill insulation.

These material standards were proposed without significant controversy. The effect of noncompliance with these standards will be to raise the probability of a fire occurring as a result of a Program installation closer to that for an installation under previously existing standards and codes.

**Federal Specification HH-I-515D*

***43 FR 35240 as amended on July 2, 1979, pursuant to the Emergency Interim Consumer Product Safety Standard Act of 1978, PL95-319.*

Installation Standards

The Program installation standards relevant to fire safety for organic and mineral fiber loose-fill thermal insulation require that:

- During installation, installers shall not smoke or carry any open flame in the attic or any truck or van used for installation.

  This requirement is intended to prevent an ignition source such as a cigarette from being accidentally dropped either into the vehicle used to convey the insulation to the residential building or on the attic floor or insulation.

- Blocking shall be installed around heat-producing devices such as recessed lighting fixtures, motors, fans, heaters and chimneys. This standard provides for air circulation around heat-producing devices.

- Precautions shall be taken to ensure that electrical wires installed in the attic do not overheat under prolonged normal rated load conditions because of encapsulation by thermal insulation. Barriers must be installed to permit air circulation around wires that might be covered by thermal insulation or else the insulation must not be installed above the underside of the wire.*

The handling restriction originates from a warning concerning the handling of thermal insulation found in the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals [ASHRAE, 1977]. The requirement for blocking around heat-producing devices has its origin in the National Electrical Code (NEC) (NFPA 70). These Articles require that fixtures be constructed or installed in such a manner that adjacent combustible material will not be subjected to temperatures in excess of 90°C (194°F). The NEC further requires that thermal insulation "not be installed within three inches of the recessed fixture enclosure, wiring compartment, or ballast and . . . not be so installed above the fixture as to entrap heat and prevent the free circulation of air unless the fixture is otherwise approved for the purpose." DOE has concluded that the maximum temperatures permitted by the NEC for recessed lighting fixtures are appropriate to eliminate the potential fire hazard. DOE also requires conformance with the National Fuel Gas Code (NFPA 54), the Standard for the Installation of Oil Burning Equipment (NFPA 31), and the Standard for Chimneys, Fireplaces, and Vents (NFPA 211) regarding the maintenance of clearance around other heat sources which may otherwise come in contact with the insulation.

The wiring barrier standard is based on laboratory tests conducted by NBS which show that when

An exception is made to the last provision when wiring is attached to attic joists and when there is proper over-current protection. The exception is made because the joist serves as a heat sink and dissipates heat which otherwise would result in excessive temperatures.

thermal insulation is placed around electrical wiring, heat dissipation is restricted and resulting wiring temperatures exceed those allowed by the NEC or Underwriter's Laboratory (UL) [Beausoleil, July 1978]. NEC requires that the type of electrical wiring often found in existing residences not be operated at temperatures in excess of 140°F. When parallel nonmetallic sheathed cables carrying 135 percent of rated current were placed between two layers of R-11 insulation, NBS found that temperatures of 298°F were reached.

The severity of this hazard due to overheated wiring depends on the temperatures reached and the length of time the high temperatures are sustained. It appears that the high temperatures are most likely to occur when the electrical system is overfused. CPSC has conducted a survey of fusing practices in low-income homes in several cities in the United States. Among the samples surveyed in each city, it was found that more than 50 percent of the homes which use fusing as over-current protection were overfused [CPSC, unpublished].

There is, however, a lack of information on how serious this potential fire hazard actually is outside of the laboratory. DOE, along with the CPSC and the NBS, all agree that the potential for a hazard exists when thermal insulation is placed over and under wiring; however, the probability of that hazard being realized and the best way to solve the problem are not known. DOE is continuing research on this issue.

CPSC is in the process of collecting fire incidence data from fire marshalls across the country. A total of 880 fires were recorded in four states over a one- to two-year period where thermal insulation was the first material ignited. Of these fires, the most common cause of the fires (17 percent) was fixed wiring. Specifically, the causes were deteriorated electrical insulation and overfusing. Data need to be collected and verified to determine how accurate and representative the information is. DOE, in conjunction with utilities across the country, is in the process of measuring temperatures reached by attic wires and the length of time the temperatures are sustained. The demonstration will include approximately 2,000 homes and will help DOE determine how significant a correlation exists between laboratory data and conditions in actual homes. Other research efforts that will provide data on this potential hazard include a study of the effects of overcurrent protection devices in homes on wiring temperatures, and an attempt to identify wiring characteristics which might cause particular concern, such as type or age of the wiring. This research is expected to be completed during 1980. Its results eventually will be incorporated into DOE's model training program for auditors.

Insulation contractors are expected to accept the blocking requirement without controversy. DOE has estimated that a majority of installers are already adhering to this requirement even in the absence of mandate to do so. Consequently, its proposed inclusion in the Program as a standard is not expected to significantly alter the incidence of fires resulting from heat-producing devices. Variations in the effectiveness of enforcement for this Program standard therefore should have little impact on the risk of fire associated with Program-related installations of organic and mineral fiber loose-fill insulation.

Somewhat less is known about compliance with the fire-safety material standards. However, since they are already in effect as CPSC and GSA standards, variations in the effectiveness of enforcement of the Program standards should not produce the same impact as it would if there were no existing standards.

Compliance with the no-smoking requirement may be very difficult to enforce. It is possible that the inclusion of this standard will not have any noticeable effect on the existing incidence of fires resulting from careless handling of open flames or cigarettes. It is also possible, however, that the standard will produce a beneficial effect by continually emphasizing a source of problems often ignored.

The inclusion of the wiring barrier provision in the proposed rules was highly controversial. Contractors and contractors' associations expressed their dissatisfaction with the wiring provisions and the divergence of these provisions from existing installation procedures. They alleged that the laboratory tests of wiring simulate only extreme situations which rarely occur in attics. They also alleged that these proposed requirements could increase the cost of an installation of organic or mineral fiber loose-fill insulation by 50 to 64 percent [DOE, April 1979(c)] and reduce effectiveness. (Some areas of the house which would have been insulated in the absence of the standard will now be left uninsulated.) Compliance with the wiring barrier provision is likely to depend heavily upon the effectiveness of the Program's enforcement mechanism. (Alternatives to the wiring barrier provision are discussed in Chapter 6.)

3.2.2.1.2 Ceiling, Wall, Floor and Water Heater Jacket Insulation: Mineral Fiber Batts and Blanket

The primary health and safety concern associated with mineral fiber batts and blanket thermal insulation is a potential fire hazard. An aesthetic concern is the effect on paint from moisture retained in insulation with an improperly installed vapor barrier.

The fire hazard arises from circumstances similar to those for organic and mineral fiber loose-fill insulation. DOE has included similar provisons in its proposed material standards for mineral fiber batts and blankets as for organic and mineral fiber loose-fill. (See section 3.2.2.1.1.) There are a few exceptions and differences, however, which are incorporated to account for differences in the construction and handling of the two types of insulation.

Material Standards

Blanket insulation and batt insulation usually have an integral vapor barrier. Often this membrane covering is made of kraft paper, a flammable material. The material standards proposed to control the fire hazard for organic and mineral fiber loose-fill insulation are not required for the kraft paper membrane. This relaxation of the material standards was permitted because the vapor barrier is installed face down onto the ceiling board rather than face up into the attic where a flame would be most likely to begin and a fire would be most likely to start.

However, should a batt or blanket be improperly installed with the vapor barrier exposed to the attic air space, then the risk of rapid flame spread or fire is greater than it would be were the kraft paper membrane required to meet the fire safety standards. With regard to this possibility, DOE has taken the CPSC's position that the chance of increased fire risk due to improper installaiton of the vapor barrier is adequately controlled if a warning is clearly displayed on the insulation stating that the vapor barrier should be installed in the down position. Accordingly, the proposed material standards for mineral fiber batts and blanket insulation include a requirement for a warning label that advises the installer of the flammability of the vapor barrier and its proper position when installed.

Installation Standards

Since batts and blankets are not conveyed into the building in a loose-fill condition, the restriction on smoking in the van during delivery is not pertinent. The standards do, however, prohibit smoking in all areas where the materials are being installed in order to protect combustible building components from accidental ignition. These risks of accidental ignition are even more significant when the material being installed is one which has an integral vapor barrier which is made of a combustible material.

Another exception to the installation standards for organic and mineral fiber loose-fill insulation concerns the blocking of recessed lighting fixtures and other heat-producing devices. This standard is not required since batt and blanket materials can reasonably be expected to remain stationary once installed. The spacing requirements are, however, identical to those in the loose-fill practice.

The sources of controversy and likelihood of compliance with the standards are similar to those for organic and mineral fiber loose-fill insulation.

The aesthetic concern arises primarily from the accumulation of condensed moisture in batts and blankets not having a properly installed vapor barrier. This retained moisture can produce paint peeling and chipping. To prevent this effect, the Program includes a requirement that a vapor barrier be provided on the winter warm side in regions where condensation is likely to be a problem.

3.2.2.1.3 Ceiling, Floor, and Wall Insulation: Polystyrene Polyurethane, and Polyisocyanurate Insulation Board

The primary health and safety concern associated with organic cellular rigid board thermal insulation is a potential fire hazard. This material may be ignited by an intense heat source such as those listed for organic and mineral fiber loose-fill insulation. Once ignited, it burns relatively rapidly. In a case of fire started elsewhere, ignition of organic cellular rigid board insulation will accelerate the flame spread. The Program contains a material standard designed to ensure that it does not add to the hazard of fire within a residential building.

Material Standards

The smoldering combustion test described in subsection 3.2.2.1.1 for organic and mineral loose-fill insulation is also prescribed for polystyrene, polyurethane, and polyisocyanurate insulation.

The flame spread characteristics of these materials must meet a criterion based on an established test method developed by the American Society for Testing and Materials (ASTM). The use of this test is required by the General Services Administration in its specifications for these types of insulation. The major manufacturers of these insulation boards dispute the validity of the criterion and the test method for their products.

Installation Standards

In order to reduce the hazard of accidental ignition of this material by an outside heat source such as a cigarette or other open flame, or of accelerating the spread of a fire originating in another source, the Program requires the following provisions:

- For interior applications of rigid board insulation on walls and ceilings, all exposed faces and edges of the insulation material must have a cover having a finish rating of not less than 15 minutes when tested according to ASTM Designation E 119-76.

- Open flames and smoking are prohibited in any area where insulation is being installed or cut.

- Many solvents used as mastic and adhesives in the installation of organic cellular rigid board insulation have flammable vapors and must be kept in approved containers. They are to be used only in accordance with the instructions provided by the manufacturers.

In order to prevent the accumulation of moisture in the insulation, the installation standard requires that:

- A suitable vapor barrier be provided on the winter warm side in regions where condensation is likely to be a problem.

ASTM E119 is the test procedure generally used to determine the fire performance of rigid board materials used in a wall system. In the test, the insulation board is covered by standard 1/2" gypsum board and subjected to temperature conditions specified in E-119. The gypsum board, acting as a thermal barrier, must prevent heat transmission sufficiently so that the backside of the thermal barrier is not greater than 250°F above ambient conditions for 15 minutes.

Some building codes already require this standard; therefore, although the use of this standard under the Program will reduce the incidence of fire in Program-related installations relative to non-Program-related installations, this reduction will not be as great as it would be if there were no previous experience with the standard.

Compliance with the 15-minute finish rating will be determined by the Program's proposed enforcement mechanisms. To the extent that test procedures other than ASTM E119 are permitted to substitute for the prescribed test and these tests are already in use, the probability of fire problems among the Program-related installations will be very nearly the same as that for non-Program-related installations. Where the currently proposed standard is more stringent than existing practices, the degree of improvement in fire safety for Program-related installations will be dependent upon implementation of the Program's enforcement mechanisms.

Compliance with fire safety standards other than the 15-minute finish rating will be difficult to enforce. Inasmuch as some installers are likely to comply with them because they incorporate common sense, they are likely to have some beneficial effect.

3.2.2.1.4 Ceiling and Wall Insulation: Mineral Cellular Loose-Fill

The primary potential health and safety concerns associated with mineral cellular loose-fill thermal insulation are fire and ceiling overload.

The potential fire hazard concern is identical to that for organic and mineral loose-fill thermal insulation (section 3.2.2.1.1) and is not discussed further here. The material standards addressed to this concern are also discussed in the earlier section.

The potential ceiling overload hazard results from the density characteristics of these materials. The densities of mineral cellular loose-fill insulation materials vary considerably.

The densities of the various insulation materials which are installed in attic areas vary considerably. Vermiculite, which weighs from 4 to 6 lbs per ft^3 and perlite, which weighs from 5 to 8 lbs per ft^3 are the heaviest materials. In order to achieve an insulating value of R-30, vermiculite must be installed to a depth of 13.2 inches with a weight per square foot ranging from 4.4 to 6.6 lbs. Perlite, which has a greater R-value per inch, must be installed to a level of 11.1 inches with a weight ranging from 4.6 to 7.4 lb per ft^2 to achieve an insulating value of R-30.

Attic insulation is generally installed between the ceiling joists and is supported entirely by the ceiling surface. (Mineral fiber batts and blanket insulation may be an exception to this since it is friction-fitted in the joist space and the total weight of the material may not be resting on the ceiling surface.) Ceiling materials, especially gypsum board, are not designed to support extensive loads. In a typical home with a 1/2 inch gypsum board ceiling mounted on a frame spacing of 16 inches on center, the Gypsum Association recommends the load not exceed 2.2

lbs per ft^2. When the ceiling is mounted on a frame with spacing of 24 inches on center, the maximum recommended load is 1.3 lbs per ft^2.

Ceilings exposed to loads exceeding these recommendations are subject to two types of damage. First, the ceiling may exhibit sagging as a result of the excessive insulation load placed upon it. This, in itself, does not pose a health hazard but may be objectionable to some from an aesthetic standpoint. A sufficiently large load, however, may cause the ceiling boards to crack under the weight, creating an obvious safety hazard for the building's occupants. The load placed on the ceiling may also cause the ceiling board to be pushed down over the nailheads. The potential for this will be greatest where washers were not used to secure the boards to the frame members. This type of failure is also likely to occur where nail spacing is large and the load is distributed over a smaller number of points. The result is a dangerous structural situation which constitutes a hazard to the occupant of the building.

This concern with the weight of mineral cellular loose-fill insulation is compounded by the effects of moisture accumulation. Moisture affects the load bearing characteristics of gypsum board in two ways. First, as the relative humidity increases, so does the weight of the gypsum board. This means that in a relatively humid environment, the load bearing capacity of the boards is further reduced. Second, as moisture in the attic area condenses and settles in the insulation, it greatly increases the load on the ceiling board. This may lead to failure of the ceiling board if it was already loaded to capacity. This problem is most likely to occur in attics which are insufficiently ventilated; however, it may also occur in other attics during climatic conditions which promote condensation.

Moisture accumulation in gypsum board may also be caused by the application of spray texture ceilings. These materials saturate the gypsum board with moisture. If the ceiling is covered on the attic side with a vapor barrier, there may be no way for the moisture to evaporate. The result would be a reduced load-bearing capacity for the ceiling. This problem is further compounded by the weight of the spray texture material itself.

DOE has no evidence that any ceiling failures have occurred because of overloaded conditions due to insulation and affected industries have reported having no knowledge of any such failures. The potential of ceiling overload hazard is thus not considered to be a genuine safety hazard.

Installation Standards

The installation standards for mineral cellular loose-fill insulation that are addressed to fire safety require the same blocking precautions as are specified for organic and mineral fiber loose-fill insulation.

The sources of controversy and the likelihood of compliance with the standards are similar to those for organic and mineral fiber loose-fill insulation. The effects of adequate and inadequate enforcement of the standards are also similar.

A possible approach to mitigating the potential ceiling overload hazard would be to establish a limitation on the loads that may be applied to installed gypsum boards. Thus, maximum loads that may be placed on gypsum board ceilings for various combinations of board thickness and frame spacing would be specified. For ceilings other than gypsum board, the allowable load could be established using acceptable engineering principles and prohibiting installation in excess of the established total allowable load. These limitations could correspond to recommendations made by the gypsum industry which have been in effect for the industry for some time. An alternative would be to develop essentially equivalent standards that are addressed to limiting the effects caused by weighting the ceiling with insulation.

If there were effective enforcement of such standards, the additional oversight provided by the Program's random inspection procedures should reduce the number of ceiling failures among the Program-related installations to a lower level than the already very low level that currently exists for non-Program-related insulation installations. Ineffective enforcement will bring the probability of ceiling failure up more nearly to its present level given the existence of the identical standard but without the extra enforcement mechanism. However, since there appears to be almost no probability of ceiling failures due to insulation overload, these changes in the likelihood of ceiling failure with and without effective enforcement of the Program's standard are not likely to make a large difference in the already low level of safety hazard due to overloaded conditions that appears to be associated with installations of these kinds of insulation.

3.2.2.1.5 Floor, Wall, and Ceiling Insulation: Reflective Insulation

The Program includes reflective aluminum foil insulation (aluminum foil faced batts) for use under floors that are over unheated crawl spaces and basements. This foil, whether used in floors, ceilings, or walls, presents a potential electrical shock hazard because of the possibility that it will come in contact with wiring which is improperly insulated or with electrical fixtures which are improperly grounded.

Installation Standard

The installation standard for reflective insulation was developed by an interagency committee from DOE, NBS, CPSC, and FTC. The committee conducted an intensive search for existing standards governing the installation of this material and concluded that none existed which were adequate to ensure the safety of the installer. The Program standards rely heavily upon manufacturer installation instructions.

The Program requires, for installations of reflective aluminum foil under the RCS Program, that contractors:

- Identify and examine all visible wiring, junction boxes, and other metallic or electrical equipment in the areas where insulation is to be installed and not install reflective insulation if the wiring is found to have frayed, cracked, deteriorated or missing electrical insulation.

- Ensure that all electrical equipment in the building is grounded and not install reflective aluminum foil insulation in a building in which electrical equipment is not grounded.

- Identify air supply and return ducts, pipes, electrical wires and other obstructions located in spaces between floor joists over crawl spaces and unheated basements; ground all metallic heating and air conditioning ducts which may come in contact with the installed insulation; and not install reflective insulation where metallic heating and air conditioning ducts are not grounded.*

Enforcement of this installation standard will produce a lower probability that an electrical shock accident will occur as a result of a Program installation of reflective foil than as a result of a non-Program installation. Ineffective enforcement will produce a probability of an accident occurring that is similar to that at present.

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* *DOE also specifies that repairs or replacement of electrical wiring to eliminate defects and all other electric-related activities are to be carried out only by personnel approved for such work.*

3.2.2.1.6 Storm Windows, Thermal Windows, Multiglazing Units, Storm Doors, and Thermal Doors

The primary health and safety concerns associated with storm and thermal windows and doors* are glass breakage and restrictions on egress. Storm and thermal doors can be hazardous to persons who are entering or leaving a house and are inattentive to the existence of a glass door. Storm windows can also be hazardous to persons who are inattentive to the existence of a second glass window. Of greater concern, however, is the possibility that they may be installed in such a manner that they cannot be opened or removed for emergency egress.

Material Standards

The Program material safety standard for storm and thermal doors prescribes that, for storm and thermal doors containing glass, safety glazing that conforms to CPSC Safety Standard, Part 1201, must be used. This standard calls for the use of shatter-resistant glass. These material standards were accepted without significant controversy.

**Thermal windows and doors differ from storm windows and doors in that the two sheets of glazing material that provide the improved thermal performance are affixed to a common frame rather than to separate frames. Thermal windows and doors are usually the primary window or door.*

Installation Standards

In order to ensure that the installer follows local building codes requiring proper egress, the Program standard will reinforce existing codes by prohibiting the installation of window or door devices in such a manner that they would restrict the means of egress which are required by applicable codes and regulations.

Enforcement of this standard under the Program's enforcement provisions will reinforce existing mechanisms for ensuring compliance with building codes. A lack of effective enforcement by Program means will not affect existing enforcement processes. Therefore, the resulting change in the probability of a hazard being created by unsafe installation should not be large.

3.2.2.1.7 Replacement Furnaces and Burners

The primary health and safety concerns associated with central heating systems in general are explosion, fire, and carbon monoxide poisoning. A DOE study conducted in 1977 to assess the safety of vent dampers also reported empirical data on accidents associated with the operation of heating systems in general [DOE, November 1977]. Approximately 22,000 accidents and 200 deaths result from the operation of heating systems each year.

The RCS Program standards for these devices are intended to assure that the replacement furnaces and burners installed under the Program will operate safely. This includes the prevention of electrical shock associated with furnace control systems and power supply.

Material Standards

The RCS Program material standards for replacement furnaces and burners are adopted from existing ANSI standards. The standards for heat pumps are adopted from existing Underwriter's Laboratory (UL) standards.

Most local building codes already require that replacement furnaces and burners meet the applicable ANSI or UL standards. Therefore, ineffective enforcement by Program means of the Program material standards should not cause a significant change in the accident rate that would be expected with effective enforcement. Existing compliance mechanisms are likely to maintain the accident rate at approximately the same level as would exist if there were no Program enforcement procedures.

Installation Standards

The Program contains installation standards for replacement oil burners but not for replacement furnaces. A separate standard for replacement furnaces was omitted because most local building codes adequately address the installation of these devices. The Program believes that additional installation standards would not increase the safety of such installations.

The standards for replacement oil burners address primarily the possibility that a new burner might have characteristics that would result in overheating certain components of the furnace. It is anticipated that most burner replacements will involve replacing a conventional burner with a high speed, flame retention head burner. Such high performance burners produce higher combustion chamber temperatures than conventional burners (2300°F vs 1800°F) and may result in higher operating temperatures than the furnace was designed to withstand. If this were to occur, the combustion chamber or tubes (in boilers) would be damaged and could produce a fire or health hazard to the building and its occupants. An additional standard is addressed to the creation of similar hazards through corrosion caused by condensation. The standards require that:

- A flame retention replacement burner not be selected for use on a hot water or steam boiler equipped with a stainless steel combustion chamber.
- The burner be replaced in accordance with the manufacturer's instructions following normal, good installation practices.
- If a flame retention burner is installed, the contractor determine if a furnace liner designed for this type of burner is required and install it if necessary.
- The completed installation be in conformance with all local and state building and fire safety codes. Where local codes do not exist, the installer must verify conformance with American National Standard Installation of Oil Burning Equipment standard Z95.1-1974 (NFPA No. 31-1974).

- The temperature of the combustion gases entering the draft regulator be above the temperature at which condensation could occur.

The installation standards for replacement oil burners were developed by NBS. DOE believes that most furnace contractors and local code officials are familiar with the potential hazards associated with high performance replacement burners and will observe or require the observance of the above precautions even in the absence of effective enforcement mechanisms. However, it is likely that ineffective enforcement of the Program standards will result in a somewhat higher rate of incidents involving replacement burners among Program installations than would be the case if the standards were well enforced.

3.2.2.1.8 Wall Insulation: Urea-Formaldehyde Foam

There are several safety and health concerns associated with the use of urea-formaldehyde (UF) foam as an insulating material.

UF foam insulation is a cellular plastic material which is prepared at the building site and installed by injection or spraying into wall cavities. The UF foam is furnished by the manufacturer as a resin concentrate of urea-formaldehyde polymer. The resin is foamed by the installer by mixing with a surfactant (foaming agent) and a mineral acid catalyst. This foam is then injected by compressed air through a specially designed portable "gun" into the wall cavity. The catalyst causes the foam to partially cure (chemically harden) within about one minute. Complete curing occurs within about one week.

Formaldehyde is present in the urea-formaldehyde-based resin and it may be liberated as a gas into the air both during the foaming operation and after injection into the wall cavity. In the latter case, the formaldehyde gas is liberated by hydrolysis (chemical decomposition in the presence of water).

Formaldehyde gas can cause health problems in humans ranging from temporary irritation to death. Health symptoms resulting from exposure to formaldehyde gas include: eye irritation, upper respiratory irritation, shortness of breath, nasal congestion, and skin rash. Inhalation of concentrated formaldehyde vapor can lead to pulmonary edema (an acute respiratory irritation), pneumonitis, and, in extreme cases, death. [Rocky Mountain Poison Center, December 5, 1978].

The response to a particular concentration level varies greatly from person to person. Formaldehyde odor can be detected by some persons at a concentration of 0.05 ppm; at 1.0 ppm its odor is detectable by nearly all people. Throat irritation has been reported at 0.5 ppm. Eye irritation can occur in the range of 0.01 ppm to 0.05 ppm. Mild upper respiratory irritation has been reported at levels as low as 0.3 ppm, and severe respiratory irritation has occurred at the level of 10.0 ppm [GCA Corporation, January 1976].

There is some controversy as to whether formaldehyde poses a health hazard at concentrations below the level where its odor is detectable. According to one manufacturer, "Toxic effects due to formaldehyde have only occurred at concentrations considerably above the odor detection level in humans (0.05-0.08 ppm). It appears that detectable odor or irritation is a sufficient warning to avoid the possible toxic effects." [Aerolite, November 28, 1978] However, the CPSC disputes this statement. It reported in a July 1978 directive, "Even traces of formaldehyde gas are sufficient to cause disabling symptoms in sensitized individuals... Many persons have reported symptoms when formaldehyde levels were well below 1.0 ppm." [CPSC, July 1978]

Sensitization refers to a tendency to show acute and chronic symptoms at low concentrations of the gas. The Rocky Mountain Poison Center has found that some persons can become sensitized with repeated exposure to formaldehyde gas [Gambel, et al.].

The CPSC and several State health and consumer agencies have reported health incidents involving the release of formaldehyde gas into homes that had been insulated with UF foam. These include reports of eye irritation, respiratory irritation, nausea, vomiting, and allergic reactions. The symptoms were reported at various times after the foam had been installed.

The severity of the incidents reported varies considerably. The CPSC files indicate that the most common symptom is immediate irritation. On several occasions, this necessitated the temporary relocation of the house's occupants. Some rare cases have been reported in which the occupants of UF-foamed houses had to be hospitalized due to the inhalation of formaldehyde gas.

The number of reported cases of health problems associated with UF foam installations, however, are small. The CPSC had received 51 complaints as of June 1978 [CPSC, June 1978]. The Massachusetts Office of Consumer Affairs had received 89 complaints of formaldehyde odor from occupants of UF-foamed houses as of August of the same year. The Massachusetts experience represents 0.29 percent of the 30,000 houses in that state that had UF foam installed at that time [Aerolite, November 28, 1978].

Data are also available on similar incidents in other countries. In the Netherlands where 60,000 dwellings had UF foam applied between 1974 and 1977, 32 cases of formaldehyde odor problems were reported (0.05 percent). In Canada, two cases were cited [Aerolite, November 28, 1978]. (The number of UF-foam insulated homes in Canada is not available.)

U.S. manufacturers of UF foam also report data on odor complaints associated with their product. Aerolite SPE claims that its UF foam has been installed in 47,000 homes with only 32 complaints of odor (0.07 percent) [Aerolite, November 28, 1978]. Polar Products Corporation has reported that only two complaints were received from the 8,000 homes insulated with its products (0.025 percent) [Polar Products Corporation, November 1978].

The emission of formaldehyde gas in the low parts per million range during the drying and curing process is normal. Liberation of the gas at higher concentrations is usually indicative of faulty preparation or installation. Improper practices that can contribute to the liberation of excess formaldehyde gas after installation include [NBS Technical Note 946]:

- Excess formaldehyde in the resin
- Excessive catalyst in the foaming agent
- Using excessive resin
- Using excessive foaming agent
- Foaming at high humidity
- Foaming with chemicals that are either too hot or too cold (the recommended temperature range is 50°F to 80°F)
- Preparing a foam that is too dense
- Failing to use a vapor barrier, or using one improperly
- Applying foam in cavities that are not vented to the outside, and
- Applying UF foam in attics.*

These potential impacts could be mitigated by material standards designed to keep the concentration of formaldehyde gas at low, safe levels and to limit its emission to a brief period of time after installation. Material and installation standards are being developed for UF foam. Installations of UF foam insulation will not be permitted under the Program until acceptable standards have been formally adopted. If such standards have not been adopted by the time of approval of the first State Plan, UF foam will be withdrawn from the Program.

*However, the Building Officials and Code Administrators International (BOCA) approved the use of UF foam to insulate attics in July 1978.

Material Standards

DOE is developing material standards to mitigate potential health and safety concerns associated with the use of UF foam. One alternative proposed would have required that:

- The free formaldehyde content of the resin used in UF foam insulation not exceed 1.0 percent by weight.

- The setting time for UF foam insulation be between 20 and 90 seconds.

- The wet density of the foam is to be at least 10.4 kg per m^3.

The option would have specified the test methods to be used in assessing UF foam for these properties. These standards were developed by the Canadian Government Specifications Board.

Controversy surrounded the inclusion of material standards for UF foam in the RCS Program. Massachusetts public health officials requested that DOE defer issuance of a UF foam standard until a determination has been made as to whether this material constitutes a health hazard. Since then DOE has had several meetings with both consumer protection officials and UF foam manufacturers concerning this issue.

To improve its understanding of any potential problems associated with the use of UF foam as an insulating material in residences, DOE has conducted several studies to investigate the effects of formaldehyde vapor emission and to determine the factors which contribute to these effects. Additionally, DOE has contracted through Oak Ridge National Laboratory to measure the formaldehyde vapor concentration in 300 homes in the Boston area. In July 1978 DOE contracted with the University of Iowa to conduct a two-year study to determine the conditions under which UF foam insulation releases excessive quantities of formaldehyde.

Another alternative could require that:

- The free formaldehyde content of the resin used in UF foam insulation not exceed 0.5 percent by weight.
- The free formaldehyde content of fresh UF foam not exceed 0.3 percent by weight.
- The setting time for UF foam insulation be between 20 and 60 seconds.
- The flame spread classification of UF foam not exceed 75.
- The wet density of the foam is to be at least 10.4 kg per m^3.

Certain minimum installation equipment criteria could also be required as part of the material standard to insure that UF foam will be installed properly. These alternative standards would provide more assurance that the foamed-in insulation will be effective and formaldehyde out-gassing will be minimized. They would also be more expensive to comply with and could be expected to increase the price of a UF foam installation.

To alert potential customers of UF foam insulation to the potential for associated health problems, the material standards specify labeling requirements which could include a warning printed on all UF resin containers to the effect:

> "CAUTION: Urea Formaldehyde Foam Insulation may release a small quantity of formaldehyde vapor. This occurrence may present a health hazard to anyone who previously has been sensitized to formaldehyde or who has a history of respiratory problems."

Because customers may not see the resin containers from which the foam is prepared or may not understand the nature of the health hazard, an alternative would be to require that a written warning be provided to the customer. This warning would advise the customer of the specific health symptoms that may occur as a result of continued exposure to formaldehyde vapor.

None of the proposed alternative standards can assure that UF foam insulation, when in place, will not release gas in potentially harmful quantities. UF foam insulation *per se* does not exist as a shelf item. It is created by the installer at the job site by mixing appropriate amounts of urea-formaldehyde resin, detergent, and catalyst along with various hardeners and conditioners. Therefore, it cannot be tested in the as-installed condition.

Rather, materials testing for compliance with the standards must rely upon samples prepared under conditions that do not necessarily match those at the job site. However, material standards will ensure a greater level of safety than would be possible without the standards or with other existing standards. The more stringent alternative would seem preferable since it would be more likely to communicate important information to homeowners.

Effective enforcement of the material standards will probably reduce the incidence of the health problems associated with UF foam for installations performed under the Program. However, since the major UF foam component manufacturers support standards for UF foam and foam installers, it is likely that they and their installers will comply with at least those provisions they support even in the absence of effective enforcement. Moreover, because of the potential for adverse publicity that could result from improper UF foam installations, foam component manufacturers have an incentive to adhere to quality standards having a similar performance objective even in the absence of a specific Program standard. Therefore, it is possible that a lack of effective Program enforcement for the UF foam material standard will not greatly alter the incidence of health problems that could be expected were enforcement 100 percent effective.

Installation Standards

DOE is developing installation standards for UF foam. The major potential problems related to the installation of UF foam concern formaldehyde gas, moisture and condensation accumulation, structural deterioration, waste heat buildup in walls, and fire prevention. The standards could address these matters through controls on:

- The foam component manufacturing process
- The foam field-mixing process
- The performance of the equipment
- The qualifications of the installers
- The procedures used to install the foam.

Mitigating measures in connection with these potential problems would likely include the following requirements:

- Foam not be placed in wall cavities with existing insulation.
- Installation sites should be inspected and prepared to prevent extrusion of foam into any space other than wall cavities between conditioned and unconditioned spaces, including electric boxes, heating/cooling ducts, plumbing connections, chimneys, window and door operating mechanisms, and basements and crawlspaces.

- Approved vapor barriers be installed where necessary.
- Interior wall finish fire rating be 15 minutes, in accordance with ASTM Designation E119-76.
- Clearance from heat producing appliances be maintained in accordance to NFPA 70, 211, 31, and 54.
- Foam not be left to dry on glass, aluminum, or vinyl building components.
- Installation site be ventilated to prevent accumulation of formaldehyde gas.
- Consumers be kept a safe distance from work areas and installation equipment.
- Foam be placed according to manufacturer's directions.
- Installation be performed only by installers trained and certified by manufacturers, and with equipment recommended by same.
- Installation conform with all applicable local and state building and fire safety codes.

- Properly aged resin be used.
- Foam components be compatible and proper ratios of each be used.
- Control of resin, detergent and air ratios be verified periodically.
- Temperature of ingredients, mixtures and equipment be under control at all times.
- Hose lines transport the material as intended.
- Gun apertures and/or mixing chambers not be faulty or dirty when used.

To ensure that the quality of the materials and installation is maintained, a quality verification program might also be administered by the local jurisdictions. This program would be applicable to both the UF foam component materials suppliers and installers.

Installations of UF foam insulation will not be permitted under the Program until acceptable standards have been formally adopted. If this has not occurred by the time the first State Plan is approved, UF foam insulation will be withdrawn from the Program.

3.2.2.1.9 Flue Opening Modifications

For the RCS Program, DOE has defined the term "flue opening modifications" to include only vent dampers. There are three potential hazards associated with the use of vent dampers. The first of these is associated with all types of vent dampers; the second is of concern only for gas heating systems; and the third is of concern only for electrically-actuated dampers. These hazards are:

- Failure of the damper to open upon burner ignition, or closure of the damper during burner firing, resulting in the venting of combustion products into the residence possibly leading to carbon monoxide poisoning

- Failure of the damper to open when the pilot is extinguished, resulting in the escape of unburned gas into the building thereby creating a fire or explosion hazard

- Electrical shock hazards.

Vent dampers may be classified into three categories based on the type of actuator used to initiate their operation. They may be thermally-actuated, pressure-actuated, or electrically-actuated. Thermally-actuated dampers rely upon high-temperature gas generated in the heating system to open the damper; pressure-actuated devices rely upon fuel pressure to open the damper just prior to ignition of the heating system; and electrically-actuated devices use a motor or a solenoid to rotate the damper unit until it is in the open position, where an interlock switch allows combustion to be started.

A study conducted by DOE [DOE, November 1977] projects that approximately 60 percent of all vent damper installations will be made on gas-fired furnaces and the remaining on oil-fired furnaces. It is assumed that half of the dampers installed on gas-fired furnaces will be electrically-actuated, the other half thermally-actuated. All oil-fired furnaces were assumed to be equipped with electrical dampers. The study estimates that a total of 25.5 million vent dampers could be retrofitted in the United States so as to return their purchase and installation costs in less than their useful lives. It also notes, however, that a more economically attractive heating system retrofit would be one combining a vent damper, electric or mechanical ignition system and reduced gas orifices.

The DOE study also provides quantitative data on the accident rates for two of the three types of vent dampers for the hazards identified above. (Pressure-actuated vent dampers were still in the design and working-model stage at the time the study was being prepared; accident rate estimates were not prepared for this type of vent damper.) Assuming that each installation is inspected at the time of installation, this study estimated that the predicted accident rate for carbon monoxide poisoning or explosion and fire for thermally-actuated dampers is 4.8×10^{-8} accidents* per year per unit. The predicted accident rate

**Because they are so new, there are no historical data available on vent dampers installed in the U.S. Approximately two million thermally-actuated vent dampers have been installed in West Germany, Austria and Switzerland since 1967. No accidents attributed to vent dampers have been reported from the European experience [DOE, November 1977].*

for electrically-actuated dampers is 2.2×10^{-8} accidents per year per unit. This rate includes accidents due to electrical shock, carbon monoxide poisoning, explosion, and fire.

In a risk analysis based on 25.5 million heating systems (7.6 million with thermal and 17.9 million with electrical dampers) and using the above accident rates, the study estimated that approximately one accident (venting and electrical shock) will occur every 1.4 years. It was estimated that in 10 percent of accidents involving venting problems, two fatalities would result. For 90 percent of the accidents involving electrical shock, a single fatality would result. Therefore, on a national basis, this would result in approximately one fatality every 3.8 years. The comparable historical annual accident rate that results from explosions, fires and carbon monoxide poisonings for central heating systems is about 22,000 accidents per year and 200 deaths per year.

The study also provides a interpretation of the uncertainty associated with the expected accident rate estimates. It notes that the actual accident rate will probably not be higher than ten times the expected value "...and almost certainly not higher than 100 times this value." [DOE, November 1977, p. 77]

Although the projected accident rate for vent dampers is very low, the potential severity of the hazard is such that DOE intends to have health and safety standards in place before permitting installations of vent dampers under the RCS Program.

Material Standards

The American National Standards Institute (ANSI) and Underwriter's Laboratory (UL) have recently promulgated material standards for vent dampers with accompanying installation guidelines. DOE has incorporated the ANSI material standards for application to gas furnace vent dampers.

The Program standards are intended to assure that the vent dampers used in the RCS Program are constructed in such a manner as to ensure their safe operation. The standards establish requirements for construction and testing which guarantee that the device:

- Does not restrict the flow of combustion gases
- Will not be damaged by exposure to high or low extremes of temperature
- Will not close when the air temperature in the vent dampers is over 225°F
- Can withstand 100,000 cycles of operation without failure
- If electrically-actuated, will not cause electrical shock.

Most local building codes already require that vent dampers on gas-fired heating systems meet the ANSI standards. Therefore, ineffective enforcement of the Program material standards for vent dampers should result in a failure rate among Program installations that approximates that of non-Program installations.

The Program requires that vent damper manufacturers provide wiring schematics of those furnace control panels with which their unit is compatible. Different controls and control equipment, such as three- to four-wire thermostats, circulators, zone controls, tankless coils, and boilers with relays, are found on units in the field. A set of wiring schematics would help to insure that the installer correctly connects the vent damper controls and would increase the assurance that a Program installation would be safe. This standard would increase the cost of a vent damper; however, the increase should not be large. Approximately five wiring schematics would cover 80 to 90 percent of the furnace controls found in the field today.

The Program evaluated other modifications to the ANSI material standard for vent dampers on gas-fired furnaces that could make it more effective. Vent dampers are currently being installed with a redundant gas valve or damper-closing temperature control. Dampers with closing temperature controls in lieu of two gas valves are required by ANSI to have a least a 10 percent open area in the nominally closed position. The damper-closing temperature control is designed to allow the vent damper to remain open when the vent gas temperature is above 225°F when tested under specified conditions. This is to keep the damper open if there is a malfunction of the automatic gas valve such that gas flows without a call for heat. A malfunction of the automatic gas valve can allow a flow of gas between zero and full flow. The ANSI installation guidelines do not allow for a test of the damper-closing temperature control. It has been determined by DOE that a vent gas temperature of 375°F measured at full gas flow will provide a vent gas temperature of at least 225°F for the majority of hazardous conditions when a valve is leaking. The Program requires that the damper-closing temperature control be tested as a means of ensuring the proper operation of the vent damper safety controls. Such a test will increase the cost of a vent damper installation. The amount of this cost is uncertain at this time.

DOE also evaluated a requirement for a second automatic gas valve on all thermally actuated vent dampers. On units currently being manufactured, the amount of opening is not proportional (i.e., nonlinear) to the gas vent temperature. It is conceivable that a unit could be manufactured which would snap open at a gas vent temperature equal to or greater than 225°F. A stuck gas valve would not necessarily mean that the thermal damper would be sufficiently open so as not to cause a hazardous spillage. A gas valve could be stuck open 20 percent with a resultant gas vent temperature of 150°F. The consequences of such a failure would be hazardous and perhaps fatal. The Program requires a redundant gas valve on all thermal damper installations. A requirement for the additional gas valve would increase the cost of a vent damper installation. The amount of this cost is uncertain at this time. However, it would also help mitigate the potential risk described above.

Installation Standards

DOE evaluated the existing ANSI installation guidelines and concluded that they did not adequately ensure a safe and effective installation. DOE was especially concerned that these guidelines did not sufficiently address the intended uses of the devices and their compatibility with other systems. DOE is presently in the process of developing new installation standards for vent dampers installed under the Program. The standards being developed are intended to ensure that:

- The thermostat, heating appliance, and chimney are in proper operating condition for continued use before the vent damper is installed

- The installer is properly qualified

- The installer has adequate installation instructions from the manufacturer

- The vent damper is compatible with the heating system in use

- The vent damper is safely and properly installed.

The standards being developed would also require that checks of safe venting capacity and draft hood spillage be conducted under worst case outside wind and temperature conditions. Vent capacities are reduced when the difference between indoor and outdoor temperatures is the least and when wind velocities are low. The provision being considered would require that all checks of venting capacity or draft hood spillage be conducted when the outside temperature is above 65°F and the wind velocity is less than 10 mph.

Inasmuch as they are more stringent than the existing ANSI standards, the alternative installation practices would impose additional costs and burdens on the installers. However, they would also provide greater assurance of the safety and effectiveness of installed vent dampers.

As indicated earlier, the predicted accident frequencies are based on the assumption that each installation is inspected at the time of installation. Since the DOE study indicates that installers can be expected to perform post-installation inspections as part of their routine installation procedure, the accident rates reported above may be taken to be indicative of what would occur in the absence of the RCS Program as well as in the absence of effective enforcement of the more stringent standards that will be required by the Program.

Should the expected installation practices not be followed, however, and post-installation inspections not be performed -- with or without the Program -- the DOE study predicts the expected accident rates will increase. The accident frequency for thermally-actuated dampers, in particular, is very sensitive to the post-installation inspections assumption. Its critical failure mode results in a sealing of the vent which prevents the normal venting of dangerous combustion products. If it is assumed that no post-installation inspections are carried out on thermally-actuated vent dampers, then the probability of an accident will increase to 3.3×10^{-7} per unit per year, up by a factor of almost seven. If the electrically-actuated damper, which requires a much more complex installation procedure, is not inspected after installation, the probability of an accident, including the hazard due to electrical shock, will increase to 2.6×10^{-8} per unit per year, up by a factor of 1.2. The smaller increase in the probability of an accident in the electrically-actuated vent dampers results from the fact that the predominant critical failure mode of these units involves the damper coming loose from the shaft. Under such conditions, the vent likely will be open continuously, enabling the combustion products to be vented.

Under the more stringent installation standard, both this "worst case" accident rate and the estimated accident rate associated with expected practice should decrease. Vent damper installations performed under the Program should be safer than those performed outside the Program.

An additional benefit should result from the installation of vent dampers under appropriate Program standards. The DOE study indicates that a program for retrofitting vent dampers on existing furnaces should result in a significant decrease in the number of furnace-related accidents. This reduction will come about as a result of utility and oil burner service personnel discovering hitherto undetected furnace and venting problems when they inspect furnaces prior to installing vent dampers. Many heating systems will be found that are in need of total replacement either because they are inefficient or unsafe. The study estimated that about 900 accidents per year and about 8 fatalities per year (both about 4 percent of current levels) will be prevented as a result of a national retrofit vent damper program for 25.5 million units.

3.2.2.1.10 Electric and Mechanical Ignition Systems

The primary health and safety concerns associated with electric and mechanical ignition systems are fire hazard and the possibility of asphyxiation.

Electric and mechanical ignition systems are used in gas-fired furnaces and boilers to automatically ignite either the gas pilot or burner. They replace standing gas pilot lights, thereby producing considerable energy savings during the off cycles of these appliances. Most electric or mechanical ignition systems are equipped with a safety feature which is designed to shut off the gas supply in the event that the pilot and/or main burner fails to ignite. If this feature should fail to operate properly, it is possible that unburned gas may escape into the furnace room and/or building, creating a significant hazard to health and safety. The escaping gas may be ignited by another source (such as a standing pilot in an adjacent appliance) causing an explosion or fire hazard. It also may result in asphyxiation of the building occupants.

Material standards for electric and mechanical ignition systems are included in the Program. DOE is developing installation standards for these systems. Installations of ignition devices will not be permitted under the Program until acceptable standards have been formally adopted. If such standards are not adopted by the time the first State Plan is approved, then electric and mechanical ignition systems will be withdrawn from the Program.

Material Standards

To control the possibility of these hazards occurring, the Program requires the use of the American National Standards Institute (ANSI) product standard for these devices [ANSI Z21.20-1975].

Installation Standards

As an alternative, DOE is developing installation standards for electric and mechanical ignition systems. One option would be to adopt the ANSI standard. This standard, entitled "Proposed American National Standard for Automatic Intermittent Pilot Ignition Systems for Field Installation" and dated September 11, 1979, is designed to adapt existing automatic intermittent ignition systems to existing pilot burners on listed forced air heating appliances and boilers equipped with atmospheric burners. DOE believes that this standard would reduce the safety hazard associated with these devices at a minimal increase in the cost of an installation. However, there are also certain limitations to this option. There is no restriction on the current on the electrode, and the standard limits the installation of the systems to ignition systems with recycling pilots. DOE is investigating the implications of these limitations for the potentially achievable safety performance and cost of electric and mechanical ignition systems.

The probability of an accident that affects the health of building's occupants occurring as a result of the installation of electrical or mechanical ignition systems under the Program will depend on the degree of compliance with the standards ultimately adopted. One study has indicated that furnace systems equipped with automatic ignition systems are safer than those without such systems because of the double-valve installation feature associated with these systems [NYS, March 1979]. Effective enforcement of the eventual program standards should therefore result in a low incidence of adverse health effects from ignition systems installed under the Program. Ineffective enforcement of these standards, however, could possibly lead to problems resulting from improper installation and faulty devices. For this reason it has been proposed that all installations of electrical and mechanical ignition systems must be inspected by a qualified inspector.

3.2.2.1.11 Indoor Air Quality

Infiltration of outside air contributes substantially to heating and cooling requirements in many (if not most) houses. Some energy conservation measures reduce infiltration rates in order to save energy. These measures are caulking and weatherstripping, storm windows, storm doors, and the plugging of other air leaks in a house. There are several pollutants which have been found in homes in varying concentrations which adversely affect health if their concentrations are high for an extended period of time [Geomet, October 1976; Geomet, October 1978; Hollowell and Traynor, April 1978; Hollowell, April 1978; Ross, May 1978]. To the extent that energy conservation measures reduce infiltration and increase the concentration of these pollutants, the health of a building's occupants may be affected adversely.

One major concern involves the air exchange rate in buildings built on soil containing a heavy concentration of radiation-producing materials such as phosphates and uranium mine tailings. Such homes are more likely to contain unusually high concentrations of radioactive materials such as radon gas than are buildings built on other soils [Budnitz, August 1978; EPA, February 1979]. Such relatively higher concentrations of airborne radioactive materials can result in increased incidence of lung cancer. [EPA, February 1979].

Another concern involves indoor-generated air pollutants. The gas stove emits carbon monoxide, nitric oxide, nitrogen dioxide, and respirable aerosols. The gaseous nitrogen compounds may then quickly oxidize or reduce to other pollutants including nitrates, nitric acid, ammonium, and organic nitrogen compounds of the amino and pyridino type [Geomet, October 8, 1976; Geomet, March 31, 1978; Hollowell and Traynor, April 1978; Hollowell, April 1978].

Other indoor air pollution sources include heating appliances, building materials and contents, and human activities such as smoking. The pollutants which can be emitted from these sources include carbon monoxide, carbon dioxide, nitric oxide, nitrogen dioxide, sulfur dioxide, ammonia, sulfates, particulates, radon, formaldehyde, mercury, fluorocarbons, vinyl chloride, microorganisms (bacteria), and odors.

Indoor concentrations of most air pollutants are not, on the average, very high, though moderate to high pollutant levels can occasionally occur for extended periods. Extended high concentrations of certain pollutants may occur in homes with particularly strong emission sources, such as unvented gas space heaters or high levels of cigarette smoking. Elevated levels of pollutants can create a potential health hazard for occupants. In particular, this affects those occupants with pre-existing health problems. Reduction of the infiltration rate through energy conservation action may, by causing the indoor levels of air pollutants to build up, turn this potential problem into an actual problem.

The probability of an indoor air quality problem occurring as a result of energy conservation practices has not been estimated precisely. Research on the potential radon problem is in progress by both DOE and the U.S. Environmental Protection Agency (EPA). [Geomet, October 1976 and March 1978, Budnitz, August 1978, and EPA, February 1979]. The nature of the radon problem, as it is presently understood, is discussed below. The nature of the potential problem associated with other sources of indoor air pollutants is discussed in the section following.

Radon*

Radon is a radioactive gas which occurs naturally in a wide variety of substances as a decay product in the uranium-238 decay chain (see Figure 3-3). Prolonged exposure to radon gas in concentrations above those normally found in the atmosphere can result in an increased incidence of lung cancer.

There are several ways by which radon can enter the residential environment and become a concern for the occupants of residential buildings. Radon's precursor, radium-226, is commonly found as a trace element in soil and rock. When soil or rock containing radium is used as a constituent of construction materials, radon is introduced into the residential environment. Radon can also enter the residential environment from radium-bearing soil underlying or in the vicinity of the building, and from groundwater or tap water passing through radium-bearing rock formations. A third method by which radon can enter the residential environment is in certain types of rock used as a thermal storage medium for the energy collected by residential solar heating systems. The rate at which the gas can escape from porous material depends on porosity,

**See section 3.3.4.1.1 for a discussion of the implications of using radon-containing materials in renewable resources applications.*

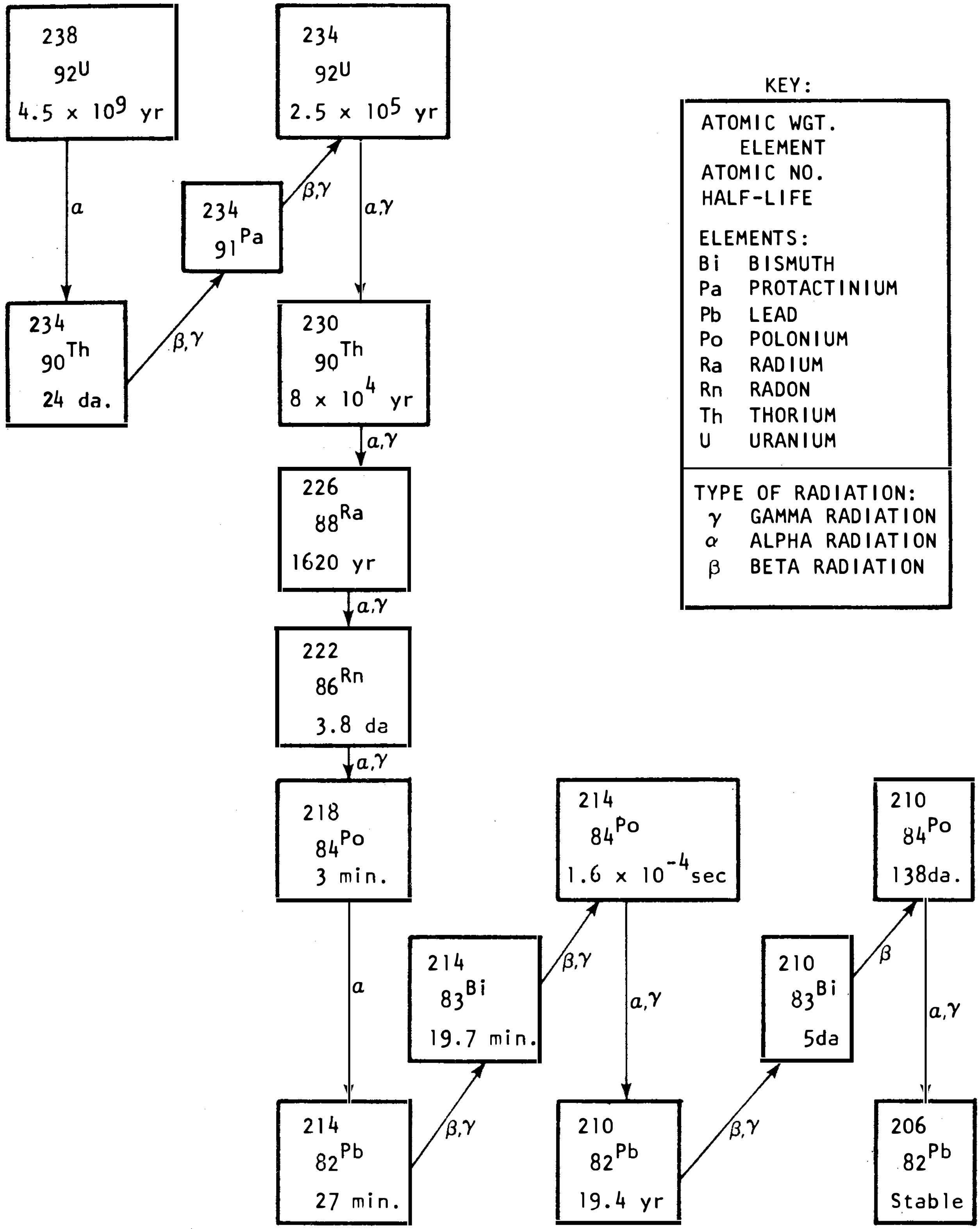

Figure 3-3. Uranium-238 Decay Series
[Guimond, February 1979]

rock size, temperature, atmospheric pressure, and other variables, including the concentration of parent radium or uranium.

Once building materials containing trace concentrations of radium are used in or under a residential building, radon will be present there throughout the life of the building. This is because of the long half-life, 1620 years, for radium-226, which gradually decays and releases radon.

Radon enters the building envelope from these sources through openings in the envelope or by diffusion through the foundation slab or masonry walls. An unknown percentage of the radon in the building's air plates out as radon daughter products on walls and other surfaces. Figure 3-4 illustrates the pathways by which radon enters and leaves a building. That portion of the radon and daughter products in the interior air which is not exhausted by ventilation or those daughter products which do not plate out are available for inhalation.

The potential radon hazard associated with installing energy conservation and renewable resource measures in a residential building is created either by reducing the ventilation rate through the use of weatherization measures, or installing a solar heat rock storage bin containing radium-bearing rocks, or both. In homes with relatively high, steady rates of air infiltration, radon which emanates from the structure or foundation area is diluted with fresh air, thereby reducing the interior concentration level. However, when fresh air infiltration is significantly reduced, the concentration of radon indoors is increased. Rock storage bins containing radium-bearing rock

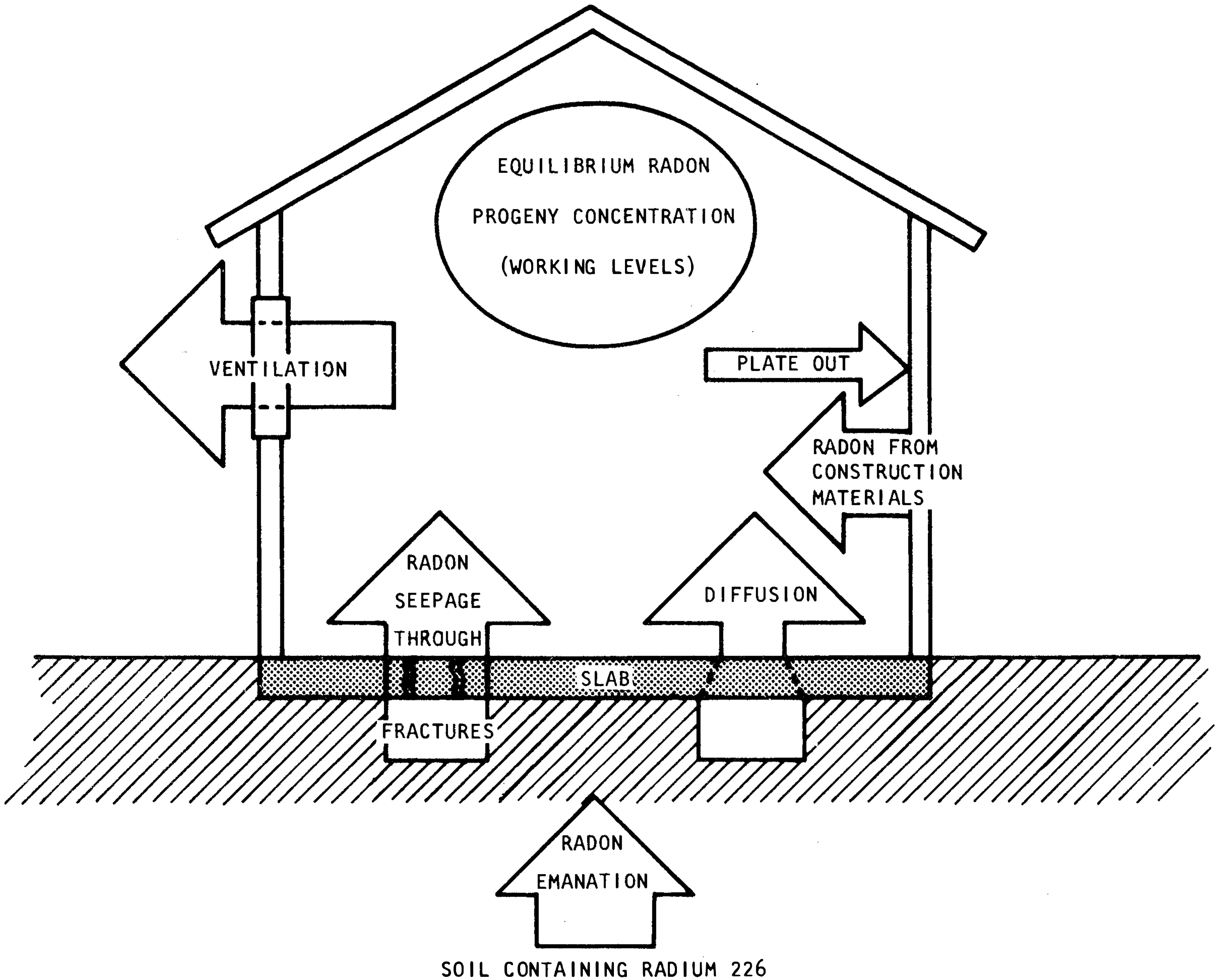

Figure 3-4. Factors Influencing Radon Decay Product Concentrations in Structures
[Guimond, February 1979]

introduce a new source of radon into the residential building. Energy conservation measures which are often installed in conjunction with solar heating and cooling systems to reduce the air infiltration rate serve to increase the interior concentration of the rock-emitted radon further.

Radon decays into other isotopes which are also radioactive, but non-gaseous. It is commonly assumed that once airborne, these isotopes will predominantly remain so by attaching to any microscopic particulates which are present. Ionic charge is an important, but not sole, mechanism responsible for this effect. Consequently, radon is the first of a chain of radioactive elements which must be considered in assessing the level of radioactivity that results from the release of radon gas.

The health hazard associated with prolonged exposure to radon is caused by the radiation emitted during the decay of radon and several of its daughter products. The predominant means of decay for these isotopes is through the emission of alpha particles [T. Kusada, July 1979]. Though alpha particles have a very short range (~2 cm), and though the amount of radioactive energy and material released is low, alpha particles can be very damaging to human tissue cells, especially in the lungs.

Radon and its alpha-emitting daughters enter the lung by one of two mechanisms. Radon itself may be inhaled as a gas and continue to decay, or its daughter products may enter the lung as elements adhering to the surfaces of respirable particulate matter. These particulates may lodge in the lungs, increasing in concentration and producing tissue damage at a short range after extended exposure.

The potential for increased risk of lung cancer resulting from chronic low level exposure to radon and its daughters is drawn from epidemiological studies of uranium miners. These miners were exposed to relatively high levels of radioactive decay products over long periods prior to the establishment of occupational health and safety standards. Such studies have provided clear indications that lung cancer is related to high-level exposure. Although they have not provided a basis for adequately quantifying the risk associated with low level exposure, their results and the results of others (e.g., Guimond, February 1979), in concert with experimental evidence, indicate that some increased risk may be associated with low-level exposure.

Estimates of the average concentration of uranium in the earth's crust range between 2 and 4 ppm. Estimates of the concentrations of uranium in building materials developed by the United Nations Scientific Committee on the Effects of Atomic Radiation [UNSCEAR, 1974] and adapted by the National Council on Radiation Protection and Measurement [NCRP, November 1977] are presented in Table 3-5. Wide variability is present in these concentrations and values of 15 ppm of uranium are common. Measurements in conventional houses in many parts of the country have indicated that radon can achieve concentrations of health significance in ordinary houses without solar rock storage heating [T. Kusada, July 1979]. These levels are thought to be the result of combinations of various sources of which the construction material is only one. Others include soil, groundwater, and tap water. Ventilation rates play an important role.

TABLE 3-5. ESTIMATES OF CONCENTRATIONS OF URANIUM IN BUILDING MATERIALS

Material	Uranium (ppm)
Granite	4.7
Sandstone	0.45
Cement	3.4
Limestone Concrete	2.3
Sandstone Concrete	0.8
Dry Wallboard	1.0
Manufactured Anhydride (by-product gypsum)	13.7

Building materials can serve as a source of radon gas anywhere in the United States. In certain areas of the county, however, the risk due to building materials and other sources is greater than in others. For example, in portions of Florida the soil is rich in phosphate which has been extensively mined for the manufacture of fertilizers. These phosphate deposits have been found to contain concentrations of uranium and its associated decay products, including radium and radon, that are 30 to 60 times greater than the concentrations that are usually found in soil and rock [Guimond, February 1979]. In 1975, the Environmental Protection Agency reported that elevated levels of radon gas were found in homes constructed on land that had been reclaimed from phosphate mining operations in Florida. Although in recent years over 90 percent of U.S. phosphate production has occurred in Florida, phosphate is also mined in Idaho, Montana, North Carolina, Utah, and Tennessee. Thus, the phosphate-bearing portions of these states must also be considered as areas where a potential risk from radon exists.

Wastes resulting from processing phosphate ore can constitute a potential radiation hazard. For example, the processing of phosphate for fertilizer production at the Tennessee Valley Authority's (TVA) Muscle Shoals plant involves the treatment of phosphate ore in an electric furnace. This process results in the production of phosphate slag, which consists of relatively fine granules having the consistency of sand. This material was used by the construction industry from 1953 to 1975 in the manufacture of concrete block. It is estimated that approximately 2.8 million tons of phosphate slag were used by the construction industry during this period, with the majority being used in block manufacture. The slag-containing block was then used in construction applications (e.g., foundations and walls) in Alabama, Tennessee, Mississippi, and Georgia. It has recently been determined that these blocks may pose a radiation hazard due to the presence of radon gas in them. In 1975 TVA stopped permitting the Muscle Shoals phosphate slag to be used in such construction applications.

Uranium mining areas serve as radon sources. In Colorado, uranium mill tailings were used as construction material in brick and concrete applications between 1952 and 1966. Such tailings have also been used as backfill around foundations. Homes which incorporate these mill tailings have been found to exhibit elevated radon concentrations.

Granite is known to contain larger trace amounts of uranium and thorium (the precursor of radium) than other materials in the earth's crust. Granite found in the vicinity of Conway, New Hampshire, appears to contain the highest known concentration (in granite) of these elements. Uranium in this granite occurs in concentrations in the range of 4.3 - 25.5 ppm and thorium in concentrations of 30 - 77 ppm. Radon producing rock formations also underlie other communities, such as Butte, Montana, where extensive mining around and under the town has exacerbated release of the gas to the local environment.

Radon Exposure Abatement Programs

The states of Alabama, Mississippi, Tennessee, and Georgia have recently joined with TVA and EPA in a cooperative program designed to assess the extent and severity of the radiation hazard posed by exposure to building materials containing Muscle Shoals phosphate slag. At present this program is primarily involved in quantifying radiation exposure at each residence where such materials were used during construction. In those cases where corrective action is warranted, it is likely that epoxy-type sealant coatings would be used to prevent the movement of radon gas from within the concrete block into the living space.

The State of Colorado has had an active radon exposure reduction program since 1966. This program involves identifying the locations at which uranium mill tailings were used in construction, evaluating the health hazard posed at each site, and correcting the problem at those sites where the hazard is significantly greater than that posed by normal background levels of radon. Where possible, the surfaces of walls and slabs containing contaminated material are being sealed in order to prevent the physical migration of the radon gas from within the wall or slab into the dwelling. When necessary, concrete slabs and/or the fill under them or around the foundation are physically removed and replaced with uncontaminated materials. Crawl-space ventilation is used wherever possible in order to improve radon dissipation rates.

The problem of elevated levels of radon gas in Florida has been addressed by EPA, and led the Agency to submit four recommendations to the Governor of Florida for handling the abnormally high levels of radon [Costle, May 30, 1979]. The first of these calls for immediate corrective action to be taken at any residence where total indoor exposure, including background, exceeds 0.02 Working Levels.* Second, at sites where the exposure is less than 0.02 WL, but greater than 0.01 WL, it is recommended that corrective action be taken to reduce the concentration insofar as is reasonably possible. The third recommendation concerns the indoor gamma radiation associated with the decay of radon. It recommends that no remedial action be taken at this time because of the low level of health hazard involved. The last recommendation states that new houses should be sited and designed so that indoor alpha and gamma radiation concentrations are maintained within the average normal indoor background range. The Governor of Florida currently has the EPA recommendations under consideration.

A standard has also been proposed in Canada to limit radon daughter concentrations in houses in four communities associated with uranium mining and processing [Federal Provincial Task Force, December 1978].

**A Working Level (WL) is defined as being "the unit equating with a concentration of decay products of radon in one liter of air which results in the release of 1.3 x 10^5 MeV of alpha energy." [Budnitz, August 1978.]*

A growing recognition of possible high levels of radon and its daughter products in various parts of the United States supports the need for more information on the composition of building materials, water, and soil at the residential site, and air change rates. Health concerns may lead to future monitoring of building material supplies and construction sites, as well as determination of air change rate standards. However, in the absence of a generally accepted standard for maximum permissible concentrations of these radioactive elements, and lack of source-strength data in residences, it is difficult to set ventilation standards.

Non-Radioactive Pollutants

A number of other substances can become concentrated within residences as a result of normal in-house activities when fresh air infiltration is minimized. Such substances, which originate in a variety of normal daily activities, have the potential to cause adverse health impacts when concentrated. Table 3-6 presents a listing of some common indoor air pollutants and cites their sources and associated potential impacts.*

**As is indicated in Table 3-6, there are several pollutants that originate outside the house. The infiltration of these will be reduced by caulking, etc., and the indoor air quality thereby improved. However, these reductions will not adequately compensate for the increases that result because the pollutants from these sources cannot leave the building as readily.*

TABLE 3-6. CHARACTERISTICS OF SOME INDOOR AIR POLLUTANTS [Congress, OTA, March 1979]

Pollutant	Major sources	Impacts	Exposure indoors
Sulfur dioxide (SO_2)	Outside air	Risk of acute and long-term respiratory problems in conjunction with particulates	Usually somewhat lower than outdoors
Carbon monoxide (CO)..	Outside air (autos), gas stoves, smoking, infiltration from garage	Headache, dizziness at lower concentrations nausea, vomiting, asphyxiation, death at higher concentrations	Can be high from indoor sources; much outdoor concentration is passed indoors
Nitrogen dioxide (NO_2)..	Outside air, gas stoves, oil or gas furnaces (when imperfectly vented)	Risk of acute respiratory problems, possible long-term respiratory problems, possible increased mortality from cardiovascular disease and cancer	Can be very high, especially when gas stove is operating
Photochemical oxidants	Outside air	Eye irritation, respiratory discomfort; long-term problems not well-understood	Lower than outdoor concentration
Total suspended particulates (including trace elements).......	Outside air and resuspension from physical activity; smoking, asbestos insulation, gas stoves, etc.	Risk of short-term pulmonary effects; some toxic components can have severe and varied effects	Can be very high, especially from smoking; particles in respirable size range dominate
Hydrocarbons.........	Outside air, smoking, pesticides, spray can propellants (fluorcarbons), cleaning solvents, building materials, etc.	Risk of a variety of severe acute and long-term effects	Can be high, also can have continuous low-level concentrations
Radon & radon daughters	Cement, stone, bricks, etc.	Enhanced risk of lung cancer, other cancers	May be significant
Bacteria & spores......	Coughing, sneezing	Spread of respiratory illness	Higher than outdoors

The results of a few recent research projects indicate that indoor levels of several important air pollutants can be as high as or higher than outdoor levels as the result of reduced air infiltration:

- Several studies have shown that household gas stoves can cause high indoor concentrations of carbon monoxide, nitrogen oxides, and fine particulates. Lawrence Berkeley Laboratory [C. Hollowell, April 1978] and other sources have shown that nitrogen oxide emissions from such stoves are sufficiently high to cause kitchen concentrations to exceed the range of recommended one-hour national ambient air quality standards (NAAQS). Some studies have also indicated that carbon monoxide levels may be raised to levels above the short-term ambient standards, but results have been extremely variable from study to study.

- Danish scientists have found high levels (up to nearly twice the legal occupational exposure limit) of formaldehyde in homes that have substantial quantities of particle board and plywood in their structure [OTA, March 1979]. Similarly high levels of formaldehyde concentrations have been found in mobile homes in the United States. And formaldehyde release is associated with a variety of consumer products.

- Several studies have shown that smoking seriously affects the indoor environment. The particulates from cigarette smoking are in the respirable size range; nicotine is the second largest component of the smoke [W.C. Hinde, 1975]. Moderate smoking (a pack a day) can cause particulate concentrations to exceed the 24-hour ambient air quality standard [C. Hollowell, 1978].

Indoor Combustion Emissions

Recent field and laboratory studies have focused on combustion-generated indoor air pollution, principally air contaminants from gas stoves and improperly vented heating systems in residential buildings. Field studies have shown that levels of carbon monoxide (CO) and nitrogen dioxide (NO_2) approach or exceed existing U.S. ambient outside air quality standards in some residential buildings with gas appliances [Hollowell, et al., 1977].

Nitrogen dioxide levels in kitchens of houses with gas stoves were observed to be as high as 0.5 ppm ($\sim 950\ \mu g/m^3$) with one top burner operating for less than 30 minutes and as high as 0.8 ppm ($\sim 1500\ \mu g/m^3$) with the oven operating for less than 20 minutes. Concentrations of NO_2 were observed to be as high as 0.6 ppm ($\sim 1200\ \mu g/m^3$) for

8 hours in the bedroom of a house with a forced-air gas-fired heating system operating under normal conditions. These NO_2 concentrations can be compared with the short-term U.S. and foreign NO_2 ambient outside air quality standards [approximately 0.25 ppm (~470 $\mu g/m^3$) for 1 hour] [Kiyoura, June/July 1976; WHO, 1977; NO_x Control Review, Summer 1978; Cullison, August 1978].

Studies using an experimental room with a volume of 800 ft^3 (27 m^3) have characterized the emissions from a new gas stove operating in this room with air exchange rates varying from 0.25 to 10 air changes per hour (ach) [Hollowell and Traynor, April 1978]. These laboratory studies have shown that gas stoves generate extremely high emissions of such species as carbon monoxide (CO), nitric oxide (NO), nitrogen dioxide (NO_2), formaldehyde (HCHO), and respirable aerosols (size $< 2.5\ \mu m$), and that the concentrations of these species become significant when the air exchange rate is controlled to less than one air change per hour. Table 3-7 gives the one-hour average CO, NO_2, and HCHO concentrations in the experimental room.

TABLE 3-7. CONTAMINANT CONCENTRATIONS IN A TEST KITCHEN*

[Hollowell, et al., June 1979]

Ventilation Conditions	Mechanical Ventilation Rate (cfm)	Air Exchange Rate (ach)	Contaminant Concentrations[a] CO ($\mu g/m^3$)	NO$_2$ ($\mu g/m^3$)	HCHO[b] ($\mu g/m^3$)
No stove vent or hood		0.25	35	2400 (1.2 ppm)	400
Hood vent (with no fan) above stove		1.0	25	1600 (0.8 ppm)	260
Hood vent with fan at low speed	50	2.5	13	800 (0.4 ppm)	140
Hood vent with fan at high speed	140	7.0	3	200 (0.1 ppm)	35
Typical Outdoor Air Concentrations During Test			1.5	50 (0.03 ppm)	10
	Air Quality Health Standards	Concentration	40[c]	470[d]	120[e]
		Averaging Time	1 hour	1 hour	maximum
	ASHRAE Standards for Ventilation Requirements in Kitchens	30-50 cfm (Standard 62-73) 20 cfm (Standard 90-75)			

[a] *1 hour average concentration in center of kitchen in which gas oven is operated at 350 F*

[b] *Calculated from measured emission rate for gas stoves*

[c] *EPA promulgated standard (1)*

[d] *EPA recommended standard (1)*

[e] *European standard (1).*

As noted in Table 3-7, the ASHRAE ventilation requirements for residential buildings are given (ASHRAE, 1973 and ASHRAE, 1975]. The studies indicated that a kitchen ventilation rate of 50 cfm, which is the upper limit recommended by ASHRAE Standard 62-73, appears to maintain CO concentrations at acceptable levels, but results in NO_2 and HCHO concentrations which exceed air quality health standards [Hollowell, et al., January 1979]. Lower ventilation rates as recommended by ASHRAE Standard 90-75 would result in even higher NO_2 and HCHO concentrations. A ventilation rate of at least 100 cfm appears to be required to keep NO_2 and HCHO concentrations to levels within the limits established by air quality health standards [Hollowell et al., June 1979].

Carbon Monoxide

The population exposure to carbon monoxide may, in principle, be increased by some residential energy conservation measures proposed under the RCS Program. Theoretical studies suggest that the indoor concentration of a pollutant with indoor sources will be relatively elevated in residences with lower indoor/outdoor air exchange rates [Silberstein, 1977]. Experimental studies have shown that operation of gas-fired stoves raises the level of carbon monoxide in the room and that higher levels are observed with lower air exchange rates [Hollowell et al., 1979], and that other combustion sources may also contribute to indoor levels of carbon monoxide [Sterling and Kabayashi, 1977].

A forced air heating system which uses combustion of hydrocarbon fuel to generate heat, which has an obstructed flue, which draws air for combustion from inside the residential space, which is located inside a residence with sufficiently low air exchange rate, and/or which has a cracked heat exchanger may not completely oxidize its fuel and hence may contribute carbon monoxide to the interior living space. Kelley and Sophocleus [1978] described three incidents in which a person died from carbon monoxide exposure in homes with bricked furnace flues. Oliver and Potters [1979] in commenting on the proposed rule noted that "in a small, representative sample of 72 of our residential gas customers, we found six heating units spilling products of combustion into the living area due to faulty venting systems." In addition, among the same sample of 72 homes, there were 11 homes in which the heat exchanger or seal were faulty and passed combustion products into the warm air distribution system.

It has been estimated that each year in the United States, 10,000 persons seek medical attention or lose one or more days of normal activity due to carbon monoxide poisoning. Furthermore, about 1,400 persons die each year from accidental exposure to carbon monoxide [Lisella, et al., 1978]. Savage, et al [1976] analyzed 237 cases of carbon monoxide poisoning from hospital records in Colorado and Wyoming from 1971 to 1973. For cities above 6,000 feet elevation, they found an unusual incidence rate of 102 cases per 100,000 population while for elevations less than 6,000 feet the incidence was 23 per 100,000. Also, they found that 33 percent of the cases resulted from episodes in the home and did not involve a vehicle in the garage. Thus it may be that the national incidence rate of residential combustion source related carbon monoxide poisonings requiring hospital attention may approach eight per 100,000 population or about 16,000 cases per year nationally. Savage et al also found that the peak months for occurrence of such cases were January and December, which happens to be the early part of the heating season when more furnaces might malfunction due to lack of attention in the summer.

The Consumer Product Safety Commission has been investigating unvented gas space heaters [CPSC, 1978]. They recently withdrew a proposed ban on the sale of this product [Dunn, 1979]. One reason for withdrawal of the ban was the belief that oxygen depletion sensors would be adequate for the task of reducing carbon monoxide poisoning associated with these products. In principle, a device which shuts off the gas supply to a combustion source when the oxygen content of the combustion air is insufficient for complete combustion could prevent the further buildup of carbon monoxide in the living space.

Potential mitigating measures to the problem of increased carbon monoxide exposure from tighter weatherized houses with malfunctioning combustion heating systems include:

- Installation of oxygen depletion sensors on gas fired furnaces
- Vents to draw combustion air from outside the living space
- Mechanical ventilation to increase the oxygen content of combustion air.

Nitrogen Dioxide and NO_x - Derived Compounds

A recent study in England [Melia, et al, 1977] has compared respiratory illness of children living in homes in which natural gas and electric stoves were used. The investigators concluded that elevated levels of nitrogen dioxide from gas stoves might have caused the increased levels of respiratory illness found to be associated with homes using gas stoves. A study in progress in six cities in the United States has reached similar conclusions in its preliminary analysis [Speizer, et al., April 1979].

Comparing the observed NO_2 concentrations in the studies illustrated in Table 3-7 [Hollowell, et al., 1979] with recommended and promulgated short-term NO_2 air quality standards in Table 3-8 indicates that these standards are exceeded under most conditions of kitchen gas stove operation except very high ventilation. Energy conservation measures which reduce outdoor air infiltration may cause or increase the incidence of potentially hazardous concentrations of NO_2 in residences.

TABLE 3-8. RECOMMENDED AND PROMULGATED SHORT-TERM NO_2 AIR QUALITY STANDARDS

[Kiyoura, June/July 1976; WHO, 1977; Cullison, August 1978]

Country	Short-Term NO_2 Air Quality Standard (0.1 ppm ≈ 190 $\mu g/m^3$)	Status
Canada (Ontario)	0.2 ppm/1 hr 0.2 ppm/24 hr	Promulgated Promulgated
Japan	0.04-0.06 ppm/24 hr	Promulgated
U.S.A.	0.25-0.50 ppm/hr	Recommended
West Germany	0.15 ppm/short-term exposure	Promulgated
WHO/UNEP	0.10-0.17 ppm/hr	Recommended

Many compounds may be derived from the various oxides of nitrogen in the atmosphere, with formation mechanisms and concentrations depending on many factors including the concentration of various nitrogen and non-nitrogen materials present, temperature, humidity, and sunlight. The compounds believed to represent the greatest potential risk to health include nitrates, nitrites, and nitrosamines.

These derived compounds can enter the body through inhalation or ingestion. Ingested nitrates can be converted through normal digestive processes to nitrates, which raise the risk of nitrate poisoning, and to nitrosamines, which potentially raise the risk of stomach and intestinal cancer. Inhaled nitrosamines introduce a potential carcinogen to the lungs; however, there appears to be no evidence that they actually have a carcinogenic effect in the body when introduced in this manner.

Ingestion of NO_x-derived compounds can produce several types of health effects. Nitrate poisoning (cyanosis) can occur when a sufficient quantity of nitrate ions is reduced by intestinal bacteria to nitrites, which, in turn, oxidize the iron in the blood hemoglobin from the ferrous to the ferric state. The resulting substance, termed methemoglobin, cannot function normally in the process of transporting oxygen to tissue. In healthy adults, methemoglobin usually accounts for less than 2.0 percent of the total hemoglobin concentration [National Research Council, 1971]. Infants usually carry higher concentrations of methemoglobin and are more susceptible to nitrate poisoning than are older children or adults because (1) fetal hemoglobin is probably more susceptible to conversion to methemoglobin, (2) bacteria capable of reducing nitrate to nitrite thrive in the less acidic conditions of the infant stomach, (3) the enzyme system for reducing methemoglobin to hemoglobin is deficient in infants, and (4) because intake of water per kilogram body weight is higher in the infant than in audits [Kravitz, et al., 1956]. Cyanosis may be produced at concentrations of about 10 percent methemoglobin. However, symptoms are not likely to become obvious at concentrations less than 20 percent.

The carcinogenic nature of ingested NO_x-derived compounds is less clear. Epidemiological studies have attempted to link ingested environmental nitrates, nitrites, and nitroso compounds with human cancer. The International Agency for Research on Cancer (IARC) investigated a possible association between these compounds in the diet and specific cancers in areas of Iran and France, where these tumors occur at a high rate and in nearby areas where the tumor rates are lower [Bogorski, 1974]. Correlations between dietary intake of nitroso compounds and cancer were not established.

Zaldivar and Wetterstand [1975] and Armijo and Coulson [1975] have shown some correlation between the per capita use of fertilizer and the incidence of stomach cancer in Chile. It has been hypothesized that nitrate from fertilizer first enters the diet by way of meat, vegetables, and drinking water. Nitrates are then reduced to nitrites by microbial action, and are thus available for *in vivo* nitrosation of secondary amines, contained in the diet, to form carcinogenic nitrosamines, which can induce stomach cancer. The suggested causal relationship remains highly speculative. Hill, et al., [1973] correlated variations in rates of stomach cancer with the nitrate content of drinking water in two English towns. However, the evidence required to demonstrate a causal role for nitrate was not provided. Gelperin, et al., [1976] found no statistically significant differences in death rates from cancers of several organs, in three areas of Illinois each with different nitrate content in the drinking water. It is doubtful, however, that the available mortality data permitted an analysis that could have detected an effect among the populations in the high-nitrate area.

The principal health effect of inhaling NO_x-derived compounds appears to be an increased incidence of asthma.

Data from unpublished reports of French et al. [WHO, 1978] indicated that in six of seven study communities in the New York City-Newark metropolitan area, when minimum temperature exceeded 50°F, increases in asthma attacks were correlated with increases in concentrations of atmospheric nitrates. Pooled data from all seven communities indicated that when minimum temperatures exceed 50°F, 40 percent more asthma attacks could be expected when 24-hour mean nitrate levels were 8 $\mu g/m^3$ or higher than when the nitrate levels were 2 $\mu g/m^3$ or lower. Concentrations of NO_2 measured by the chemilumescence method, were not associated with asthma attacks.

There is no evidence that atmospheric nitrates contribute significantly to the <u>in vivo</u> formation of nitrosamines or that inhaled nitrosamines represent significant health hazards.

It is also highly unlikely that certain inhaled NO_x-derived compounds will produce nitrate poisoning. The total weekly ingested intake of nitrate in the general populations of the United States [Ashton, 1970] and in England [Hill, 1973] has been estimated to average about 400,000 to 500,000 μg. Because concentrations in water, in cured meats, and in vegetables vary greatly, as do the quantities of these materials consumed by individuals, the ingestion estimates must be applied with caution. By comparison the worst case for inhaled intake of nitrate would probably find less than 40 $\mu g/m^3$ nitrate in the ambient air [Pitts, 1973]. An adult engaged in heavy exercise, who might inhale 20 m^3 of air per day, could be expected to inhale no more than 5,600 μg of nitrate per week, or less than 1.5 percent of the lowest estimate of total weekly ingested intake. Similarly, this ingested total would not be equalled through inhalation of indoor air. Thus, it is considered to be unlikely that the concentrations of nitrate in the ambient or indoor air contribute significantly to the production of acute nitrate poisoning.

Inasmuch as an effect of the RCS Program would be to increase the quantities of NO_x-derived compounds already present in indoor air for inhalation, and would have no effect on the quantities available for ingestion, the RCS Program is not expected to significantly increase the health effects due to NO_x-derived compounds.

Formaldehyde*

In addition to being a combustion product, formaldehyde (HCHO) is an inexpensive, high volume chemical which is used throughout the world in a variety of products, mainly in urea, phenolic, melamine and acetal resins. These resins are used in large quantities in building materials such as insulation, particleboard, plywood, textiles, adhesives, and many other consumer products such as furniture, clothing, and smoking tobacco.

Total aliphatic aldehydes and formaldehyde have been measured at several occupied and unoccupied energy-efficient research houses at various geographic locations in the United States. It has been determined that at low ventilation rates of 0.3 air changes per hour (ach) or less, the indoor formaldehyde and aldehyde concentrations can exceed the promulgated European indoor formaldehyde standard [Hollowell, et al., 1979] of 120 $\mu g/m^3$. Figure 3-5 illustrates the results of monitoring one of these houses in surburban Maryland. The outdoor concentrations were typically 20 $\mu g/m^3$ (16 ppb) or less.

**See Section 3.2.2.1.8 for a discussion of the generic background of the health implications of formaldehyde in the indoor air.*

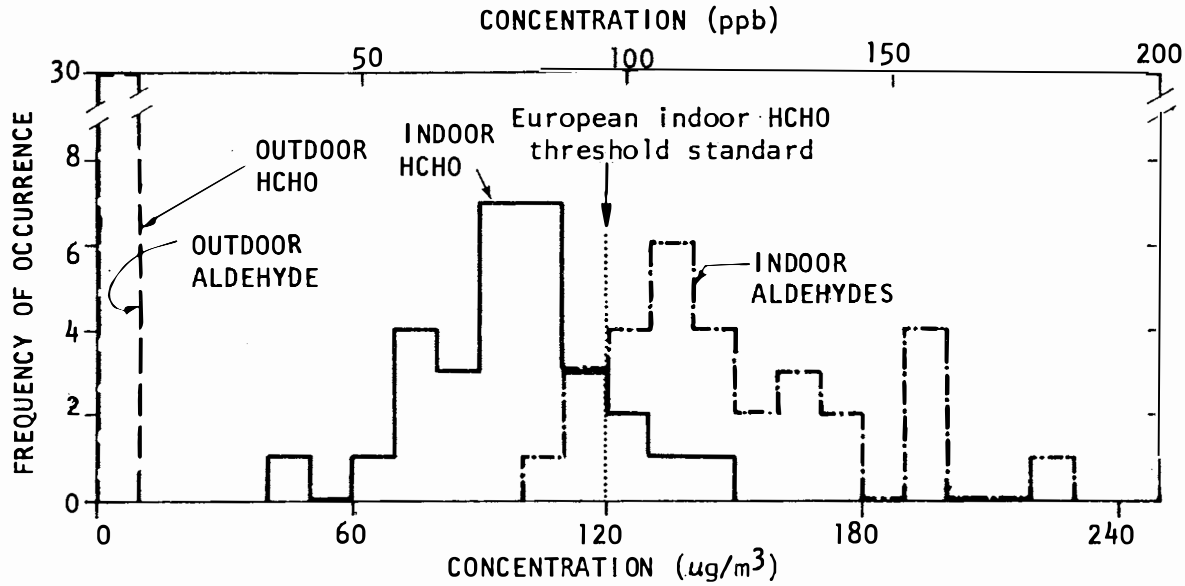

Figure 3-5. Histogram of Indoor and Outdoor Formaldehyde and Total Aliphatic Aldehyde Concentrations

The observed concentrations in this example can be compared with recommended and promulgated formaldehyde air quality standards in Table 3-9. For the air exchange rate of 0.2 ach in the experimental house, which represents an intentional, low infiltration condition which may occur as the result of certain conservation measures under the RCS Program, the indoor formaldehyde concentration exceeds the recommended United States ambient air quality and the European formaldehyde threshold standards.

TABLE 3-9. RECOMMENDED AND PROMULGATED FORMALDEHYDE AIR QUALITY STANDARDS*

Country	HCHO Standard (0.1 ppm = 120 $\mu g/m^3$)	Status	
AMBIENT AIR			
U.S.A.	0.1 ppm maximum	Recommended	[American Industrial Hygiene Association, 1968]
INDOOR AIR			
Denmark	0.12 ppm maximum	Recommended	[Anderson, August/September 1978]
The Netherlands	0.1 ppm maximum	Promulgated	[Baars, September 1978]
Sweden	0.1-0.7 ppm maximum	Recommended	[Sindel, July 1978; Lindvall, August 1978]
West Germany	0.1 ppm maximum	Recommended	[Seifert, May 1978]
OCCUPATIONAL AIR			
Denmark	1 ppm TLV**	Promulgated	[Anderson, et al., 1975]
U.S.A.	3 ppm TWA***	Promulgated (OSHA)	[40 FR 23072; OSHA, 1975]
	2 ppm TLV**	Promulgated (ACGIH)	[American Conference on Governmental Industrial Hygienists, 1978]
	2 ppm/30 min	Recommended (NIOSH)	[NIOSH, December 1976]
West Germany	1 ppm TLV**	Promulgated	[Anderson, et al., 1975]

Sources include: Anderson, August/September 1978; Sindel, July 1978; Lindvall, August 1978; Baars, September 1978.

** *TLV = Threshold limit value*

*** *TWA = 8 hours time weighted average.*

Respiratory Disease from Air Conditioning and Heating Systems

The best known ailment resulting from exposure to soil microorganisms living in heating and cooling systems is hypersensitivity pneumonitis (HP). The acute syndrome of this disease includes chills, fever, cough, dyspnea, and malaise [Metzger, et al., 1976]. Symptoms appear from four to eight hours after inhalation of an organic dust. Since these symptoms are similar to those produced by many other causes, the etiology of the disease was not recognized until the early 1970s.

In one of the earliest reported cases [Fink et al., 1971], the condition of a woman suffering from intermittent cough and dyspnea, associated with several lung function abnormalities and an interstitial granulomatous pneumonitis, improved dramatically after she entered a hospital, although she received no medication. When she returned to her home, the HP symptoms returned. Thermophilic actinomycetes, soil microorganisms which grow in a warm, humid environment, were isolated from the furnace humidifier.

Among the more common thermophilic actinomycetes are *Micropolyspora faeni*, *Thermoactinomyces vulgaris*, *Thermoactinomyces sacchari*, and *Thermoactinomyces candidus*. Both *M. faeni* and *T. candidus* have been implicated in the hypersensitivity pneumonitides called "farmer's lung," "bagassesis," and "mushroom picker's disease" [Fink, et al., 1976].

Once thermophilic actinomycetes were identified as causal agents in HP, several investigations of the home or office air conditioning and heating related systems of HP patients were undertaken. Cases in which these organisms were implicated were reported by Weiss and Soleymani [1971], Sweet, et al. [1971], Tourville, et al. [1972], Kohler, et al. [1976], and Burke, et al. [1977]. A epidemiological study of 272 residents of a midwestern neighborhood was made by Banaszak, et al. [1974], who divided participants into those who exhibited symptoms of HP and those who were asymptomatic. T. vulgaris was found in the air of the homes of 69 of 93 of those with HP symptoms and 32 of 64 of the control group's homes, indicating a significant relationship between symptoms and exposure ($x^2 = 9.67$). In addition, precipitating antibodies against various thermophilic antigens were found with a significantly higher frequency ($p < 0.01$) among symptomatic subjects.

Other agents have been implicated in HP disease. Although Kohler, et al. [1976] suspected T. vulgaris from a home humidifier in one case, rod-shaped bacilli (both gram-positive and gram-negative) were present in the humidifier and bronchial challenge with these bacteria produced the HP symptoms. Pickering, et al. [1976] were unable to identify a particular causal agent in respiratory symptoms among nine employees of a printing factory, although a 2-3 mm thick layer of "slimy growth" was present on the baffle plates through which factory air left a humidifier. When a new steam humidification system was installed, the slime did not form and the respiratory symptoms stopped. Scrapings from the air conditioning unit included the fungal genera Phoma, Penicillium, and Cladosporium, as well as "fairly large numbers of bacteria." Penicillium and Cladosporium are very common in both indoor and outdoor air in a wide variety of climates [Lumpkins, et al., 1973; Lumpkins and

Corbitt, 1976] so it is not surprising that they were found in the printing factory. Aspergillis, another very common fungal genus, was also found in the workplace air.

Metzger, et al. [1976] report a case in which a man developed symptoms of HP after regularly using a home sauna constructed of cedar and redwood. The major antigen was believed to be the fungus Aureobesidium pullulans, which is commonly found in redwood and cedar and is known to produce allergic reactions. The organism was found in the cedar bucket used in the sauna.

After three Swedish office workers developed a fever, minor respiratory leucocytosis and an increase in segmented white cells, Rylander, et al. [1977] found flavobacteria in the office humidifier. Both immunoglobulins and antibodies to Flavobacterium and endotoxin were slightly elevated in these patients.

Smith and Massanari [1977] report on several cases of bacteremia among hospital patients whose rooms were furnished with unused humidifiers. The bacterium Acinobacter calcoaceticus was isolated from the stagnant water in the humidifier units. Although the organism is a relatively mild pathogen, it was able to cause infection by entry into intravenous wounds.

Technical Approaches to Maintaining Indoor Air Quality While Reducing Infiltration

There are several technical approaches available for preserving an acceptable indoor air quality level while at the same time reducing the infiltration of cold or hot outside air. The first of these involves the use of heat exchanging devices in residential ventilation systems. Outside air is warmed or cooled by exchange of thermal energy with the exhaust air in the heat exchanger system. This process reduces the energy needed to heat/cool the air being replaced, while at the same time allowing adequate ventilation to occur.

The second approach involves the use of air cleaning equipment. Such equipment reduces polluting substances after they have been released to the air, thereby maintaining concentration levels in the residence within a safe range. Reduction is usually accomplished via absorption in liquids (often water), adsorption on activated carbon, chemical reaction (oxidation), or electrostatic filter.

The third approach involves reducing the production of polluting substances at their source. This approach stresses efficient design, operation and maintenance of equipment and appliances so that pollutant production (which is often increased due to poor maintenance) is minimized.

A fourth approach involves the use of sealants and coatings on building materials to preclude or reduce radon and formaldehyde emanation into residential living spaces. This approach would minimize the likelihood of human tissue damage from the short-range alpha particles of radon decay.

The first approach involves a significant modification to existing residential ventilation systems. Its use would constitute a change in conventional residential heating/cooling design and practice. The high cost of the retrofit work makes the first approach impractical for a program such as the RCS Program, except for overriding considerations of health in certain areas. A reduction in indoor radon and daughter elements may be accomplished by the removal of small dust particles to which the daughter elements adhere by an electrostatic air cleaner. In areas with potential radon problems, such an approach may be cost effective. The third approach is practical, but it is likely to be much less effective than the first two in preventing the buildup of pollutant levels in a building with a low air exchange rate. The fourth approach in combination with ventilation and filtration presents promise in the control of radon and formaldehyde concentrations.

The health effects associated with reducing the infiltration rate are not well understood. The numerous studies cited in this discussion of the potential problems are part of the on-going effort to develop a better understanding of these health effects. To the extent that reducing the infiltration rate, in fact, exacerbates indoor air quality problems, and these, in turn, produce adverse health effects, the installation of caulking and weather-stripping, etc., could create adverse health effects. The extent of this causal effect is not known, however. Until such time as more conclusive findings are available, DOE has refrained from establishing special precautions for use with weatherization measures installed under the RCS Program.

3.2.2.1.12 Energy Conserving Practices

The energy-conserving practices included in the RCS Program were examined for potential adverse health and safety impacts. None of the practices themselves constitute a health or safety hazard; however, under certain circumstances, the implementation of one of the practices could lead to safety problems.

Each recommended practice is designed to reduce energy usage either by changing a human behavior pattern or by the installation of a low-cost (less than $20) hardware item designed to reduce household energy usage. Each must be able to be installed or practiced independently of the suggested energy conservation measures. The practices included in the Program are:

- Changing the furnace and air conditioning filters
- Installing a flow restrictor in shower heads and faucets
- Installing low-flow shower heads and faucets
- Sealing leaks in pipes and ducts
- Setting back thermostats in winter at nights or when rooms are not in use
- Reducing the thermostat setting in winter during the day
- Setting up the thermostat in summer or turning it off when no one is home
- Reducing the thermostat setting on water heaters
- Closing vents, valves and doors in infrequently used rooms.

In addition, the state governors may designate for inclusion in the state Plan other practices that meet the criteria described above. DOE is also considering adding one other practice, furnace efficiency maintenance and adjustment. This practice would require elimination of the $20 limit on the cost of the practices, and would be accomplished through contractors.

None of these practices, when voluntarily put into effect by a residential customer and used in keeping with common sense and normal safety precautions, is likely to constitute a health or safety hazard. With one possible exception, none of them requires that the customer enter an area of the home or adjust equipment that might constitute an unusual hazard. None of the indirect effects is likely to constitute a hazard to health or safety.

The one possible exception is the recommendation that leaks in pipes and ducts be sealed. There are conceivable scenarios in which an uninformed homeowner could be injured in attempting to implement this practice. For example:

- Many residences have air conditioning ducts that run over unprotected ceilings. In attempting to reach such ducts to inspect or seal them, a customer who does not know that the ceiling will not support his weight may step on the ceiling and fall through to the floor below.

- A customer who attempts to tighten, solder or plug leaks in hot water or steam heating pipes might be exposed to burns and scalding if he has not turned off the water or steam supply and permitted the pipe to cool or if he rapidly restores the supply without testing the repair first.

These practices are commonplace and widely recommended as ways of reducing energy loss. They are likely to be implemented by customers or contractors not under the purview of the Program's compliance procedures; therefore, DOE has no direct means for enforcing the normal safety precautions associated with these practices. Nonetheless, a means such as the Program Announcement might be used to inform residential customers of the appropriate safety precautions and the reasons for observing them.

Any potential health and safety hazards associated with State-proposed energy-conserving practices will be evaluated in connection with the review of the State Residential Conservation Service Plan.

3.3 Impacts Potentially Attributable to the Installation of Renewable Resource Measures

3.3.1 Approach

As discussed in section 3.1, renewable resource measures will be analyzed qualitatively due to a lack of a verifiable estimate of market penetration attributable exclusively to the RCS component of the comprehensive National Energy Act (NEA). In addition to the analysis described in section 3.1, DOE considered active solar penetration estimates prepared for DOE using the SPURR method (an economic simulation model developed for DOE by Mitre Corporation). These subsequent estimates were based upon the cumulative impact of the NEA. Again, demand for solar energy systems resulting from the RCS Program could not be specifically identified.

The cumulative NEA estimates thus have not been used as a quantitative base for analysis of the effects of the RCS component. It also appears that market penetrations occurring as a result of NEA programs may be primarily attributable to tax credits rather than to specific programs such as the RCS. DOE believes that purchases of renewable resources in the foreseeable future will be influenced more by cost considerations and the availability of tax credits than by services of the Program itself.

There are no verifiable published market penetration estimates for either wind or passive solar resource measures. DOE sponsored work is underway, however, to develop such projections for applications of small wind energy conversion systems [Rockwell, May 1979] and for passive solar applications.

Because specific market penetration estimates are not available for renewable resource applications stimulated by the RCS Program, it was not possible to estimate the quantitative national or regional environmental impacts caused by the Program.

In the absence of quantifiable data, DOE has analyzed information available through other Federal programs to support commercialization of renewable resource measures (in addition to publicly available literature) in order to prepare a thorough qualitative evaluation of the impacts potentially associated with renewable resource measures incorporated within the RCS Program.

DOE, in conjunction with the U.S. Department of Housing and Urban Development (HUD), the U.S. National Aeronautics and Space Administration (NASA), the U.S. Department of Defense (DOD), the National Bureau of Standards (NBS), and other Federal agencies, has been involved in the demonstration of solar energy for water heating and space heating and cooling since 1975. Under the National Solar Heating and Cooling Demonstration Program, DOE is funding the installation of over 900 solar systems affecting approximately 11,500 residential units [DOE, September 1978] and approximately 270 commercial solar projects [DOE, January 1979]. In addition, there is a HUD/DOE hot water initiative involving ten states which will affect an anticipated 10,000 residential units [HUD, March 28, 1977].

The evaluations and experience generated from these demonstration programs have been taken into account in the following analysis. Project experience information will continue to be made available from existing programs providing additional data to be drawn upon in the administration of this Program.*

3.3.2 Potential Impacts

Renewable resource measures have potential environmental impacts in four categories. The impact categories include: (1) air quality; (2) water quality; (3) land use and aesthetic impacts; and (4) structural or other on-site impacts. Table 3-10 provides an overview of these environmental concerns, identifies the potential impact of the measures upon each category, and identifies strategies to minimize or eliminate adverse potential impacts. More detailed analyses of potential site-specific impacts are set forth in Section 3.3.4 for the renewable resource measures.

In connection with the Program implementation, all approved plans, as previously described, must be conducted in conformance with Program standards and State and local codes and ordinances. Each solar and wind application must necessarily comply with applicable environmental laws. In addition to these existing laws and regulations that form the background for environmental compliance, the Program contains specific standards to insure that potential risks to the natural and man-made environments are minimized.

On the basis of practical experience with its residential solar demonstration program, HUD addressed environmental concerns for passive and active solar heating and cooling systems through its Intermediate Minimum Property

**This analysis of the potential environmental impacts for renewable resource measures in the RCS Program is based upon information and data contained in previous environmental analyses, documents available in the literature addressing the environmental impacts of the renewable resource technologies which may be included in the RCS Program, and information from other sources.*

TABLE 3-10. OVERVIEW OF POTENTIAL ENVIRONMENTAL CONCERNS OF RENEWABLE RESOURCE MEASURES

Potential Environmental Concern	Strategies to Minimize or Eliminate Potential Concerns
I. AIR QUALITY IMPACTS	
A. Active Solar Systems	
1. Outgassing Contamination	
a. Insulation	Allow for proper atmospheric dispersion.
	Use proper insulation, selection of materials, and pretreatment of insulation when applicable.
b. Fire Conditions	Coordinate start-up time of system to closely follow installation.
	Follow proper MPS fire safety and materials standards.
	Adhere to local fire ordinances.
	Utilize proper firefighting equipment.
2. Manufacturing	Enforcement of existing environmental laws pertinent to each industry where production increase is significant.
B. Passive Solar Systems	
1. Degradation of Air Quality	
a. High Humidity	Follow local/State building codes concerning ventilation
b. Mold and Fungus	Use of fungicides and other cleaning materials; ventilation (as per codes).

TABLE 3-10. (continued)

Potential Environmental Concern	Strategies to Minimize or Eliminate Potential Concerns
c. Pollutants (CO, Formaldehyde, Radon)	Follow State codes re: ventilation
C. Wind Energy Conversion Systems	
1. Manufacturing	Enforcement of existing environmental laws pertinent to each industry where production increase is significant.
II. WATER QUALITY IMPACTS	
A. Active Solar Systems	
1. Potable Water Contamination	Use double-walled exchangers. Employ effective, non-toxic working/storage fluids (studies on-going as noted in text). Adhere to MPS equipment, systems, and materials standards.
2. Contamination Caused by Disposal of System Fluids	Use catch basins for dilution and holding of toxic working fluids. EPA regulates disposal of fluids and requires monitoring of groundwater near disposal sites. Utilize test results from studies on the impact of effective chemical load of sewage treatment plant efficiency. Monitor environmental effects on waterways and groundwater of low-level contamination via long-term data collection.
3. Manufacturing	Enforcement of existing environmental laws pertinent to each industry where production increase is significant.

TABLE 3-10. (continued)

Potential Environmental Concern	Strategies to Minimize or Eliminate Potential Concerns
B. Passive Solar Systems	
1. Potable Water Contamination	Employ effective, non-toxic working/ storage fluid - (studies on-going)
2. Contamination Caused by Disposal of System Fluids	Use catch basins for dilution and holding of toxic working fluids.
	EPA regulates disposal of fluids and requires monitoring of groundwater near disposal sites.
	Utilize test results from studies on the impact of effective chemical load on sewage treatment plant efficiency - (studies on-going).
	Monitor environmental effects on waterways and groundwater of low-level contamination via long-term data collection.
	Use catch basins for dilution and holding of toxic working fluids.
	EPA regulates disposal of fluids and requires monitoring of groundwater near disposal sites.
3. Manufacturing	Enforcement of existing environmental laws pertinent to each industry where production increase is significant.
C. Wind Energy Conversion Systems	
1. Manufacturing	Enforcement of existing environmental laws pertinent to each industry where production increase is significant.

TABLE 3-10. (continued)

Potential Environmental Concern	Strategies to Minimize or Eliminate Potential Concerns
III. LAND USE & AESTHETIC IMPACTS	
A. Active Solar Systems	
1. Zoning and Solar Access	Use local zoning and planning procedures.
2. Aesthetics of Design	Use local zoning and planning procedure. Use shields to conceal structures.
B. Passive Solar Systems	
1. Solar Access	Use local zoning and planning procedures.
2. Aesthetics of Design	Use local zoning and planning procedures, where applicable.
C. Wind Energy Conversion Systems	
1. Siting/Zoning of Wind Structures	Use local zoning and planning procedures.
2. Electromagnetic Radiation Interference	Not needed.
3. Noise	Siting per local codes. Appropriate maintenance of systems.
4. Visual Disruption of Landscape	Use local zoning and planning procedures.
IV. STRUCTURAL & OTHER ON-SITE IMPACTS	
A. Active Solar Systems	
1. Risk of Credible Accidents	Adhere to MPS standards for load requirements, thermal stress issues, and for hail, snow, wind and seismic loads. Adhere to local/state building codes.

TABLE 3-10. (continued)

Potential Environmental Concern	Strategies to Minimize or Eliminate Potential Concerns
b. Glass Breakage	Fence, screen or shelter collector system from public for safety and from possible vandalism. Use heat-tempered glazing and develop less hazardous non-glass glazings through research.
c. Glare	Proper placement of collectors. Treat glare-causing surfaces with non-glossy coatings.
d. Maintenance, Installation and Design	Use proper designs for safe maintenance and installation, per MPS requirements. Provide a detailed installation, operation and maintenance manual with each solar system, per MPS requirements.
B. Passive Solar Systems	
1. Risk of Credible Accidents	
a. Design Loads	Adhere to local/State building codes.
b. Glass Breakage	Fence, screen or shelter collector system from public for safety and from possible vandalism. Use heat-tempered glazing and develop less hazardous non-glass glazings through research.
c. Glare	Proper placement of collectors. Treat glare-causing surfaces with non-glossy coatings.

TABLE 3-10. (continued)

Potential Environmental Concern	Strategies to Minimize or Eliminate Potential Concerns
d. Maintenance, Installation and Design	Use proper designs for safe maintenance and installation. Provide a detailed installation, operation and maintenance procedure for each solar system.
C. Wind Energy Conversion System	
1. Risk of Credible Accidents	
a. Blade Failure	Adhere to rule which establishes minimum distance of tower from structure.
b. Tower Failure	Adhere to rule which establishes minimum distance of tower from structure.
c. Maintenance, Installation and Design	Adhere to rule which requires certification by manufacturer or his designated representative that system is correctly installed, and inspection by local government. Provide a detailed installation, operation and maintenance procedure for each installation.

Standards (MPS) for Solar Heating and Domestic Hot Water Systems [HUD, 1977(a)].* The environmental and safety considerations for solar heating and cooling applications have also been addressed in a series of National Bureau of Standards (NBS) and DOE reports and publications [DOE, December 1, 1977; Waksman, September 1978; Searcy, December 1978; DOE, September 1978; DOE, April 1979(b)]. The criteria, standards, and considerations referenced above were developed to provide specific guidelines for technical performance for use by solar designers, manufacturers, and builders; and to provide a basis for the continuing development of definitive performance standards and criteria as solar energy technologies mature. The Program requires solar domestic hot water heaters and active solar space heating systems to be constructed and installed in compliance with the HUD Intermediate Minimum Property Standards Supplement [HUD, 1977(a)].** DOE is developing standards for thermosiphon hot water heaters and solar swimming pool heaters.

To the greatest extent possible, the MPS and solar supplements are based upon current state-of-the-art practices and on nationally recognized standards and model codes. The origins of the specific provisions of the MPS are identified within the MPS itself. There are no known significant controversies regarding the effectiveness of the MPS in protecting public health. Controversies do exist, however, regarding alleged potentially overstringent requirements in some areas (e.g., costs associated with documentation and testing; and costs associated with providing protection equivalent to that provided by the use of double wall heat exchangers).

**The Minimum Property Standards (MPS) were developed to provide a sound technical basis for the planning and design of housing under numerous programs of the Department of Housing and Urban Development (HUD). The "Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems" were prepared as a supplement to the MPS and deal with aspects of planning and design that are different from conventional housing by reason of the solar system under consideration.*

***The solar supplements are currently being reviewed by HUD. At such time as supplements are revised, DOE will consider the effects of any revisions upon the RCS Program.*

DOE has determined that standards for passive solar measures are not necessary.* Passive measures are essentially design elements of a building structure, and, in many cases, could employ standard building materials and practices. This is especially true for potential retrofit applications sought by the RCS Program. Compliance with State and local codes and ordinances should minimize any potential adverse impacts associated with installation of passive solar measures. It is believed that periodic cleaning of residential passive systems and ventilation will mitigate potential problems. These matters are discussed further in this chapter.

Thermosiphon water heaters are solar energy systems which have many of the technical attributes of both active and passive systems. The thermosiphon employs many components common to a conventional active solar hot water and space heating system (e.g., conventional collectors). However, the thermosiphon is conceptually very similar to a passive solar heating system in that heat transfer is accomplished by convection rather than by pumps or fans.

In the worst case, potential impacts are likely to be similar to those discussed under site-specific air quality impacts (outgassing) for active solar systems. However, because thermosiphon systems do not use air as a heat transfer medium, radon is not considered to be a potential problem. Because thermosiphon systems do not utilize inhibitors or antifreeze, contamination of potable water or ground water is only a very remote possibility.

**Passive solar space heating and cooling systems present special problems. First, it is a developing technology whose growth could be inhibited by premature Federal Standards, especially those increasing costs unnecessarily. In addition, the numerous passive solar devices vary greatly in cost, heating/cooling output, and method of installation and use. These factors mitigate against prescribing any standard for installation or materials for passive systems at this time.*

Swimming pool heaters vary widely in their physical properties, and can be divided into two types: those of simple, low-technology construction, and those employing flat plate collectors. The simple units, typically, can be installed by the consumer. DOE's ongoing assessment of these simple units has not demonstrated a need for standards to protect consumer health or safety. Thus, DOE has determined that no standards are necessary for this class of swimming pool heaters.

DOE is developing standards for pool heaters employing flat plate collectors or utilizing a non-potable heat-transfer fluid. One option would be to require them to be installed in conformance with the HUD Intermediate Minimum Property Standards [HUD, 1977(a)]. These heaters represent a small portion of the current sales of solar pool heating systems. Additionally, these heaters employ components that are very similar (often ordered from the same suppliers) to the components utilized in solar hot water heating units and active hydronic space heating systems. Thus, in the worst case, these heaters will demonstrate the same environmental characteristics as the other active solar systems.

Less data exists on residential applications of Wind Energy Conversion Systems (WECS) than solar active and passive technologies. No Federal standard analogous to the HUD/MPS currently exists for WECS.

3.3.3 National/Regional Impacts

3.3.3.1 Pollutant Emission Increases

An assessment of the RCS Program using an Input/Output Model indicates that the manufacture of active solar measures will require the increased utilization of resources including: aluminum, copper, glass, steel and fiberglass (glass reinforced plastic) [Science Applications, Inc., September 1978].

Applications of passive solar systems will result in some increased use of various building materials, such as glass, brick, and insulation. Materials used in the manufacturing of wind energy conversion systems include fiberglass, aluminum, copper and steel.

Airborne and waterborne pollution emissions associated with the extraction and preparation of these materials and their subsequent fabrication into renewable resource measures may increase due to the applications resulting from the RCS Program. The environmental issues associated with the extraction and manufacturing of these materials has been assessed in Section 3.2.1.1. However, the sales of renewable resource measures directly attributable to the RCS Program will probably be relatively small because of their present relatively high initial costs and relatively long payback periods. Moreover, because the production of renewable resource measures is expected to be dispersed across the United States, DOE anticipates a minimal impact upon emission of air pollutants.

3.3.3.2 Pollutant Emission Reductions

The reduction in energy derived from conventional sources will result in a reduction in emissions associated with the sources. Because electric resistance space and water heating is relatively more expensive, on a national scale, it is assumed that households using these forms of heating will be more likely to utilize renewable resources than households relying on oil or gas for these purposes. Therefore, the pollutants whose emissions would most likely be reduced are those produced from burning of fossil fuels in electric power plants.

Care must be taken not to overemphasize the benefits realized from the substitution of renewable resources for conventional fuels. The displacement will affect primarily the quantity of fuel consumed. Because the total energy expected to be displaced by renewable resources measures as a result of the RCS Program is small, the benefits resulting from reduced emissions will also be small.

3.3.3.3 Net Pollution Impact

The RCS Program will probably result in a reduction in pollutants from conventional energy use (primarily electric production) and an increase in pollutants associated with the manufacture of the renewable resource equipment. Because of the lack of quantitative data, no quantitative estimates of pollutant increases or decreases are possible. Net impacts resulting from the installation of renewable resource measures within the RCS Program will be minor because of the relatively small changes in electricity production and manufacturing occurring as a result of the Program.

3.3.4 Site-Specific Impacts

As previously discussed, verifiable data concerning the degree of potential site-specific impacts associated with the installation of specific renewable resource measures are not available to the extent necessary to perform a quantitative analysis of impacts. Qualitative research [HUD, 1977(a); DOE, December 1, 1977; Waksman, September 1978; Searcy, December 1978; DOE, September 1978; DOE, April 1979(b)] data are available to assess potential site-specific impacts.

In every case where DOE could not definitively conclude that an impact would not exist, analysis of the potential concern is presented on a worst case basis. Mitigating measures to minimize or eliminate potential impacts are discussed in relation to each measure.

In the case where the standards and criteria are imposed but not effectively enforced, however, adverse impacts could occur at a level somewhere between the described worst case and the minimal level contemplated under full compliance with the rule.

3.3.4.1 Air Quality

Collector outgassing due to overheat or building fire is of concern, as are the ventilation reductions motivated by reducing heat losses. Program standards and State and local codes are directed toward mitigating these concerns.

3.3.4.1.1 Active Solar Systems

Outgassing

If solar collectors overheat due to stagnation conditions (that is, exposure to the sun without heat removal via heat transfer fluid circulation, caused, for example, by the unlikely failure of the pump or a valve), organic chemical compounds which are often present in the insulation materials, or result from their degradation, may be discharged. This phenomenon is known as "outgassing." Its occurrence is often evidenced by a thin film (coating) of condensable products on the collector glazing. Most fumes released during outgassing are simple starches that are used as binders for many inorganic insulation materials (e.g., fiberglass). Outgassing impacts are minimized due to containment within the collector unit or, if vented, due to rapid atmospheric dilution and the dispersed locations of collectors. These outgassed fumes can be minimized through design and operation procedures discussed later in this section. DOE does not believe that fumes from outgassing during stagnation periods constitute a significant health problem. Actual field experience has shown that fumes from outgassing during stagnation periods rarely pose a health hazard [DOE, December 1, 1977].

In an extreme case of collector over-temperature conditions, a fire may occur. This may occur through fire involvement of another portion of the building. In such conditions, several highly toxic fire gases including ammonia, carbon monoxide, hydrogen chloride, hydrogen cyanide, and hydrogen sulfide may be released in addition to normal fire gases from building materials. These gases would be the fire products of the heat transfer fluid, plastic caulking or glazing materials, and urethane insulation used in the collector construction [National Fire Protection Association, January 1976].

A severe fire may produce sufficient quantities of these hazardous gases to result in additional jeopardy to the health and safety of building occupants and fire fighters. As in any extreme fire condition, the entire building structure would pose a safety threat to fire fighters and occupants. As in the fire involvement of any building, fire fighters may have to use self-contained oxygen equipment. It is expected that persons in the general area will avoid potential fume and fire dangers by responding promptly to alarms and evacuating the immediate vicinity of the building.

To further evaluate the combustion/outgassing issue, DOE has funded ongoing research into such matters as: identification of components of complex combustion/degradation breakdowns; toxicity screening and short-term toxicological testing of combustion materials; and estimates of the transport and dispersion behavior of point source combustion products [Searcy, December 1978; DOE, September 1978; DOE, April 1979(b)]. Substantive results will be available in several years. As additional information is forthcoming, Program standards will be reviewed.

The current state of knowledge with respect to active system combustibility and toxicity can be summarized thus:

"...in recent years considerable research has been conducted on products formed by combustion from a variety of (solar system) materials. These studies have not identified any significantly hazardous materials. Some confirmatory studies are presently underway. Additionally, a recent study using atmospheric dispersion models indicate that human exposure via atmospheric transport would be insignificant." [DOE, September 1978]

Radon*

Some solar space heating systems use rocks as the storage medium for solar-collected thermal energy. Typically, for these systems, air is heated in solar collectors. Then the heated air is passed through a bed of rocks, to which the solar thermal energy is transferred. Heating of the residence is obtained by passing air across the heated rocks, drawing off the stored thermal energy from the rocks, and venting the heated air into the residence.

This type of solar space heating system may create potential problems of radon exposure to the occupants of the residence. As discussed in section 3.2.2.1.11, unusually high levels of radon are released by some types of rocks. Should such rocks be used as the heat storage medium, the solar space heating system could draw radon and its daughter products into the residence. And use of rocks with lesser levels of radon release could potentially cause high radon concentrations if outdoor air exchange rates are low, which is typical of solar-heated homes.

**See section 3.2.2.1.11 for a discussion of the generic background of the implications of radon in the indoor air.*

The potential health problems that could be caused by this exposure to radon would be analogous to those discussed in section 3.2.2.1.11 since the exposure phenomena would be the same as for the conservation measures. The extent of the health problems potentially caused by the solar application could differ, however, and this matter is under active investigation.

A preliminary and conservative worst-case estimate of the contribution of rock storage to Rn^{222} concentration levels in a solar-heated house has been made. A simple model which accounts for radioactive decay of the Rn^{222}, air change rate, outdoor level and the rock source was applied to an 1800-ft^2 house utilizing either a nominal 20×10^3 or larger 60×10^3 lbs of rocks. For a uranium concentration of 10 ppm in 20×10^3 lbs or 3 ppm in 60×10^3 lbs, and air change rate of 0.2 per hour will lead to about $3\frac{Pci}{\ell}$ of Rn^{222} (0.03 WL* assuming equilibrium with Rn^{222} daughters) in less than a day. No other sources of radon are accounted for in this estimate. This level of radon would exceed the preliminary State standards discussed in section 3.2.2.1.11.

DOE is continuing its examination of the problems associated with the use of rock storage for solar heating. Alternatives to the present rock storage methods are also being explored, as well as feasible ways to minimize any potential problems created by solar rock storage systems.

**A Working Level (WL) is defined as being "the unit equating with a concentration of decay products of radon in one liter of air which results in the release of 1.3 x 10^5 MeV of alpha energy"*

Microorganisms*

Additional potential air quality impacts associated with active solar heating and cooling systems concern the formation of microorganisms. The problem is germane to residential heating systems in general, and solar heating systems employing rock storage in particular. Although it has been established that airborne pathogens can grow in home heating and air-conditioning systems, two issues need further investigation in order to better understand the phenomena and relate the problems posed here in terms of residential heating and cooling systems, in general, to solar space heating systems employing rock storage.

- The microenvironmental conditions required for more serious airborne pathogens than thermoactinomycetes to grow

- The microenvironment of rock-based heat storage systems, in terms of the variables which affect microbial growth

Conditions Required for Growth

Knowledge of the autoecology of medically significant bacteria, actinomycetes, fungi, and viruses is necessary to determine ranges of conditions under which growth is likely to occur in heat storage systems. Parameters which need to be understood include temperature, humidity, pH, types of physical substrates on which the organisms are known to live, nutrient requirements, and

**See section 3.2.2.1.11 for a discussion of the types of microorganisms and the generic background and implication of these microorganisms in residential air handling systems.*

whether the organisms are aerobic, anaerobic, or facultatively anaerobic. Ranges of growth rates under different conditions should be ascertained. Toxins produced by the organisms should be identified. Finally, the viability of these organisms, including spores, in the air should be taken into account.

Characterization of Storage System Environment

The microenvironment of a rock-based heating system needs to be more fully understood in order to gauge its suitability as a breeding site for pathogens of interest. Important variables include:

- Air and surface temperatures
- Surface moisture (density, pH, chemical composition)
- Chemical composition of the rock surface
- Availability of nutrients
- Local humidity
- Presence of competitor and predator organisms.

Mitigating Measures

Potential dangers of outgassing from solar collectors can be prevented by proper system design and materials selection. This involves the selection of insulation materials which will exhibit thermal and chemical stability at maximum collector temperatures as measured during stagnant or "no-flow" conditions. In addition, certain types of insulation may be pretreated before being installed in collectors. This pretreatment involves the heating of the insulation to expel volatile materials. The upper temperature limit for fire resistance of fiberglass insulation with organic binders may also be somewhat increased as a result of such pretreatment.

The National Solar Heating and Cooling Demonstration Program experience reinforces the conclusion that the problem of potential outgassing can be dealt with by using appropriate procedures. Procedures recommended by the Project Experience Handbook [DOE, DOE/CS-0045/D] include:

- Ensuring that collector structures can withstand stagnation temperatures when a building is not in use due to power failure, lack of occupancy, or construction activities;

- Checking prior to operation for outgassing of inorganic materials fogging collector glazing;

- If necessary, protecting collectors against high stagnation temperatures which may occur following installation but before startup. To minimize possible stagnation damage, scheduling installation to occur shortly before system turn-on;

- Evaluating insulation for collectors to ensure that it will be free from swelling during stagnant conditions; and,

- Choosing a collector with an absorber plate coating suitable to withstand protracted stagnation conditions.

Correct labeling of system materials and strict adherence to manufacturers' installation guidelines will help assure the success of this approach. When these actions are taken, the likelihood of adverse impacts due to outgassing should be minimized. The site-specific and dispersed nature of this Program will further diminish potential outgassing problems.

The Program relies upon materials, design, and installation standards governing active solar space and water heating systems that will keep to an insignificant level potential air quality impacts arising from the use of active solar systems installed under the RCS Program guidance. These standards cover design, insulation, installation, insulation materials, and systems testing [HUD, 1977(d)].

Alternatives for mitigating radon concentrations in indoor air are discussed in Section 3.2.2.1.11. The use of rock storage for solar heated homes should include similar considerations. Several other alternatives exist for controlling indoor radon levels, but their efficacy has not been evaluated. These would include coatings on storage rock to reduce radon emanation, filters in the air circulation system through the storage, and use of materials other than natural stone for a heat storage medium.

Control Methods

If biological growth in rock-based heat storage systems is determined to pose a health problem, then one option would be to implement control measures. Control strategies could include application of microbicides and/or fungicides, treating the rocks to make nutrients unavailable, system design changes to increase or decrease airflow and condensation, specification of operating parameters to minimize growth, and use of air cleaning devices such as filters. Side effects from use of any particular control technique should, of course, be identified. Certain measures to minimize microbiological health risks, such as air infiltration, could also serve to minimize release of radon into the residence.

Long-range studies are continuing to examine further the potential environmental effects of microorganisms on air quality in living spaces [DOE, June 1979]. The HUD MPS, which the Program requires for active systems, require that components and materials used in solar heating, cooling, and hot water systems shall not promote the growth of fungi, molds, or mildew [MPS Section S-600-6.7].

3.3.4.1.2 Passive Solar Systems

There are several potential adverse air quality impacts which could occur as a result of a passive solar retrofit. Buildings modified to capture and store solar heat tend to be better sealed and can therefore potentially suffer from degradation of interior air quality. The potential health effects associated with tightening the sealing of a building (or reducing the air exchange rate) are discussed in Section 3.2.2.1.11.

There are also potential adverse health effects associated with the formation of molds and fungi in some passive systems. Spores of fungi are a major allergenic pollutant. Mold and fungi could disperse into the atmosphere within the building. These potential health effects can be minimized, however, by normal household cleaning and ventilation.

3.3.4.1.3 Wind Energy Conversion Systems (WECS)

Wind energy devices encompass equipment using wind energy to produce energy in any form for personal residential purposes. Because of the relatively small, diversified nature of these devices, they are not expected to impact air quality in any material manner.

3.3.4.2 Water Quality

Active or passive solar systems that utilize an antifreeze might have the potential to impact water quality. These potentials arise from four cases:

- Improper installation resulting in leaks
- Fluid spills during installation and maintenance
- Improper disposal of fluid, and
- Damage resulting from freezing.

Potential problems involving passive systems using fluids to store heat are considered to be insignificant because these systems are not anticipated to be built as a result of the RCS Program. This is because such systems are more expensive than other passive techniques and because the addition of water storage requires modifications which raise system costs to such levels that homeowners acting under the RCS Program would be expected to choose other methods of energy conservation.

3.3.4.2.1 Active Solar Systems

Contamination of Potable Water Supply

A primary concern in solar system design is to avoid or eliminate potential health impacts related to heating potable water (drinkable water). The heat transfer fluids themselves (e.g., glycol fluids) or, in a water-based system, the various additives used as corrosion inhibitors, pH controllers, freeze protectants, and bactericides, could potentially contaminate water supplies and pose a health hazard if proper precautions are not followed. DOE has sponsored research to determine how a potable water system could be contaminated by a heat transfer fluid and to determine the toxic characteristics of various typical heat transfer fluids. In addition, research and development [DOE, May 1978; DOE, June 1979] is ongoing to develop nontoxic inhibitors and protectants. Results from these ongoing studies should be available in the near future.

The solar system heat transfer fluid typically heats potable water through a heat exchanger. Solar energy systems using liquid and/or air as heat transport media may require one or more heat exchangers. These are used to transfer heat between two different media while preventing mixing or contamination of one by the other. Several types of heat exchangers are available to fill the needs of the various applications. For the RCS Program, for which the HUD Intermediate Minimum Property Standards Supplement has been specified, solar energy systems using a compatible fluid must incorporate a double wall heat exchanger (or provide equivalent safety) [HUD, 1977(f)].

Some of the materials used in the working fluids are potentially toxic. The toxicities of many of these potential working fluids and additives have been identified, based on experience in other industrial sectors at this time. The Environmental Development Plan documents 12 commonly used fluid additives [DOE, June 1979] which are toxic to varying degrees. The glycols used as freeze protectants, identical to the commonly used car radiator antifreeze solutions, are regarded as moderately toxic.

Long-term research being conducted within DOE upon such matters as short-term toxicological screening and testing, reviewing of available information on toxicological materials, and assessing controls needed to mitigate impacts from toxic materials will significantly reduce some current uncertainties associated with the potential hazards of solar working fluids. In particular, the Environmental Readiness Document [DOE, September 1978] enumerates several concerns relative to toxic fluids and leakage and notes that further studies are in preparation and underway on the identification of working fluids presently used or under consideration. In those instances where there is some question on the toxicity issue, this document calls for further confirmatory studies.

While various toxic chemicals are used in some working fluids, the Environmental Readiness Document [DOE, September 1978] stresses that none of them present a significant concern so as to compromise the solar application objectives of the Program. Nontoxic fluids and additives are also being investigated for solar energy system use. Research and development work is underway with the goal of developing effective, nontoxic, and inexpensive heat transfer fluids [DOE, May 1978].

Thermal storage media may include molten salts, organic waxes, or plastic/paraffin capsules for liquid systems, and rocks, metal fillings, silica gel, or ceramics for air systems. Leakage control can be facilitated by the proper design and test criteria (as set forth in the MPS Sections S-515-7, S-601-12). A current DOE study is designed to identify solar energy system materials, including storage media, and publish a list of acceptable materials [DOE, June 1979].

Contamination of Surface Water and Soil

Another concern associated with the site is that improper disposal, spillage or leakage of solar system fluids could contaminate surface waters and soil or seriously affect the operation of local sewage treatment plants. The issues in this instance are that many of the liquid working fluids and/or storage media used in solar heating and cooling systems will degrade over time and periodically must be flushed and replaced. In addition, there is the possibility that these fluids may leak as a result of system failure.

As noted earlier, several ongoing studies are being conducted to assess the effect of toxic fluids on potable water, sewage treatment facilities, soil, vegetation, and groundwater. These include:

- <u>Solar Heating and Cooling Waste Disposal Impact</u> (Sandia Laboratories. Presently being completed.)

- <u>Hazardous Properties and Environmental Effects of Materials Used in Solar Heating and Cooling Technologies</u> (Sandia Laboratories. Several interim handbooks will appear on this subject with final publication estimated for August, 1980).

- <u>Potential Effects of Solar Heating and Cooling Fluids Related to Ecosystems</u> (Los Alamos Scientific Laboratory. Ongoing.)

Results of these studies will provide data on the environmental impacts of solar heating and cooling fluids, additives, and storage media, and advance the state of the art regarding measures to further decrease or eliminate these potential problems.

Mitigating Considerations

The standards set forth as an integral part of this Program require that certain actions be taken to eliminate the potential problems related to solar active space and water heating. The Program standards require that special solder be used on joints and that all joints be tested to ensure that leaks are not present. The standards also require that heat transfer fluids [HUD, 1977(b)] be compatible with metals used in the system to prevent system degradation and potential leakage [HUD, 1977(e)].

The Program standard requires that heat exchangers (the point at which such contamination might occur) be designed with a minimum of two walls or interfaces between the nonpotable fluid and the potable water supply. The standard [HUD, 1977(f)] also provides that equivalent safety may be provided by other means, but specifically prohibits the use of only a single wall system.

The Program standards further require proper disposal of fluids and contain [HUD, 1977(h)] standards for catch basins as a part of each installation [HUD, 1977(c)]. Further, the standards require operation and maintenance manuals to be provided to the purchasers to assure that routine maintenance is properly performed [HUD, 1977(g)]. It is believed that compliance with the Program standards will eliminate these potential problems.

While it is believed that compliance with the Program standards will eliminate these potential problems, surveys may be necessary in the future to determine whether users are following the maintenance manuals. If dependence upon purchasers to maintain systems properly proves to be unsatisfactory, then design improvements to reduce this dependence may be necessary.

In systems installed in areas subject to freezing temperatures a potential may exist for damage resulting from freezing. The Program standard requires actions to eliminate this potential problem [HUD, 1977(i)]. Freeze protection by one of several methods including drainage or antifreeze is required by the standard. It is believed that the compliance with these requirements eliminates the potential problems that may affect water quality arising from freeze damage.

Any flushing disposal problems which may occur through non-compliance with provisions of Program standards are further subject to provisions of the Resource Conservation and Recovery Act.

3.3.4.2.2 Passive Solar Systems

Water used for Trombe wall thermal storage and roof pond heating or cooling could contain antifreeze additives. Where used, the handling and disposal of these materials present the same potential environmental impact problems as do the heat transfer and storage fluids used for active solar systems. Localized problems of pollution could result were there fluids to be discharged into surface or groundwater. The mitigating measures for environmental protection presented for the active solar systems are also appropriate for passive applications.

The nature of the RCS Program and the cost of roof pond systems will probably result in very few of these systems being installed as a result of the RCS Program. The passive systems most likely to be included in the RCS Program encompass selective shading, sunspace (greenhouses), and direct gain. These systems do not employ liquid materials.

3.3.4.2.3 Wind Energy Conversion Systems

Small WECS are not expected to impact water quality in any material manner.

3.3.4.3 Land Use and Aesthetic Impacts

3.3.4.3.1 Active Solar Systems

Research and experience indicate that aesthetic considerations are not likely to be a significant barrier to widespread residential solar applications. This subject is discussed fully in Chapter 7, where it is noted that many architects have found solar energy systems to be compatible with even the most traditional designs for both new and retrofit installations. A forthcoming publication [A. Piscope, forthcoming] presents numerous examples of active solar systems that have been installed in ways that significantly enhance their architectural integration into the existing residential structure. The discussion of Chapter 7 also notes that site inspections, the literature concerning legal aspects of solar applications, and DOE/HUD Demonstration Program records indicate that aesthetic considerations have been an issue in relatively few cases, and that the issues were satisfactorily resolved in most cases.

The utility of yard space may be impaired as the result of installing renewable resource measures. The location of solar collectors at ground level will have such an impact. Solar collector siting could utilize roof areas that are properly oriented and unshaded to avoid this impact.

3.3.4.3.2 Passive Solar Systems

Passive system design necessitates the integration of the solar system into the overall building design. The comments as to aesthetic impacts cited above for active systems also apply to passive systems. Aesthetic impacts will also be mitigated by the requirement that passive buildings will be regulated through the local zoning board to insure community acceptance.

3.3.4.3.3 Wind Energy Conversion Systems

A recent analysis of public reaction to wind energy systems [University of Illinois, 1977] indicated that over 80 percent of the people surveyed were favorably disposed to the use of wind energy as a means of generating electric power. All of the possible classes of sites for wind systems were viewed favorably by the survey sample. The use of wind systems along shorelines met the greatest opposition; but, even in that case, over 75 percent of those surveyed indicated approval of wind turbine siting in wasted areas. Since the bulk of potential residential sites for wind systems will be inland, strongly positive public sentiment toward wind systems would be expected. In general, residential wind system applications would involve only a single unit which, because of its relatively modest size, would not be visually imposing. Therefore, public acceptance does not appear to constitute a barrier to wind system implementation.

Small WECS mounted on towers located in the yard will restrict the yard space for recreational or other family uses. During the audit procedure, the homeowner could be advised of the potential loss of yard space.

3.3.4.4 Structural and Other On-Site Impacts

3.3.4.4.1 Active Systems

The potential hazards to maintenance personnel during maintenance and repair is one concern of this category. Active systems tend to require large glass areas which present the possibility of safety hazards when broken. Also, solar collectors carry their working fluids in glass tubes, which complicates the maintenance of these solar systems. For these systems, broken glass could cut persons, thus exposing them to potentially toxic fluids. Ongoing investigations within DOE address such matters as the use of non-glazed collectors and structural loadbearing capacities for roof-mounted systems [DOE, May 1978; DOE, December 1978].

In order to minimize the problem of possible glass breakage, solar collector areas could be fenced, and/or protective covers/screens placed over the collectors in instances where collectors are sited adjacent to public areas. Presently, the hazards of broken glass often are minimized by using heat-tempered glass which "beads" when broken. Research to develop new, durable glazing materials is being conducted by several institutions, including ATLAS Corporation, Hughes Corporation, Research Triangle Corporation, and Springborn Laboratories. The Program standard (MPS Sections S-515-2.2, S-601) addresses load and thermal stress issues for glazing materials. Compliance with these standards will minimize any hazards resulting from glass breakage.

Other safety factors which must be considered are maintenance access to the collector and the proper placement of the collector to prevent impediments to emergency exits. These issues are addressed by Program standards (MPS Sections S-309-1, S-405-6, S-600-6.6). In addition, proper maintenance clothing and equipment, a safety drainage/basin system to drain off and hold the toxic working fluids in times of repair, installation, maintenance, or flushing will facilitate safe and efficient maintenance of the solar energy system.

The MPS (Section S-600-3) requires that a detailed installation, operation and maintenance manual be provided to workers and installers in order to minimize accidents by familiarizing maintenance personnel with the systems. MPS provisions requiring proper labeling of all solar energy system components, equipment, and hazardous substances (such as certain working fluids) should also lead to greater safety of maintenance and installation.

A final potential health and safety concern is that solar radiation reflected from the active system collector modules can cause localized glare problems. The intensity of this glare will vary according to a number of factors such as solar intensity, solar angle, solar time, reflectivity of covers and absorption surface, and pitch of roof. The glare resulting from flat plate collectors is expected to be low in intensity and thus not a serious hazard if proper design and review procedures are used as required by the rule.

3.3.4.4.2 Passive Systems

In addition to the structural and other on-site concerns discussed with respect to active systems, certain similar concerns must be assessed with respect to passive systems. An Environmental Readiness Document (ERD) prepared by DOE [DOE, September 1978] addressed potential structural and fire problems posed by additional glass areas required as part of a passive retrofit. It is possible, in the design of a passive solar application, to compromise the fire integrity of a building. This would pose a hazard to the health and safety of the occupants and the fire fighters. It is expected that these issues will be addressed by fire and building codes. State RCS Programs are expected to monitor conformance to these codes. The hazards of glass breakage and the associated aspects of structural integrity, are discussed in the above noted ERD. As a result of the greater glass areas involved by passive applications, greater problems of breakage could result. These problems can be minimized by the use of shatter-proof glass and careful structural design evaluation. Adherence to local building codes should minimize potential impacts associated with reduction of structural or fire integrity of residences.

3.3.4.4.3 Wind Energy Conversion Systems

Numerous Wind Energy Conversion Systems are currently either commercially available or under development. While technical innovations are improving the efficiency of such devices, in principle they are similar to the windmills known to many societies over the last several hundred years.

While capable of producing other useful forms of work (e.g., water pumping, direct mechanical work), the modern Wind Energy Conversion System (WECS) is being developed primarily as a means of producing electricity. These systems range from the 1.5 MW and larger units envisioned for utility applications, and the intermediate units sized for industrial or multi-residence power, down to the Small Wind Energy Conversion System (SWECS) designed for single family residences.

Each category of WECS may pose a unique set of potential environmental impacts. SWECS which may be installed as a result of the RCS Program would likely have smaller support structures, operate at lower voltages, and are subject to less structural stress than are the utility-size WECS. Depending upon a number of considerations*, a Small Wind Energy Conversion System sold as a result of the RCS Program, might be described as follows:

**Considerations affecting design of a SWECS include site topography and wind characterization, load requirements, provision for storage versus direct use of power, type of tower, and the type of rotor.*

- Size (Power) less than 50 kW

- Voltage less than 500 volts

- Tower height 20-30 meters (less than 100 ft) including rotor of 20 ft diameter.

These smaller wind systems have less substantial potential environmental impacts than those impacts attributable to the larger machines contemplated for utility applications.* For example, the siting issues associated with a utility sized WECS complex are expected to be considerably more complex than in the case of single residential SWECS. The large size of projected rotors and the large electro-magnetic field associated with a larger WECS should cause greater concern for interference with radio and television communications than in the case of a typical residential SWECS.

The primary concerns associated with the residential use of Small Wind Energy Conversion Systems relate to the structural integrity of the wind energy equipment including the tower support and the rotor subsystem. Additional issues relate to the safety of utility line maintenance personnel, interference with electromagnetic transmissions, and noise.

<u>Potential Tower Failure</u>

Many kinds of towers, ranging from telephone poles to special purpose tetrahedral frames, are used to support wind energy equipment. Some types of towers

**A utility wind system would likely be based upon multiple groupings of WECS larger than 1.5 MW. A single machine might require a tower in the order of 100-150 ft, and a rotor of 200-300 ft in diameter.*

employed for SWECS are otherwise used to support transmission lines. Thus, there is a well developed technological base for SWECS tower design, fabrication, and installation.

The structural integrity of the tower provides some cause for concern because the tower may be subject to excessive vibration and static stresses or material fatigue. These problems may arise from rotor overspeed conditions, the yawing movement of a horizontal axis turbine as it turns downwind to track changes in the direction of wind flow or even from routine operation of the SWECS over a long period of time. In addition, seismic activity and placement of a tower base on an inadequate foundation could also pose structural problems and contribute to additional stresses on the wind system.

In the event of tower collapse, the wind turbine may fall in any direction but the affected area will be quite limited. The maximum horizontal extension of the turbine (if the rotor retains its integrity) would equal the tower height plus one-half the diameter of the rotor. To provide substantial protection against tower failure, the rule establishes this distance as the minimum distance separating a SWECS unit from an occupied structure.

Since the rotor would be feathered and braked far in advance of the occurrence of wind speeds exceeding tower design limits, there would be a very low likelihood of blade throw accompanying tower collapse. However, it is conceivable that the rotor might break (in conjunction with tower collapse) by striking the tower or the ground; such an eventuality would increase the area of impact depending on the orientation of the rotor and the attitude of tower collapse.

Tower collapse attributable to wind loads is viewed as a highly unlikely occurrence. The only wind conditions viewed as potentially hazardous are tornadoes or exceptionally high wind gusts which greatly exceed design limits.

Other possible causes of tower collapse include undermining of the foundation due to flooding or ground settling or the occurrence of a sudden geologic calamity such as an earthquake. Foundation undermining would be a relatively gradual process which would likely be noted and corrected during periodic maintenance and inspection activities. During earthquakes, the wind turbine would likely pose less risk than other structures because of its relatively low mass and the absence of loosely attached overhangs or facades.

Mindful of the stresses that SWECS applications place on towers, major tower manufacturing companies have developed application analyses computer programs. These analyses are intended to assure the correct match of tower to SWECS application. It is common practice when designing a tower to specify the load requirements as computed by the SWECS manufacturer. This process uses a variety of computation techniques and existing standards. At this time, no single consensus standard exists for tower load. The current industry practice serves to reduce the likelihood of tower failure resulting from inadequate design.

Nevertheless, the correctness of the tower/SWECS match is of concern to the Program. An ongoing DOE technology development program at the Rocky Flats Wind System Development Facility is analyzing and testing tower adequacy for SWECS applications. Fundamental structural characteristics and responses of towers carrying SWECS equipment are being assessed in order to improve the state of knowledge concerning specific towers and wind equipment.

Potential Blade Failure

Fracture and break-up of SWECS blades is an extremely rare and unlikely phenomenon. It has been estimated that the likelihood of a blade breaking apart from any one SWECS unit is on the order of one occurrence in 100 years [Northeast Solar Energy Center, March 1979].

Several analyses have been performed to assess the danger inherent in SWECS blade failure. A recent preliminary study, sponsored by the Northeast Solar Energy Center, a DOE field operation, [Bisplinghoff, March 1979] attempted to make a first order approximation of the safety zone requirements associated with SWECS blade failure. This "worst case" analysis addressed only the maximum blade throw which might occur in the event of rotor failure, and did not consider blade tumbling which would tend to significantly reduce the maximum blade throw distance. DOE is sponsoring additional analytical work to improve the state of knowledge concerning the determination of zones of relative safety surrounding a SWECS which is expected to lead to a better definition of the SWECS safety zone requirements. This information may be used by States in establishing zoning and siting requirements of SWECS applications.

The Program is developing standards for siting of wind systems near residential structures and power transmission lines. Adherence to these siting conditions should substantially mitigate safety concerns relating to SWECS.

Safety of Repair Personnel

Utility line repair personnel must isolate the segment of a line to be repaired from the power or generation source. In the past, this was a relatively straightforward process. The location of the power or generation source was known and generally singular. Recently, numerous residential SWECS units generating electricity and intertied directly with the utility grids, have been installed across the country. Additional installations of this type are being introduced and even more will be stimulated by the RCS Program. These units create a distributed generation source and tend to complicate the problem of isolating a utility line for repair. The problem is enhanced as a consequence of the co-excitation potential of multiple, grid-connected SWECS units.

This specific safety problem is the subject of a major DOE-sponsored research program being conducted for the Rocky Flats Facility. Requirements for a SWECS-utility line intertie unit, including safety-enhancing features, will be defined by July 1980. It is planned to begin development of prototype intertie equipment by late 1980. Development of standards for use by States and utilities to guide utility line maintenance and regulate the related SWECS-grid intertie equipment will also begin in late 1980.

The Program is developing standards to address safe installation, requiring the wind machine manufacturer, or his designated representative, to inspect the installed machine and certify the correctness of the installation. Moreover, adequacy of electrical connections are governed by local codes, and enforcement by local governments within a State Plan is expected as an integral aspect of State Plans. The Program requires that all wind system applications be inspected for adequacy within one week of installation.

Electromagnetic Interference

Electromagnetic radiation interference may occur when signals reflected from moving rotor blades interact with the original signals, causing fluctuations in signal frequency and amplitude which degrade reception quality. Types of signals which may be affected are in the higher frequencies such as television, navigational aid (navaid), and microwave at points where geometries favorable for interference occur among the wind, turbine, transmitter, and receiver. Other factors affecting the magnitude and severity of this impact include blade area and speed, direct signal strength, and reflected signal strength relative to the direct signal. A recent analysis by DOE [DOE, September 1978(b)] concluded that SWECS are based on a proven technology and that no major environmental problems concerning electromagnetic interference have been encountered in the operation of these systems.

Noise

While operational noise from large WECS systems may include both audible and infrasonic sound which could have potential adverse impacts, such as annoyance or interference with human activities and wildlife disturbance, the potential in small WECS is considerably reduced [DOE, March 1978]. Conceivably, a small WECS system, through climatic wear and tear, could become noisy. Even this marginal impact can be overcome by appropriate maintenance of the system.

Technical Assistance to State Programs

To further mitigate any potential adverse effects of residential applications of SWECS, DOE is developing technical materials to assist States to monitor or regulate SWECS applications. Two assessments are underway to help identify the specific support needs. One assessment is of the standards needed to regulate the application of SWECS within a State. The other assessment seeks to understand the needs for local ordinances and State-level application criteria.

As a partial response to the second assessment, work has begun on developing qualifications criteria for application of SWECS in State Programs. These qualifications criteria will provide a basis for State regulation of SWECS applications, in general, considering such factors as siting, noise, maintenance, and performance.

Other environmental data to be made available to States by DOE concern noise levels created by various wind machines. Measurements are being made at Rocky Flats of sound levels at various distances and over a range of frequencies. These data can be used directly by States and in local zoning ordinances.

Finally, the DOE Rocky Flats Facility provides a comprehensive SWECS field test service, the results of which are available to State governments wishing to establish rigorous and empirical criteria for SWECS equipment offered for sale within their State in response to the RCS Program. Dynamic full scale testing of complete SWECS units (tower-mounted wind machines) is performed, as is performance testing of SWECS power generation equipment.

3.3.5 Beneficial Impacts

Beneficial impacts include the energy savings resulting from the Program, and the resulting progress toward energy independence and pollution reduction. The widespread installation of solar domestic hot water systems, the more limited use of solar space heating, the use of passive solar techniques, the utilization of solar heating for swimming pools, and the application of wind devices will result in a reduction in non-renewable energy use during the term of the Program. Based on a review of the suggested measures in the Program, and the economics of the suggestions, it appears that this reduction will be greatest in electricity, smaller in oil consumption, with the least reduction being that of natural gas usage.

3.3.5.1 Types of Emissions

The types of environmental emission impacts which could result from the noted reduction are described as being: (a) waterborne emissions; and (b) airborne emissions [Brookhaven Laboratory, March 31, 1977]. They are described as follows:

- Waterborne emissions include such components as acids, bases, dissolved solids, suspended solids, and non-degradable organics. These react to create biological oxygen and chemical oxygen demands.

- Airborne emissions include particulates, oxides of nitrogen, sulfur dioxide, hydrocarbons, carbon monoxide, carbon dioxide, and aldehydes.

Emissions resulting from the use of natural gas for space heating and domestic water are described in the BNL document which notes that the primary type of emissions are airborne, with a small component of non-degradable organics in the waterborne emissions category. The emissions created by the use of distillate oil for space heating and hot water, as noted in the BNL document, have both airborne and waterborne components.

Emissions resulting from generation of electricity, a secondary source of pollution, contain no waterborne emissions for all types of power generation with the exception of coal-fired steam electric generation. Gas turbine electric generation, both natural gas and oil-fired, and steam electric generation, both natural gas and oil-fired, have large components of airborne emissions. Coal-fired generation of electricity, in addition to waterborne emissions, has a large component of airborne emissions.

3.3.5.2 Regional and Local Benefits

Regional environmental benefits will be derived in large measure from the substitution of solar and wind energy for electrical energy. These benefits would consist primarily of a reduction of airborne emissions from electric power plants.

Reduction of these emissions would be minor, however, in that both airborne and waterborne pollutants will be, to an increasing degree, restricted by Federal standards of performance for new stationary sources [40 CFR Part 60] and by EPA efficient guidelines for electric power plant cooling water [40 CFR Part 423] respectively.

The reduction created by solar application displacements of non-renewable fuels will vary from region to region. In those regions, such as the Northeast, where distillate oils are heavily used for home heating and domestic hot water, the displacement of oil by solar will create greater reductions in airborne and waterborne emissions. For regions, such as the Midwest, where natural gas is favored for residential energy, the lesser displacement of gas by solar applications will create no appreciable reduction in emissions.

3.3.6 Potential Cumulative and Long-Term Environmental Effects

It is believed that the cumulative and long-term environmental effects of the renewable resource component of the RCS Program will be beneficial. The Program should help reduce energy consumption in participating buildings, help reduce anticipated energy costs and help effectuate beneficial environmental results.

It appears, based on the discussion of pollution abatement resulting from the use of renewable resource energy systems, that the more successful the Program, the greater the environmental benefits. Greater and more widespread use of solar and wind measures will diminish the use of oil, gas, and electricity. This, in turn, will reduce the air and water pollution created by the use of these energy sources.

As a result of the consumer response to the Program, the manufacturing activities needed to support the increase in demand for renewable resource systems will increase. This, in turn, will create an increase in emissions normally associated with these activities. As noted earlier, these emission increases will be small in context of the several industries involved. Moreover, it appears that these increases in emissions would be generally offset by the greater abatement due to fuel displacement.

3.4 Economic and Social Impacts

This section presents a discussion of the estimated economic and social impacts resulting from implementation of the RCS Program initiatives. The results presented here are aggregate five-year impacts.

3.4.1 Economic Impacts

The estimated economic impacts of the RCS Program have been discussed in considerable detail in Parts 2 and 3 of the Regulatory Analysis developed for the proposed rule [DOE, October 1979]. Summarized results of this discussion are presented below to provide an overview of the general characteristics of these impacts.

As discussed in Chapters 1 and 3 of this EIS, the maximum anticipated response rate is estimated to be 7 percent per year which represents an expected "worst case" from the standpoint of the severity and extent of impacts associated with the RCS Program. This percentage was assumed in estimating the impacts discussed below.

3.4.1.1 Cost Impacts

Costs of the RCS Program have been estimated for Program management and for consumer expenditures. The methodology, assumptions and results of these estimations appear in the Final Regulatory Analysis for the RCS Program [October 1979].

Program Management

Aggregate total costs of developing and administering the five-year RCS Program under the requirements of the original proposed rule are estimated to be $5.9 billion [DOE, October 1979 (Part 2)]. This estimate includes costs to governments, covered utilities, and home heating suppliers of implementing both the energy conservation and renewable resources components of the Program.

Consumer Expenditures

With a 7 percent annual response rate, households will invest $12.2 billion in the purchase and installation of energy conservation measures as a result of the RCS Program. In return, they will realize an estimated gross savings in energy costs of $52.8 billion over the life of the measures installed [DOE, October 1979 (Appendix to Part 2)].

3.4.1.2 Employment Impacts

The RCS Program will result in additional employment by government, utilities, home heating suppliers, and industry. In general these positions will be filled by skilled or professional personnel. They include, for each year of the Program:

- 5,800 to 6,100 professional positions
- 4,500 clerical positions
- 20,400 auditors for conservation and renewable resource measures
- 1,100 post-installation inspectors.

The impact on employment in industry has not been estimated, primarily because of a lack of reasonably reliable data. In interviews, numerous industry personnel indicated their reluctance to hire additional labor or to increase production significantly for a five-year program.

3.4.2 Human Values and Social Impacts

In addition to other beneficial impacts previously discussed, the installation of energy conservation measures and renewable resource measures should generally help create a more pleasant and livable residential environment. For example, the installation of storm windows will make homes more comfortable by reducing the heat loss through or around the windows. The installation of caulking, weatherstripping, and storm windows, in addition to reducing heat loss, will reduce sound transmission between the outside and inside of the house. The installation of renewable resource measures should help save energy and help teach positive human values about energy usage and conservation. As with many other home improvements, the addition of those measures are likely to give residential buildings higher resale values.

3.4.3 Other Impacts

There is no present reason to conclude that the RCS Program will have an impact on cultural resources or endangered species. The reduction in energy usage and pollutant emissions resulting from the installation of energy conservation measures may, however, have a small beneficial impact on natural habitats.

REFERENCES - CHAPTER 3.0

Aerolite SPE Corporation, November 28, 1978. Memorandum to the U.S. Department of Energy.

American Conference on Governmental Industrial Hygienists. "TLV's--Threshold Limits Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1977."

American Industrial Hygiene Association, 1968. "Community Air Quality Guides, Aldehydes," American Industrial Hygiene Association Journal, May 1978.

American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc., 1973. ASHRAE Standard 62-73. "Standards for Natural and Mechanical Ventilation."

American Society of Heating, Refrigeration, and Air Conditioning Engineers, 1977. ASHRAE Handbook and Product Directory, 1977 Fundamentals.

Armijo, R., and A.H. Coulson, 1975. "Epidemiology of Stomach Cancer in Chile: The role of nitrogen fertilizer." International Journal of Epidemiology, Vol. 4, pp. 301-309.

Andersen, I., G.R. Lundgvist, and L. Mølhave, 1975. "Indoor Air Pollution Due to Chipboard Used as a Construction Material." Atmospheric Environment 9, 1121.

Andersen, I., August/September 1978. "Formaldehyde in the Indoor Environment--Health Implications and the Setting of Standards." International Indoor Climate Symposium, Copenhagen, Denmark.

Arthur D. Little, Inc., November 1977. An Assessment of Retrofit Automatic Vent Dampers for Residential Heating Systems.

Ashton, M.R., 1970. "The occurrence of nitrates and nitrites in foods." BFMIRA Literature Survey No. 7, p. 32.

Baars, R, August/September 1978. "The Formal Aspects of the Formaldehyde Problem in the Netherlands," International Indoor Climate Symposium, Copenhagen, Denmark.

Banaszak, E. F., et al., 1974. "Epidemiologic studies relating to thermophilic fungi and hypersensitivity lung syndromes." American Review of Respiratory Disease, 10(5):585-591.

Battelle Columbus Laboratories, June 1976. Metals Mining and Milling Process Profiles with Environmental Aspects, Industrial Environmental Research Laboratory, PB-256-394.

Beausoliel, Robert W., William J. Meese and Lawrence S. Galowin, July 1978. Exploratory Study for Temperatures Produced by Self-Heating of Residential Branch Circuit Wiring When Surrounded by Thermal Insulation, National Bureau of Standards, NBSIR 78-1477.

Berk, J.V., et al., April 1978. Design of Mobile Laboratory for Ventilation Studies and Indoor Air Pollution Monitoring, Lawrence Berkeley Laboratory.

Berk, J.V., C.D. Hollowell, and C.I. Lin, July 1979. Indoor Air Quality Measurements in Energy-Efficient Houses, Lawrence Berkeley Laboratory, LBL-8894, U.S. Department of Energy.

Bisplinghoff, R.L., March 1979. Wind Turbine Blade Throw Range Analyses, Northeast Solar Energy Center.

Bogovski, P., 1974. "Organizational and research activities of the analysis of N-nitroso compounds of the IARC. N-Nitroso compounds in the environment." Scientific publication No. 9. International Agency for Research on Cancer, Lyon, France.

Brookhaven National Laboratory, March 31, 1977. Final Assessment of Environmental Impacts of the State Energy Conservation Program, BNL-21166.

Brookhaven National Laboratory, June 1978. An Assessment of Thermal Insulation Materials and Systems for Building Applications, BNL-50862.

Budnitz, R.J., et al., August 1978. Human Disease from Radon Exposures: The Impact of Energy Conservation in Buildings, Lawrence Berkeley Laboratory, LBL-7809, U.S. Department of Energy.

Burke, G. W., et al., 1977. "Alergic alveolitis caused by home humidifiers." Journal of American Medical Association (JAMA), 238(25):2705-2708.

Consumer Product Safety Commission, June 1978. Press release.

Consumer Product Safety Commission, July 1978(a). Directorate for hazard identification and analysis.

Consumer Product Safety Commission, July 1978(b). "Unvented Gas Space Heaters," Hazard Analysis Report.

Costle, Douglas M., Administrator, U.S. Environmental Protection Agency, letter to The Honorable Robert Graham, Governor of Florida, May 30, 1979.

Cullison, A.E., August 1978. "Rigid Air Pollution Standard for NO_x Modified in Japan," World Environment Report, Vol. 4, No. 1.

Dunn, S.E., 1979. "Unvented Gas Fired Space Heaters, Withdrawal of Proposed Rule." 44FR (61):18516-18517.

Federal-Provincial Task Force on Radioactivity (Canada), December 1978. Working Party on Radiation Criteria; Recommendations.

Fink, J. N. et al., 1971. "Interstital pneumonitis due to hypersensitivity to an organism contaminating a heating system." Annals of Internal Medicine, 74(1):80-83.

Fink, J. N., et al., 1976. "Interstitial lung disease due to contamination of forced air systems." Annals of Internal Medicine, 84(4):406-413.

GCA Corporation, January 1976. Assessment of Formaldehyde as a Potential Air Pollution Problem, Environmental Protection Agency, NTIS PB 258-360.

Gelperin, A., V.K. Moses, and G. Fox, 1976. "Nitrate in water supplies and cancer." Illinois Journal of Medicine, Vol. 149, pp. 251-253.

Geomet, Inc., October 8, 1976. The Status of Indoor Air Pollution Research, U.S. Environmental Protection Agency.

Geomet, Inc., March 31, 1978. Indoor Air Pollution in the Residential Environment, U.S. Environmental Protection Agency and U.S. Department of Housing and Urban Development.

Guimond, Richard J., et al., February 1979. Indoor Radiation Exposure Due to Radium-226 in Florida Phosphate Lands, U.S. Environmental Protection Agency.

Hill, M.J., G. Hawksworth, and G. Tattersall, 1973. "Bacteria, nitrosamines and cancer of the stomach." British Journal on Cancer, Vol. 28, No. 6, pp. 562-567.

Hinde, W. C., and M. S. First. "Concentrations of Nicotine and Tobacco Smoke in Public Places," New England Journal of Medicine, (292:844-5), 1975.

Hollowell, C.D., R.J. Budnitz, and G.W. Traynor, 1977. "Combustion-Generated Indoor Air Pollution," Proceedings of The Fourth International Clean Air Congress, Tokyo, Japan, pp. 684-7, The Japanese Union of Air Pollution Prevention Associations, Tokyo, Japan.

Hollowell, C.D., and G.W. Traynor, April 1978. Combustion-Generated Indoor Air Pollution, Lawrence Berkeley Laboratory, LBL-7832, U.S. Department of Energy.

Hollowell, C.D., et al., April 1978. Indoor Air Quality Measurements in Energy Efficient Buildings, Lawrence Berkeley Laboratory, LBL-7831, U.S. Department of Energy.

Hollowell, C.D., et al., November 1978. Impact of Reduced Infiltration and Ventilation on Indoor Air Quality in Residential Buildings, Lawrence Berkeley Laboratory.

Hollowell, C.D., J.V. Berk, and G.W. Traynor, January 1979. "Impact of Reduced Infiltration and Ventilation on Indoor Air Quality in Residential Buildings," Lawrence Berkeley Laboratory, LBL-8470, U.S. Department of Energy.

Hollowell, C.D., et al., June 1979. Impact of Energy Conservation in Buildings on Health, Lawrence Berkeley Laboratory, LBL-9379, U.S. Department of Energy.

Honeywell, n.d. Installing the Honeywell Chromotherm, the Fuel Saver.

Kelley, J.S. and G.J. Sophocleus, 1978. "Retinal Hemorrhages in Subacute Carbon Monoxide Poisoning, Exposures in Homes with Blocked Furnace Flues," JAMA 239 (15):1515-17.

Kiyoura, R., June/July 1976. International Comparison and Critical Analysis of Nitrogen Dioxide Air Quality Standards. Paper No. 76-17.03, In: Proceedings of 69th Annual Meeting of the Air Pollution Control Association.

Kohler, P. F., et al., 1976. "Humidifier lung: hypersensitivity pneumonitis related to thermotolerant bacterial aerosols." Chest, 69(2) Supp:294-2.

Kravitz, H., L.D. Elegant, E. Kaiser, and B.M. Kagan, 1956. "Methemoglobin values in premature and mature infants and children." American Medical Association Journal on Disabilities in Children, Vol. 91, pp. 1-5.

Kusada, T., C. M. Hunt, and D. E. McNall. "Radioactivity (Radon and Daughter Products) as a Potential Factor in Building Ventilation." ASHRAE Journal, Vol. 21, No. 7. (July 1979), pp. 30-34.

Lin, C.I., et al., July 1979. Indoor/Outdoor Measurements of Formaldehyde and Total Aldehydes, Lawrence Berkeley Laboratory, LBL-9397, U.S. Department of Energy.

Lisella, F.S., W. Johnson, and K. Holt, February 1978. "Mortality from Carbon Monoxide in Georgia, 1961-1973," Journal of Medical Association of Georgia, pp. 98-100.

Long, K. R., and R. Hahne, 1979. Processes in Urea Formaldehyde Based Forms Resulting in Formaldehyde Emission and Deterioration of Insulating Properties. Proposal to Union Carbide Corporation Nuclear Division.

Lowenheim, F. A., and M. K. Moran, 1975. Faith, Keyes, and Clark's Industrial Chemicals. Fourth Edition. John Wiley & Sons.

Lumpkins, E. D., and S. Corbitt, 1976. "Airborne Fungi Survey II. Culture plate survey of the home environment." Annals of Allergy, 36(1):40-44.

Lumpkins, E. D., S. L. Corbitt, and G. M. Tredman, 1973. "Airborne Fungi Survey I. Culture plate survey of the home environment." Annals of Allergy, 31(8):361-370.

Melia, R.J.W., C. duV Florey, D.G. Altman, and A.V. Swan, 1977. "Association Between Gas Cooking and Respiratory Disease in Children," British Medical Journal, Vol. 2, No. 149.

Mendis, Matthew S. and H.L. Schultz, July 1976. Environmental Residuals Coefficients for the Project Independence Evaluation System Model, Hittman Associates, Inc., HIT-654, U.S. Environmental Protection Agency.

Metzger, W. J., et al., 1976. "Sauna takers disease: hypersensitivity pneumonitis due to contaminated water in a home sauna." JAMA, 236(19):2209-2211.

Monsanto Research Corporation, April 1978. Source Assessment: Crushed Limestone, State of the Art, Industrial Environmental Research Laboratory, PB-281-422.

Monsanto Research Corporation, March 1978. Source Assessment: Rubber Processing, State of the Art, Industrial Environmental Research Laboratory.

National Association of Regulatory Utility Commissioners, 1978. 1977 Annual Report on Utility and Carrier Regulations.

National Council on Radiation Protection and Measurement, November 1, 1977. Radiation Exposure from Consumer Products and Miscellaneous Sources, NCRP Report No. 56. Washington, DC.

National Fire Protection Association, January 1976. Fire Protection Handbook - 14th Edition.

National Institute for Occupational Safety and Health, December 1976. "Criteria for a Recommended Standard . . . Occupational Exposure to Formaldehyde."

National Research Council, 1972. "Accumulation of nitrate." Committee on Nitrate Accumulation, Agricultural Board, Division of Biology and Agriculture, Washington, D.C., National Academy of Sciences.

National Solar Heating and Cooling Information Center. Information supplied by telephone.

New York State Public Service Commission and Brooklyn Union Gas Company, March 1979. Energy Conservation and Performance Evaluation of Replacing Standing Pilots in Central Heating Systems.

Northeast Solar Energy Center, March 1979. Proposed Amendments to the Master Plan and Zoning Ordinance of the Town of Hanover, New Hampshire.

NO_x Control Review, Summer 1978. "Short-Term NO_2 Standard in Preparation," Vol. 3, No. 3.

Oliver, F., and T.F. Potters, August 31, 1979. Letter from Public Service Company of Colorado to U.S. Department of Energy, Conservation Staff.

Occupational Safety and Health Administration, 1975. 40 FR 23072.

Pickering, C. A. C., et al., 1976. "Investigation of a respiratory disease associated with an air-conditioning system." Clinical Allergy, 6(2):109-118.

Piscope, A., forthcoming. Planning for the Aesthetic Installation of Solar Collectors on Existing Homes.

Pitts, J.N., Jr., and A.L. Loyd, 1973. "Discharges into the atmosphere." In: Nitrogenous Compounds in the Environment, EPA-SAB-73-001. U.S. Environmental Protection Agency, Washington, D.C.

Polar Products Corporation, November 1978. Memorandum to the U.S. Department of Energy.

Personal Communication between Dr. Bernd Siefert (Institut fur Wasser-Boden und Lufthygiene des Bundesgeshundheitsamtes, Berlin, F.D.R.) and G.W. Traynor (Lawrence Berkeley Laboratory), May 1978.

Personal Communication between Jan Sundell (Statens Planverk, Stockholm, Sweden) and G.W. Traynor (Lawrence Berkeley Laboratory), July 1978.

Personal Communication between Thomas Lindvall (Karolmska Institute, Stockholm, Sweden) and G.W. Traynor (Lawrence Berkeley Laboratory), August 1978.

Rice University, 1964(a). The Natural Radiation Environment: Richardson, K.A., "Thorium, Uranium and Potassium in the Conway Granite, New Hampshire, USA."

Rice University, 1964(b). The Natural Radiation Environment: Tanner, Allan B., "Radon Migration in the Ground: A Review."

Robertshaw, n.d. Installation Guide and Owners Manual: Uni-Line Pilot Ignition System.

Rockwell International, May 1979. Rocky Flats Plant Wind Energy Market Penetration Study.

Rocky Mountain Poison Center, December 5, 1978. Position paper on UF foam insulation.

Ross, H., and D. Grimsrud, May 1978. Air Infiltration in Buildings: Literature Survey and Proposed Research Agenda. U.S. Department of Energy.

Rylander, et al., 1977. "Luftfaktarfeber: endotoxin som genetisk faktor?" Lakartidningen, 74(43):3739-3740.

Savage, E.P., J.W. Malberg, H.W. Wheeler, and J.D. Tessari, 1976. "Accidental Carbon Monoxide Poisonings in Colorado and Wyoming, 1971-1973," Public Health Reports 91 (6):560-562.

Science Applications, Inc., and JRB, September 1978. Macro-economic Impacts of the Utility Retrofit Program.

Searcy, Jimmie Q., December 1978. Hazardous Properties and Environmental Effects of Materials Used in Solar Heating and Cooling (SHAC) Technologies: Interim Handbook, Sandia Laboratories, U.S. Department of Energy, DOE/EV-0028, GPO 061-000-00297-3.

Silberstein, S., November 1977. "Outdoor Sources of Indoor Air Pollution," Brookhaven National Laboratory, BNL-58762.

Smith, P. W., and R. M. Massanari, 1977. "Room humidifiers as the source of Acinobacter infections." JAMA, 237(8):795-797.

Speizer, F.W., Benjamin Ferris, Jr., Y.M.M. Bishop, and J. Spengler, April 1979. "Health Effects of Indoor Exposure, Preliminary Results," presented at the American Chemical Society Meeting, Honolulu, Hawaii.

Sterling, T.D. and D.M. Kobayashi, 1977. "Exposure to Pollutants in Enclosed Living Spaces," Environmental Research, 13:1-35.

Sweet, L. C., et al., 1971. "Hypersensitivity pneumonitis related to a home furnace humidifier." Journal of Allergy and Clinical Immunology, 48(3):171-178.

Tourville, D. R., et al., 1972. "Hypersensitivity pneumonitis due to contamination of home humidifier." Journal of Allergy and Clinical Immunology, 49(4):245-251.

Traynor, G.W., D.W. Anthon, and C.D. Hollowell, July 1979. "Indoor Air Quality: Gas Stove Emissions," Energy and Environmental Division Annual Report - 1978, Lawrence Berkeley Laboratory, LBL-8894, U.S. Department of Energy.

United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), 1974. Ionizing Radiation: Levels and Effects, Volume I: Levels. United Nations.

U.S. Congress, Office of Technology Assessment, March 1979. Residential Energy Conservation.

U.S. Consumer Product Safety Commission, n.d. Unpublished survey data.

U.S. Department of Commerce, National Bureau of Standards, July 1978. A Preliminary Study of the Fire Safety of Thermal Insulation for Use in Attics and Enclosed Spaces in Residences, NBSIR 78-1487.

U.S. Department of Commerce, National Bureau of Standards, July 1978. Exploratory Study of Temperatures Produced by Self-Heating of Residential Branch Circuit Wiring When Surrounded by Thermal Insulation, NBSIR 78-1477.

U.S. Department of Commerce, National Bureau of Standards, April 1979. Methodology and Technical Support Used in the Economic Analysis of Suggested Energy Conservation Measures for the Residential Conservation Service Program.

U.S. Department of Commerce, National Bureau of Standards. NBS Technical Note 946.

U.S. Department of Energy, November 1977. An Assessment of Retrofit Automatic Vent Dampers for Residential Heating Systems, DOE/TID 29340.

U.S. Department of Energy, December 1, 1977. Draft Environmental Impact Statement of the National Solar Heating and Cooling Program.

U.S. Department of Energy, March 1978. Environmental Development Plan (EDP); Wind Energy Conversion, DOE/EDP-007.

U.S. Department of Energy, April 1978: 1977 Annual Report to Congress.

U.S. Department of Energy, May 1978. Solar Heating and Cooling Research and Development Project Summaries, DOE/CS-0010, GPO 061-000-00072-1.

U.S. Department of Energy, June 1978. Utility Sponsored Insulation Programs.

U.S. Department of Energy, September 1978(a). Environmental Readiness Document; Solar: Hot Water and Passive, Commercialization Phase III, DOE/ERD-0010.

U.S. Department of Energy, September 1978(b). Environmental Readiness Document, Large and Small Wind Systems.

U.S. Department of Energy, September 1978(c). National Solar Heating and Cooling Demonstration Program Project Experience Handbook, DOE/CS-0045/D.

U.S. Department of Energy, November 1978. Material Criteria and Installation Practices for the Retrofit Application of Insulation and Other Weatherization Materials.

U.S. Department of Energy, December 1978. Hazardous Properties and Environmental Effects of Materials Used in Solar Heating and Cooling (SHAC) Technologies, DOE/EV-0028.

U.S. Department of Energy, 1979. Energy Supply and Demand in the Midterm: 1985, 1990, and 1995, DOE/EIA-0102/52.

U.S. Department of Energy, January 1979. Solar Heating and Cooling Demonstration Project Summaries, DOE/CS-0038-2, GPO 061-000-0024-3.

U.S. Department of Energy, April 1979(a). Monthly Energy Review, EIA-0035/4.

U.S. Department of Energy, April 1979(b). Environmental Readiness Document, Solar Heating and Cooling of Buildings, DOE/ERD-0029.

U.S. Department of Energy, April 1979(c). Review Draft Regulatory Analysis for the Residential Conservation Service Program.

U.S. Department of Energy, April 1979(d). Analysis Report -- Energy Supply and Demand in the Midterm: 1985, 1990, and 1995, DOE/EIA-0102/54.

U.S. Department of Energy, June 1979. Draft Environmental Development Plan (EDP), Solar Heating and Cooling of Buildings, DOE/EDP-0018.

U.S. Department of Energy, October 1979. Final Regulatory Analysis and Urban and Community Impact Analysis for the Residential Conservation Service Program.

U.S. Department of Energy and U.S. Environmental Protection Agency, March 1978. Energy/Environment Fact Book, EPA-60019-77-041.

U.S. Department of Housing and Urban Development, 1977(a). HUD Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems, Volume 5, 4930.2.

U.S. Department of Housing and Urban Development, 1977(b). HUD Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems, Supplement S-515-1.10.

U.S. Department of Housing and Urban Development, 1977(c). HUD Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems, Supplement S-515-1.2.1.

U.S. Department of Housing and Urban Development, 1977(d). HUD Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems, Supplements S-515-2.13, S-515-11.2.1.1, and S-607-3.1.

U.S. Department of Housing and Urban Development, 1977(e). HUD Intermediate Minimum Properties Standards for Solar Heating and Domestic Hot Water Systems, Supplements S-515-2.3.2 and S-515-2.3.3.

U.S. Department of Housing and Urban Development, 1977(f). HUD Intermediate Minimum Properties Standards for Solar Heating and Domestic Hot Water Systems, Supplement S-515-9.1.

U.S. Department of Housing and Urban Development, 1977(g). HUD Intermediate Minimum Properties Standards for Solar Heating and Domestic Hot Water Systems, Supplement S-600.3.

U.S. Department of Housing and Urban Development, 1977(h). HUD Intermediate Minimum Properties Standards for Solar Heating and Domestic Hot Water Systems, Supplement S-615.9.

U.S. Department of Housing and Urban Development, 1977(i). HUD Intermediate Minimum Properties Standards for Solar Heating and Domestic Hot Water Systems, Supplement S-615-10-15.

U.S. Department of Housing and Urban Development, March 28, 1977. Press release: HUD 77-87.

U.S. Environmental Protection Agency, April 1973. Compilation of Air Pollution Emission Factors, second edition, including supplements, PB-223-996.

U.S. Environmental Protection Agency, January 1974(a). Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Insulation Fiberglass Manufacturing Segment of the Glass Manufacturing Point Source Category.

U.S. Environmental Protection Agency, January 1974(b). Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Flat Glass Segment of the Glass Manufacturing Point Source Category.

U.S. Environmental Protection Agency, March 1974(a). Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Primary Aluminum Smelting Subcategory of the Aluminum Segment of the Nonferrous Metals Manufacturing Point Source Category.

U.S. Environmental Protection Agency, March 1974(b). Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Major Inorganic Products Segment of the Inorganic Chemicals Manufacturing Point Source Category.

U.S. Environmental Protection Agency, 1974(a). Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Major Organic Chemicals Manufacturing Point Source Category.

U.S. Environmental Protection Agency, April 1974(b). Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Petroleum Refining Point Source Category.

U.S. Environmental Protection Agency, June 1974. Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Steel Making Segment of the Iron and Steel Manufacturing Point Source Category.

U.S. Environmental Protection Agency. August 1974. Effluent Limitations Guidelines for Existing Sources and Standards of Performance for New Sources.

U.S. Environmental Protection Agency, September 1974. Addendum Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Synthetic Resins Segment of the Plastics and Synthetic Materials Manufacturing Point Source Category.

U.S. Environmental Protection Agency, January 1975. Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Other Non-Fertilizer Phosphate Chemicals Segment of the Phosphate Manufacturing Point Source Category.

U.S. Environmental Protection Agency, February 1975. Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Primary Copper Smelting Subcategory and the Primary Copper Refining Subcategory of the Copper Segment of the Non-Ferrous Metals Manufacturing Point Source Category.

U.S. Environmental Protection Agency, May 1975. Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Significant Inorganic Chemicals Manufacturing Point Source Category.

U.S. Environmental Protection Agency, June 1975. Draft Development Document for Effluent Limitations Guidelines and Standards of Performance for the Machinery and Mechanical Products Manufacturing Point Source Category.

U.S. Environmental Protection Agency, October 1975. Development Document for Interim Final Effluent Limitations Guidelines and New Source Performance Standards for the Coal Mining Point Source Category.

U.S. Environmental Protection Agency, January 26, 1976. Standards of Performance for New Stationary Sources, Primary Aluminum Industry, FRL471-4.

U.S. Environmental Protection Agency, May 1976. Development Document for Interim Final Effluent Limitations Guidelines and New Source Performance Standards for the Coal Mining Point Source Category.

U.S. Environmental Protection Agency, June 1976. Development Document for Interim Final Effluent Limitations Guidelines and Standards of Performance for the Mineral Mining and Processing Industry.

U.S. Environmental Protection Agency, August 1977. Compilation of Air Pollutant Emission Factors. Third Edition (Including Supplements 1-7).

U.S. Environmental Protection Agency, May 1978(a). Source Assessment: Crushed Sandstone, Quartz, and Quartzite, State of the Art, EPA-600/2-78-004n.

U.S. Environmental Protection Agency, May 1978(b). Supplement No. 8 for Compilation of Air Pollutant Emission Factors. Third Edition (Including Supplements 1-7), AP 42.

U.S. Environmental Protection Agency, February 1979. Indoor Radiation Exposure Due to Radium-226 In Florida Phosphate Lands, EPA520/4-78-013.

U.S. Environmental Protection Agency, March 1979. Supplement No. 9 for Compilation of Air Pollutant Emission Factors. Third Edition (Including Supplements 1-7).

University of Iowa. Measurement of Out-Gassing of Formaldehyde in UF Insulation under Chamber Conditions.

Waksman, David, and John Halton, September 1978. Environmental and Safety Considerations for Solar Heating and Cooling Applications, U.S. Department of Commerce, National Bureau of Standards, NBSIR 78-1532, U.S. Department of Energy and U.S. Department of Housing and Urban Development, NTIS 78-1532.

Weiss, N. S., and Y. Soleymani, 1971. "Hypersensitivity lung disease caused by contamination of an air-conditioning system." Annals of Allergy, 29(3):154-156.

World Health Organization, 1977. "WHO Environmental Health Criteria for Oxides of Nitrogen," Ambio, Vol 6, No. 290.

World Health Organization, 1978. "Nitrates, Nitrites and N-Nitroso Compounds." Environmental Health Criteria No. 5. World Health Organization, Geneva, p. 107.

Zaldivar, R., and W.H. Wetterstand, 1975. "Further evidence of a positive correlation between exposure to nitrate fertilizers ($NaNO_3$ and KNO_3) and gastric cancer death rates: nitrites and nitrosamines." Experientia, Vol. 31, pp. 1354-1355.

4.0 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

As has been discussed in detail, it is likely that the implementation of the RCS Program will have beneficial impacts upon the environment and thus upon the maintenance and enhancement of the long-term productivity of land, water, and other environmental resources. On the national level, it is believed that the pollutant emission increases and decreases attributable to increased demand for energy conservation and renewable resource measures as a result of the Program will represent a small percentage of nationwide emissions and will be insignificant. It was concluded that the net changes in projected emissions would be even smaller. Thus, it is highly unlikely that this Program, because of its nature, will constrain the diversity and range of potential uses of the environment. It is far more likely that the Program will help broaden the diversity and range of potential environmental uses through information dissemination, education, and practical applications.

The RCS Program does not involve trade-offs between short-term environmental gains at the expense of long-term losses or vice versa and would not foreclose future options. Specifically, the national impacts of the Program are projected to be beneficial. On a site-specific basis, DOE has endeavored to ensure that any residential energy conservation measures available in connection with the Program have been carefully analyzed in terms of their environmental implications and that the findings are made easily available to interested persons. Moreover, future options are available through the ability to add energy conservation measures to the Program. However, they will be added only after specified criteria have been met including an adequate environmental analysis.

5.0 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible or irretrievable resource commitments generally concern changes initiated by the Program which, at some later time, could not be altered so as to restore the present order of environmental resources. Generally, these irretrievable commitments involve the destruction, transformation, or consumption of resources that are not renewable, not recoverable for subsequent use, or are scarce.

The analysis of the environmental impacts that the RCS Program might cause reached several conclusions. Regarding estimated increases in production for selected energy conservation measures, the analysis concluded there might be some associated increases in air and water pollutants but that such increases would not be significant on a nationwide basis or at the industry level. Any incremental increase in pollutants associated with the remaining energy conservation measures was estimated to be even more minimal. The net pollution analysis showed a reduction in air and water pollutant emissions associated with the estimated decreased demand for energy. Similar conclusions were reached, on a more qualitative basis, regarding estimated air and water pollution impacts attributable to renewable resource measures. It was estimated that the net change in emissions in both categories of measures would be beneficial but also small when analyzed on a national basis (see Table 3-4). Increased production might also cause some increase in the use of human resources.

Apart from the foregoing summary of potential air and water pollution, the environmental analysis did not disclose any basis in fact to conclude that implementation of the

Program will result in the consumption, destruction, or transformation of any scarce or nonrenewable resources or in the curtailment of the range of potential uses of the environment.

6.0 DESCRIPTION OF ALTERNATIVES TO THE PROGRAM*

The purpose of this section is to evaluate the reasonable alternatives to the proposed RCS Program, including the no-action alternative. Section 6.1 discusses the possible effect of not having an RCS Program. Section 6.2 describes the effects of selected alternatives within the RCS Program. Section 6.3 discusses policy and legislative alternatives that might be used to increase the effectiveness and scope of the Program or to achieve similar goals.

**Various Program alternatives were analyzed in connection with the regulatory analyses. Those alternatives were analyzed in detail in the Draft and Final Regulatory Analyses and were summarized in the Notice of Proposed Rulemaking. Public comment was invited on the draft analysis and proposed rule.*

The Draft Regulatory Analysis examined proposals relating to (1) the scope of the Program audit, (2) the scope of the energy conservation measures audit, (3) the scope and duration of post-installation inspections, (4) the scope of training for energy auditors, (5) the scope of installation standards for loose-fill insulation, (6) the material standard for putty, (7) the material standard for glazing compound, and (8) the material standard for attic insulation. This information was utilized in connection with this EIS. Of these eight sets of alternatives discussed in the Draft Regulatory Analysis, numbers 1, 2, 4, 6, and 7 have not been addressed in this EIS, because they were not considered to present important variations in potential health, safety, or other environmental impacts. Alternative sets 3, 5, and 8 have been addressed in this chapter.

The Final Regulatory Analysis addressed additional alternatives proposed during public comment on the proposed rule and its impact analyses. Those additional alternatives considered to present important variations in potential health, safety, or other environmental impacts have also been addressed in this chapter.

6.1 No-Action Alternative

The impacts of the RCS Program were analyzed in relation to a no-action or baseline alternative postulated to extend through the Program period (from 1980 through 1984) [DOE, October 1979]. This analysis resulted in the estimation that up to 17.2 million homeowners could install at least one energy conservation measure as a result of the Program and, if they did so, could reduce the projected residential energy usage by up to 11.04 quads. (The savings associated with renewable resources are not quantified. They are expected to be much smaller than 11.04 quads.) Using these assumptions, the pollutant emission changes associated with the decreased need to produce energy and the increased need to produce certain energy conservation materials were estimated and used to provide a basis for assessing the environmental impact of the RCS Program.

Using the same baseline period to evaluate the no-action alternative leads to the conclusions that, if the RCS Program were not implemented, (1) less than the estimated 17.2 million homeowners who might participate in the Program would install and benefit from energy conservation and renewable resource measures, (2) less than the estimated reduction in residential energy usage of up to 11.04 quads would be realized, and (3) less than the estimated pollutant emission changes (primarily reductions) would occur.

If the baseline were extended beyond 1984, however, it is possible that some of the households that are expected to install measures from 1980 through 1984 as a result of the RCS Program would eventually install the measures even in the absence of the Program. The likelihood that they would do so should be high if energy-related expenses continue to increase as a proportion of household budgets. Such rising expenses may eventually make the installation of an increasing number of measures a financially attractive or even imperative option regardless of the RCS Program.

Using an extended baseline period to evaluate the no-action alternative leads to the conclusions that it is likely that (1) installation of energy conservation and renewable resource measures by an undetermined number of households that would have installed them under the Program might still be accomplished but at a later date, (2) some of the reduction in residential energy usage associated with these installations might still be realized but at a later date, and (3) some of the corresponding pollutant emission changes might similarly be delayed but might still be realized.

Since the RCS Program provides for consumer information and specifies installation and materials standards, the no-action alternative is also likely to result in a more poorly informed public and in a reduction in benefits that would have been obtained by compliance with the standards. In addition, some people who would have installed measures regardless of the existence of the RCS Program, will take advantage of its services, and will thus be more likely to have safe and effective products installed than had there been no Program. If the RCS Program were not implemented, this benefit would also be negated.

On balance, it seems probable that the no-action alternative would fail to achieve many of the positive impacts estimated in connection with the implementation of the RCS Program. To the extent that the no-action alternative would achieve similar impacts, it seems likely that such impacts would be smaller in magnitude and take considerably longer to occur. Perhaps most importantly, many of the benefits associated with safety and effectiveness standards which are expected to be realized in connection with the Program might not be realized if the no-action alternative were adopted.

6.2 Alternatives Within the Program

6.2.1 Enforcement of Installation Standards

6.2.1.1 Effectiveness

The Program includes a system of post-installation inspections as a mechanism to enforce the installation standards of the RCS Program. A primary purpose of these inspections is to ensure the safety and effectiveness of installations carried out under the Program. The proposed rule requires post-installation inspections of all installations of vent dampers, electric or mechanical ignition systems, and wind energy systems. It requires random post-installation inspections of a specified percentage of all other measures installed under the Program.

The enforcement program established for the RCS Program is related to the experience of utilities which currently have retrofit programs that contain post-installation inspections. Utilities included in this group are the Pacific Gas and Electric Co. (PG & E), Arizona Public Service Co., Salt River Project, and the Tennessee Valley Authority (TVA). Each of these utilities inspect some percentage of the installations that occur under its retrofit program. The percentage inspected ranges from about 5 percent for the

Arizona Public Service Co. and the Salt River Project to 100 percent for the TVA.

The Arizona Public Service Co. inspections are limited to insulation R-values only: that is, the utility checks that the R-value specified by the contractor was actually installed. The Arizona Public Service Co. reported that, of 8000 inspections carried out since the program was begun, only twice was a contractor recalled to the job site.

The Salt River Project, which has to date conducted approximately 24,000 audits and sold about 3,500 installations, reports that its 5 percent random inspections of attic insulation installations have resulted in "practically no problems." "Occasionally," however, cases have been found in which recessed lighting fixtures had been covered by insulation, incorrect materials were used, and work was completed in an unworkmanlike manner. No injuries were reported as a result of these installations. The Salt River Project operates with a specified list of licensed contractors.

The Pacific Gas and Electric Co., whose program was initiated in January 1978, has a policy of inspecting all wall and attic insulation installations for which customers request an inspection. PG & E also urges all customers to request inspections following installation. PG & E reports that, when its program was first begun, the contractor call-back rate was in the range of 40 to 50 percent of all installations. However, by December 1978, that failure rate had dropped to 2 percent. PG & E attributed the initial problems to contractors' inexperience in making installations comply with its standards. Once the contractors become familiar with the standards, installations were increasingly made in conformance with such standards.

TVA's home retrofit program has been in operation for three years and requires a post-installation inspection of any job for which TVA provides financing. To date, TVA has conducted 16,000 such inspections. However, it has only recently begun to maintain a record of the number of installations which were found to be inadequate. TVA reports that in approximately 25 percent of all installations the contractor has been required to return to the site for corrective action. TVA inspects insulation installations for both R-value and handling of recessed lighting fixtures. It inspects storm doors and storm window installations for workmanship and thermal breaks. TVA has been promoting measures other than attic insulation since November 1978. It believes that defects in installations of attic insulation have been reduced overall. As would be expected, the learning process reflects higher initial failure rates for the other measures inspected. As contractors gain experience with standards, conformance increases rapidly.

The effectiveness of the Program enforcement will depend particularly on several factors: first, the extent to which people who decide to purchase measures because of the Program audit do so through the utility's arrangement service (or are otherwise included in the pool for post-installation inspections); secondly, meaningful sanctions and the resources devoted to the inspections by the States or their inspection agents; and third, whether and how much the customer must pay for such inspections, which is to be decided by each Public Utility Commission.

If the 100 percent post-installation inspections of vent dampers, wind energy devices, and electronic ignition systems are carried out as required by the Program, DOE believes the potential hazards of these devices will be reduced to a minimum. However, if the price of the required inspection is perceived by customers as high, customers may decide not to have such inspections. The degree to which this might happen cannot be estimated.

The Program's random post-installation inspection requirement for all other suggested measures is principally designed to assure the effectiveness of the inspected measures. Conversations with representatives of utilities currently inspecting installations of insulation and other measures included in the RCS Program under this category have identified no situations in which improper installation has resulted in a health hazard to the occupants. Thus, reasonable alternatives could include smaller percentages of post-installation inspections consistent with appropriate action to ensure effectiveness. The Program permits States to reduce the 10 percent random inspection requirements upon demonstration to and approval by DOE that the 10 percent level is unnecessary to ensure safe and effective installations under the Program.

The effectiveness of the random inspections in assuring safety and quality will also depend on how effectively contractors are sanctioned for failing to meet the standards and upon the resources devoted to such inspections. If contractors are removed from the Program lists for a specified reasons (e.g., number or type of violations), they may be more likely to meet the standards in every job than if they merely have to correct those violations discovered through the inspections. The sanctions for violation of the standards will be determined by the States. DOE intends to monitor the effectiveness of the enforcement program instituted by the States and to consider changes in the RCS Program regulations if it determines that health and safety problems may occur.

6.2.1.2 Alternative Levels of Inspections

Three alternatives were proposed for the required scope of the random post-installation inspections covering all measures except vent dampers, electric or mechanical ignition systems, and wind systems*:

(1) No inspection requirement

(2) Require distribution of self-inspection materials to all audited homes and offer post-installation inspections on request.

(3) Require inspection of all installed measures.

Two additional alternatives were proposed regarding the duration of the requirement for post-installation inspections:

(4) Require inspections for the duration of the Program.

(5) After an unspecified initial period, States may, at their discretion, remove the inspection requirement.

As mentioned above, DOE has found some evidence that certain conservation and solar measures are not currently being installed properly. Eliminating inspections altogether, as in proposed alternative 1, would increase the safety risk of the covered devices and decrease their effectiveness relative to that under the Program. Perhaps the most noticeable change would be in the effectiveness and safety of insulation measures, as shown by existing inspec-

See the next subsection, 6.2.1.3, regarding these three proposed measures.

tion programs, and the effectiveness and safety of solar systems because of their complexity and relatively recent development. (Alternatives for urea-formaldehyde foam insulation are discussed in Section 6.2.1.4). The magnitude of these problems is uncertain.

The second alternative could potentially accomplish the same degree of safety and effectiveness as the Program requirements. The Program proposed inspection of 20 percent of all measures installed (except that 100 percent inspection would be required for vent dampers, electric or mechanical ignition systems, and wind energy systems). Many of the measures can readily be inspected for both safety and effectiveness by a homeowner. For example, caulking and weatherstripping can be checked easily, as can storm windows and doors, thermal windows and doors, and clock thermostats. Moreover, valuable public information is widely available regarding these measures.

On the other hand, there are some measures which cannot be inspected readily. These measures include ceiling, wall, and floor insulation, active solar space heating systems, and solar domestic hot water systems (and combined active solar space heating-hot water systems). These measures could be inspected by qualified inspectors on request by the homeowner. This alternative, as the first, would noticeably lower the costs of implementing the Program.

There would be no assurance, however, that installations other than these for which inspections are required would be inspected. The effectiveness of the second alternative would depend upon the initiative of the homeowner to conduct the inspection or request it (which would, in turn, be dependent upon the cost of the post-installation inspection) and the quality of the self-inspection documents used by the homeowner. These factors are subject to substantial variation and uncertainty. Thus, while this option might help mitigate potential costs, it would not be likely to achieve the safety and effectiveness which could be realized by requiring inspection of some or all measures installed.

Alternatives 3 and 4 would be both the most expensive approaches and the most likely to reduce safety hazards to a minimum. The magnitude of this reduction cannot be estimated accurately at this time. The adoption of options 3 and 4 would probably add substantial costs to the Program without commensurate value. As noted above, many of the measures can be inspected easily by homeowners. Moreover, as described previously, initial inspections and random post-installation inspections have been successful. Combining these options, as proposed, is thus preferable to alternatives 3 and 4.

Alternative 5 is different from the Program in that it would allow a State to end its inspection program without having to demonstrate that it was no longer needed. The effect of this alternative on potential safety problems cannot be quantified. However, it would not seem reasonable to permit inspections to end without a demonstrable factual basis. The Program permits States to reduce the proposed random inspection percentage requirement if such a basis can be demonstrated to the satisfaction of DOE. It would seem that some level of periodic, selective inspections would be very important for ensuring sensitivity to safety and health considerations and that elimination of these inspections should be permitted only upon a demonstration that they are not required to achieve safety and effectiveness.

6.2.1.3 Vent Dampers, Electric or Mechanical Ignition Systems, Wind Energy Devices

The uncertainty about the magnitude of the potential safety impacts of each of these devices was discussed in Chapter 3 on potential impacts. The Program requires an inspection of every installation of these three devices which occurs under the Program. This approach should minimize the potentially severe safety and health effects associated with these measures should they malfunction. This approach also entails increased personnel and costs. However, these costs were deemed necessary in light of the potential safety impacts of these measures.

An alternative approach would be to reduce the post-inspection requirement to 100 percent of the first ten installations by each contractor, and 20 percent thereafter. This less costly alternative assumes that the higher initial inspection level would assure proper understanding of and compliance with the RCS installation standards by contractors, few of whom are likely to have extensive experience with these devices, while the 20 percent spot checks will be sufficient to ensure safety thereafter. As mentioned above, the effectiveness of the subsequent 20 percent random inspection would depend on meaningful enforcement and sanctions established by States for violations of the standards. The magnitude of the potential increase in safety hazard, if any, associated with reducing the 100 percent inspection requirement in this manner is uncertain.

On balance, DOE believes it is preferable to require 100 percent post-installation inspections for these three devices, at least until there is a factual basis to conclude that potential health and safety risks are minimal. Other alternatives may be suitable for measures with lower potential risks or where there is widespread knowledge and experience with the devices. However, regarding these three devices, more public education and experience is necessary before adopting less stringent alternatives.

6.2.1.4 Urea-Formaldehyde Foam

Uncertainty about the magnitude of the potential safety hazards of this product was discussed in Chapter 3 on potential impacts. The Program requires post-installation inspection of 40 percent of the first ten UF foam insulation installations by each contractor and a random 10 percent of all installations over the life of the Program. The critical aspect of this requirement is to ensure that each contractor installs urea-formaldehyde foam properly from the beginning of his or her association with the RCS Program. The initial inspections should assure this; the subsequent random inspections will help assure continuing reliability. Although this reliability requirement entails costs, they are outweighed by the demonstrated necessity to assure proper installation.

An alternative would be to require inspection of all installations of UF foam insulation performed under the Program. This increase would undoubtedly reduce the potential for unsafe installations under the Program; however, the extent of this reduction cannot be quantified. This approach would increase costs significantly. Moreover, it is not likely that increased post-installation inspections will be more effective than the proposed level. The essential point is that contractors will know that their work will be checked and that they will be held accountable for improper installation.

If urea-formaldehyde foam insulation is improperly installed, the potential health hazard (i.e., formaldehyde vapor) is extremely expensive to correct. It is also almost impossible to determine if the problem occurred as a result of faulty materials or faulty installation. A possible resolution of this problem would be to require the manufacturer and the installer to agree in advance of installation to share jointly and severally in liability for any damages caused in connection with the urea-formaldehyde foam. This alternative would also reduce the potential for health or safety hazards by increasing the incentive to use safe materials and perform a proper installation. The willingness of manufacturers and installers to participate in a program containing such a liability requirement is uncertain.

6.2.2 Material Standards Enforcement

The Program does not require enforcement of material standards. Although contractors must use standard products for all installations performed under the Program, no check of these products is required, with one exception. If a customer or any other person alleges injury because a contractor used substandard products, he or she shall be entitled to redress under appropriate procedures. These procedures might include testing for compliance.

The health and safety hazards of each product have been discussed in Chapter 3, as has the intent and source of the standards contained in the Program. For many of the manufacturers whose products are installed under the RCS, some form of testing procedures currently exists for virtually all of the safety-related properties. The same is true for many of the effectiveness-related properties. As examples: (1) the fire safety and corrosiveness standards proposed by DOE for cellulose insulation are the same as those proposed by the Consumer Product Safety Commission (CPSC); (2) GSA has a testing program which includes fire safety testing for all insulation it purchases (many manufacturers produce all their insulation to GSA specifications); (3) most local building codes do not allow the installation of vent dampers which do not bear the label of a major testing laboratory (such as UL or AGA) that conducts random inspections for compliance with voluntary safety standards.

Some other standards established for material properties are not currently enforced or verified in any way by any testing authorities. Though GSA is likely to adopt certain of DOE's fire safety test procedures in the near future, and then to begin testing for compliance, other RCS Program standards will have no such backup.

Two alternatives are possible to help assure compliance with the material standards:

(1) Require that all materials used in the Program be tested by an independent laboratory for compliance with the safety-related sections of the material standards. These sections are, (a) for all insulation: fire safety and corrosion; (b) for vent dampers and electric or mechanical ignition devices: the entire standard; and (c) for urea-formaldehyde foam insulation: the standard for free formaldehyde content. Laboratories testing insulation would have to be accredited under the National Voluntary Laboratory Accreditation Program (NAVLAP) of the Department of Commerce.

(2) Require that all materials used in the Program be labelled or give other evidence of compliance with DOE

material standards. One alternative to labelling is the distribution of specification sheets (containing test results) to all retailers or contractors to be given to the ultimate user of the product.

Each alternative may reduce the potential for health and safety hazards arising from improperly made material. The first alternative is likely to have the greatest effect since actual testing would be required. The degree to which any potential hazard would be reduced under this alternative cannot be quantified at this time. The disadvantage of this alternative is that it might be costly for many manufacturers to comply with it. Prices for their products might rise, and as a result some manufacturers might not participate in the Program. Some large manufacturers with their own testing facilities might object to the requirement for "independent" testing.

The second alternative is likely to be less effective than the first option since some manufacturers may label their products incorrectly. As with the first alternative, the degree of risk reduction is uncertain. However, DOE believes that the great majority of manufacturers will properly label their products. This alternative is therefore likely to be effective in ensuring compliance with DOE material standards. The alternative also would provide more information to consumers under the Program. On the other hand, it might increase some product costs and might cause some manufacturers to keep their products out of the Program.

A third alternative could be to include both requirements in the Program. This alternative would reduce the potential for hazards and provide more information to the ultimate users. It would, however, increase costs and possibly reduce manufacturer participation. An intermediate approach would be merely to require that either of these alternatives be used. This alternative, while less costly than requiring both proposals, would also be subject to the same objections noted above but to a lesser degree.

6.2.3 Additional Measures

The proposed National RCS Program establishes a mandatory mechanism for adding measures to the audits and other services which utilities and home heating suppliers must offer. That is, for inclusion in the national RCS Program, these measures must be designated by the Secretary by rule in compliance with Section 210(11)(I) of the Act. Several criteria have been proposed for adding measures by rule. These criteria are:

(1) The measure's primary purpose must be the conservation of energy or the use of solar or wind energy;

(2) The measure must be shown to have the potential to save enough energy to pay for its purchase and installation in a substantial fraction of the residential buildings in at least one climate zone;

(3) The measure must not increase consumption of nonrenewable energy in typical houses in a substantial portion of the United States. That is, measures will not be added which would save energy in houses in some areas of the country but which would increase energy use if installed in houses in other areas;

(4) The measure must be shown to have a significant energy savings potential for the nation if installed in houses in which it is appropriate;

(5) The measure must not involve switching from the use of one nonrenewable fuel to another;

(6) Test data or acceptable methods of calculation must be available to estimate the energy cost savings of the measure in individual houses; and

(7) The measure must not present a significant safety, fire, or health hazard when properly installed.

Criterion (7) is especially important.

A more stringent health and safety alternative to criterion (7) would require the following standard in evaluating a proposed additional measure:

(7a) If any evidence exists that the measure creates a potential health, safety, or fire hazard when improperly installed, then necessary material and installation standards which prevent such hazards must be followed.

If such evidence exists of potential hazards, then the Program would establish a requirement for post-installation inspections to reduce the potential number of improper installations.

One alternative would be to eliminate criterion (7) and the alternative criterion from the evaluation of potential additional measures. However, Section 212(b) of NECPA requires that if measures are added to the Program by rule, the Secretary must promulgate necessary safety, effectiveness, and installation standards. Therefore, this alternative would be unacceptable in view of the Congressional mandate.

The resolution thus must be between reasonable alternative criteria which allow evaluation of safety and effectiveness, hazards and the development of appropriate standards. In that regard, criterion (7) is more open-ended than the suggested alternative (7a). For example, questions which would have to be answered under criterion (7) would address what constitutes the proper installation of a given measure and whether such "proper" installation rules out, by definition, a significant safety, fire, or health hazard (thereby possibly negating the need for standards). In contrast, the alternative standard (7a) effectively requires that whenever there is any evidence of a potential health, safety, or fire hazard associated with a proposed measure, necessary material and installation standards be established before adding the measure to the Program. Adoption of the alternative might entail additional costs to manufacturers and might delay the use of some proposed measures until necessary standards are incorporated or designed but would avoid the definitional problems of criterion (7).

Another alternative would be not to add any measure for which evidence exists of potential health or safety problems from improper installation. This alternative would maximize the reduction of potential health or safety problems. A disadvantage of this alternative would be the loss of additional measures which may have a significant energy saving potential and whose demonstrated potential for health or safety problems could be minimized or eliminated through appropriate material and installation standards.

Another alternative or means of complementing the Program list of measures would be to establish an appropriate mechanism for States to include measures in their State Plans for use in their own jurisdictions (State measures).

Such a mechanism could require, as a minimum, certification of the measure by a State agency and approval of the certification by DOE. State measures would not be included as a part of the national Program but rather be offered by States in conjunction with the national Program. They would be offered only in the State certifying them.

States would certify to DOE that such State measures complied with all applicable laws and that there had been adequate public notice and public hearings prior to their inclusion in the State Plan. DOE could further ensure that the potential environmental impacts of any proposed State measures were considered fully by requiring, prior to approval, that the certification include assurances of the following State actions:

(1) The State must have made an adequate analysis of the potential environmental impacts of the proposed State measure, held public hearings on it as part of the State Plan development, and evaluated and completed its analysis in response to the public comments.

(2) The proposed State measure must not have a significant adverse environmental impact.

(3) If the improper manufacture or installation of the measure could create a potential health or safety problem, then the State must establish adequate procedures to mitigate this problem. For example, these procedures could be mandatory material and installation standards.

(4) The measure must reduce energy use in a way which is consistent with national energy policy. That is, the measure must: (a) save oil, such as a conversion from oil

heating to gas heating; (b) save oil and gas (such as a conversion from gas heating to a heat pump where the electricity is generated with coal); or (c) save nonrenewable resources (such as a whole house fan or an effective system to use renewable resources).

(5) The measure must not increase oil consumption, (thus precluding conversions from gas heating to heat pumps where electricity is at least partially generated with oil).

The State agency certification alternative would allow States flexibility in adding measures to address their specific jurisdictional needs, while preserving DOE's ability to ensure that these measures do not adversely affect the Program. Assuming such a mechanism, this alternative might increase the potential for safety hazards in some cases since some States might not have the necessary resources for evaluating potential hazards or for developing and enforcing standards. Since States would be just as concerned with potential health or safety risks as would DOE, it is possible that some States might exclude measures with potential hazards (even though such hazards might be minimized or eliminated through appropriate standards) because of the lack of available resources for the development or enforcement of standards. Viewed as an alternative, this mechanism could disperse personnel requirements; on the other hand, it could increase burdens on State agencies. Viewed as a complementary function, this mechanism might stimulate increased State agency interest and participation, improve the quality of research evaluation and dissemination, and even accelerate the process in some instances. On balance, it would seem that adoption of this option would help achieve the Congressional goals underlying the creation of the RCS Program, particularly in light of the checks and balances established by the proposed criteria.

6.2.4 Indoor Air Quality

As discussed in Chapter 3 on potential impacts, some energy conservation measures reduce the air exchange rate of a house. Reducing the air exchange rate in a house containing a high magnitude of air pollutant emissions could also reduce indoor air quality.

An alternative which could be implemented to mitigate this potential impact and to help inform households of it would be to include consideration of indoor air quality in any audit of energy conservation measures. A checklist could be developed of the potential air pollution sources in a home. During an audit the auditor and the homeowner could review the checklist to determine which sources are contained in the home being audited. If the home contains a considerable number of air pollution sources with a large amount of air pollutant emissions, the auditor could inform the homeowner of the potential impact of relevant energy conservation measures on indoor air quality and of the energy conservation measures that do not affect the air exchange rate. The auditor could also give the homeowner suggestions about how to reduce emissions from indoor air pollution sources. Finally, the auditor could inform the customer of the various ventilation and filtration techniques available for maintaining or improving indoor air quality when installing energy conservation measures which reduce air exchange rates. This alternative would give the homeowner valuable information with which to evaluate the advantages and disadvantages of installing certain energy conservation measures.

Adoption of this alternative would require a longer and costlier audit (with potential corresponding decreases in household participation, energy savings, and pollutant emission changes). It would be important to avoid addressing potential air quality impacts in a subjective manner, which would accomplish little in communicating appropriate information to homeowners so that informed decisions could be made. However, it is also possible that an evaluation and disclosure process could be developed which minimizes time and costs while communicating safety and health considerations on a specific, factual basis. It is likely that specific statements regarding pollutant sources or problems would be beneficial and help mitigate potential indoor air quality impacts. The extent to which this alternative would reduce potential indoor air pollution hazards cannot be quantified since its success would depend primarily upon diligent action by homeowners in response to the information communicated to them.

Another alternative would be to establish the auditing requirements described above only in those parts of the country in which radon is believed to exist in significant concentrations. Utilities could be required to establish a monitoring program in which the air quality would be measured in a specified percentage of the homes which are audited. If significant radon concentrations were found, the utility would be required to inform all customers of the potential problem.

As with the first alternative, auditing and testing costs would be higher than under the proposed action. Also, because of the uncertainty about the magnitude of any potential hazards in a particular house, warnings and disclosures could unnecessarily persuade customers to avoid infiltration reduction techniques. However, by limiting discussion of indoor air quality to those areas where radon is found to be a problem, this alternative would entail lower costs than the first alternative. It would also be less effective because it would limit disclosures of indoor air quality concerns to areas where radon is found to be a problem. It would not address these concerns in other areas where indoor air quality may also become a problem because of other types of pollutants. On balance, the first alternative would seem preferable since it would require focused indoor air quality discussions wherever the Program is in effect. Potentially increased costs would be outweighed by considerations of safety and health.

A third alternative that might contribute to controlling indoor air quality would be to require the use of outside air for combustion in heating furnaces as a measure in the Program. This action might reduce the buildup of indoor-generated pollutants within a residence and reduce the potential for spillage of combustion products in certain tightly weatherized houses. On the other hand, the National Bureau of Standards has concluded that this action frequently would not reduce energy consumption in houses. Considering the lack of verifiable data surrounding the nature of this potential indoor air quality problem, inclusion of outside air for combustion as a Program measure would not appear to be appropriate or necessary.

6.2.5 Scope of Installation Standards for Loose-Fill Insulation

Several requirements were proposed to govern the installation of loose-fill insulation. These requirements have been combined into three alternatives which were considered in the development of the Program:

(1) The first alternative would require the use of:

(a) Soffit vent baffles;

(b) Barriers around recessed lights;

(c) Minimum ventilation requirements in attics;

(d) Vapor barrier on ceilings and walls in attics and bathrooms in Zone 1 only;

(e) Inspection for moisture damage; and

(f) Wire guards unless all loose-fill insulation is below the level of any wiring.

(2) The second alternative would require the use of (a) through (e) above.

(3) The third alternative would require the use of (a) through (e) and include a restriction that all loose-fill insulation be below the level of any wiring.

The first alternative would result in the lowest potential health and safety hazard since no wiring could be covered with insulation. It would probably have the highest installation and materials cost of the three proposed alternatives. The estimated cost of this alternative is addressed in the Regulatory Analysis [DOE, October 1979].

The second alternative would have a higher safety risk than the first alternative since attic wiring would probably be covered in many installations. The magnitude of this safety risk is not known. However, DOE believes the potential for hazard to be small since little or no field data have been found which support laboratory findings about the potential. DOE is conducting research to assess the potential risk (as discussed in Chapter 3). The estimated cost of this alternative is less than that of the first alternative and is addressed in the Regulatory Analysis [DOE, October 1979].

The third alternative would have approximately the same impact as the first since no wiring would be covered with insulation. However, it is more restrictive than the first alternative. Insulation levels could be substantially reduced in some attics to avoid covering wiring under this mandatory restriction.

The second alternative is considered preferable because of the uncertainty surrounding the actual fire hazard associated with covering attic wiring with insulation and the relatively high costs and other drawbacks of the first and third alternatives.

6.2.6 Required Standards for Mineral Fiber Batt Insulation

Some mineral fiber batts are manufactured with a kraft paper vapor barrier attached. Kraft paper is flammable and cannot pass the critical radiant flux test or the smoldering combustion test required for loose-fill insulation under the Program. The materials standard for mineral fiber batt insulation included in the Program does not require the kraft paper covering to be tested for critical radiant flux or smoldering combustion. The standard does require the following statement to appear on all kraft paper coverings:

> "Caution - This membrane covering is flammable. When installed, it should not be exposed."

DOE has accepted CPSC's position that installing the vapor barrier as specified in the warning will control the risk of injury from fire associated with the paper.

The installation standard requires all vapor barriers, including kraft paper, to be installed facing the winter-warm direction in attics and under floors in condensation Zones I and II, thus assuring that the kraft paper is not exposed. If the kraft paper is installed in walls, it must be covered with a fire resistant material having a finish rating of not less than 15 minutes when tested according to ASTM Designation E119-76.

One alternative is to require all vapor barriers to pass the critical radiant flux test and the smoldering combustion test. This would eliminate kraft paper vapor barriers from the Program because of the large expense involved in treating it to pass the fire safety tests. However, it would also decrease the potential for fire safety hazards with mineral fiber batts. The magnitude of this decrease is not known. The potential hazard accepted by the Program standard is believed to be very small (as discussed in Section 3.2.2.1.2).

Another alternative is to expand the installation standard to cover the application of vapor barriers in condensation Zone III. The requirement would be the same as for Zones I and II, i.e., that all vapor barriers must face the winter warm side thus precluding their installation in an exposed manner. This alternative would decrease the potential hazards which may be associated with exposed kraft paper barriers in Zone III. As noted above, however, the potential hazard is believed to be very small. Moreover, controversy exists regarding both the need for and direction of installing a vapor barrier in Zone III. Some information indicates that installing vapor barriers facing the winter-warm side in Zone III may result in moisture damage in some buildings and/or require unwarranted additional expense on the part of the consumer.

6.2.7 Delay Case

The potential health and safety hazards from the installation of various products are of varying magnitude. These potential hazards are discussed in Chapter 3. Potentially serious hazards exist in connection with the installation of certain measures and considerable uncertainty surrounds the magnitude of the hazards associated with other measures and with the infiltration problem. These hazards and uncertainties relate to:

- Vent dampers: the risk of explosion or of release of toxic gases

- Electric or mechanical ignition systems: the risk of explosion or suffocation

- Wind energy systems: the risk of damage from flying parts if the system comes apart while in operation

- Urea-formaldehyde foam wall insulation: the release of formaldehyde gas over an extended time

- Indoor air quality: the installation of caulking, weatherstripping, storm windows, storm doors, and/or other measures which reduce air infiltration may increase to harmful levels the concentration of certain pollutants (including radon) which are present in many homes.

These measures can be divided into three groups. The first group contains vent dampers and electric or mechanical ignition devices. The potential for safety hazards with these devices is well understood. There is sufficient experience and data about them to develop material and installation standards which can be expected to reduce the potential for hazards. Two major uncertainties remain: (1) the magnitude of the safety hazard of these devices if no standards are promulgated; and (2) the magnitude of the potential hazard with the standards and enforcement.

The second group includes wind energy devices and urea-formaldehyde foam. The nature, causes, and remedies of the potential safety hazards for these proposed devices are less well understood than for the first group. Urea-formaldehyde foam has been installed in several thousand homes and the safety problems have been documented. But the causes of these problems and the procedures necessary to prevent them are not completely resolved. Chapter 3 describes the research in this area. Wind energy devices have been installed in far fewer cases and the magnitude of the potential for hazards in the residential building context is not well understood. Chapter 3 describes the safety research being conducted in this area.

The third group includes measures where there is the potential for indoor air quality hazards resulting from the tightening up or sealing of a home resulting from the installation of such measures as storm windows, storm doors, caulking, and/or weatherstripping. There is agreement that high indoor concentrations of certain pollutants could be hazardous. It is also known that sources of these pollutants exist in many homes. These sources include cigarette smoking, aerosol cans, and others discussed in Chapter 3. However, there is considerable uncertainty about whether concentrations of these pollutants present in existing homes may be hazardous and whether and to what extent reducing air infiltration rates is likely to create or increase any such potential hazards.

Recognizing the uncertainty that surrounds the potential hazards associated with the measures in each group, DOE considered several alternatives that would delay the inclusion of these measures in the Program until the degree of uncertainty could be reduced. The alternatives considered included:

(1) Delaying inclusion of such measures until research on all of them is concluded and potential hazards and mitigating strategies are better understood. It is estimated that it would take approximately two years to achieve this level of certainty. During this time, none of those products would be allowed to be installed under the Program.

(2) Delaying inclusion of each proposed measure until potential hazards are assessed more definitively and mitigating strategies are developed. For vent dampers and electric or mechanical ignition devices, such a delay would be approximately six months during which time further data could be collected and evaluated. For urea-formaldehyde foam, the delay would be about 18 months. For wind devices, the delay would be about 18 months. For measures affecting general indoor air quality, the delay would be about six months. Quantification of the potential hazard of low-level radon exposure may take eighteen months or more.

Either alternative could be expected to further minimize or eliminate potential hazards. Delayed inclusion of vent dampers, electric or mechanical ignition devices, and wind energy systems would probably not have a significant effect on the Program because fewer of these measures are expected to be installed under the Program than other measures and because they are relatively less cost-effective. The delay of inclusion of urea-formaldehyde foam insulation would also probably not affect the Program significantly since there are other wall insulation products which can be substituted. However, delayed inclusion of these measures could also have negative effects since it is likely that increasing numbers of persons will install them or have them installed with or without the benefit of the safety and health information which the Program would provide.

The delay of inclusion of caulking, weatherstripping, storm windows, and storm doors, which may cause potential indoor air quality hazards under certain circumstances, could affect the Program significantly. The reduction of air infiltration has been found to be an important recommendation for energy saving. The delayed inclusion of these measures may inhibit the success of the Program significantly. Moreover, these measures are probably the most well known. Because of the increasing cost of energy, it is likely that increasing numbers of residential building owners will utilize these measures, with or without the services of the Program. In the latter case, they might not benefit from information the Program might otherwise communicate to them. Delay regarding inclusion of these measures would seem to serve little purpose and might even be counter-productive. As discussed above (Section 6.2.4) a more appropriate focus would be on ensuring communication of practical knowledge to minimize or eliminate potential indoor air quality problems while continuing to encourage the conservation of energy in residential buildings.

6.3 Policy and Legislative Alternatives

6.3.1 Legislation with Similar Goals

6.3.1.1 Mandatory Program

A major goal of the National Energy Conservation Policy Act is to improve the energy efficiency of America's homes.* Under existing legislation, the Residential Conservation Service Program will contribute to meeting this goal by providing information and services to homeowners and occupants.

An alternative to help meet this same goal would be a requirement that all existing residences meet specified energy efficiency standards, for example, at the time they are sold. Such a proposal, generally called a "time-of-transfer" requirement, has been considered by the U.S. Congress and by a few State legislatures. A time-of-transfer requirement would be based on an energy efficiency standard for existing homes. This standard would be analogous to the lists of suggested measures contained in the RCS Program rule, though some suggested measures might not be considered appropriate for a mandatory program. This alternative would require new legislation.

Approximately three million existing single-family homes are sold each year. Thus, some improvement would probably be assured for those homes (some of which would already include some measures). The estimated energy savings from such a program by 1985 would be approximately the same as those projected for a moderately successful Residential Conservation Service Program, since on the average between three and four million homeowners a year are expected to install measures because of the RCS Program.

*NECPA §102(b) Congress declared the intent to "reduce the growth in demand for energy in the United States," *inter alia*.*

The national pollution effects could therefore be expected to be about the same as those projected for the RCS Program in Chapter 3. Many of the potential adverse site-specific effects might be reduced below those for the RCS Program if a time-of-transfer program included 100 percent inspection of all required conservation measures for compliance with appropriate safety and effectiveness standards. This approach would entail substantial costs. Indoor air quality would still be a potential problem under this alternative since storm windows and doors, caulking, and weatherstripping are likely to be installed in a large number of houses.

6.3.1.2 Increased Tax Incentives

The Energy Tax Act of 1978 included tax credits for certain conservation and renewable resource measures installed in residences. These credits complement the information and services provided through the RCS Program. Increased tax credits would probably substantially increase the purchases of both conservation and solar measures. In particular, increased credits for those taxpayers who participated in the RCS Program would probably substantially increase the effectiveness of the Program.

If additional tax credits were related to the RCS Program and increased the participation in it, the potentially positive and adverse impacts of the Program would be increased proportionately. If such credits were not tied in any way to the RCS Program, however, then certain adverse impacts might increase more than the positive impacts since no safety standards are required for measures currently eligible for tax credits. Thus, increased tax credits independent of the RCS Program could increase potential site-specific hazards associated with such devices or products as vent dampers and urea-formaldehyde foam insulation.

6.3.2 Amendments to NECPA

6.3.2.1 Increased Funding for Promotion and Training

Increased funding would probably help increase the number of homeowners participating in the RCS Program and the number who eventually reduce energy consumption as a result of the Program since increased funding to DOE and to States and utilities should increase Program effectiveness. Such funds would be appropriated by Congress and by the States and authorized agencies. The funds could pay for increased (or higher quality) promotion for the Program and for increased training for auditors, inspectors, and installers. The principal effect of such alternatives probably would be to magnify each of the positive and adverse effects described in Chapter 3. Adoption of this option would entail increased costs and personnel.

6.3.2.2 Funding for Enforcement

Similarly, funds could be appropriated to assist State listing of contractors and lenders and State enforcement programs. As NECPA and the Program currently exist, States and utilities must generate adequate funds for listing and enforcement from their own revenues. The larger part of those funds probably will come from utility revenues authorized by State Regulatory Authorities; however, many States may be unwilling or unable to find adequate revenues to complete the funding for their listing and enforcement programs. Inadequate funding will probably aggravate the safety and effectiveness problems arising from the improper installation of measures described in Chapter 3. Federal funding would help mitigate this problem. Meaningful enforcement is crucial to the success of the Program, especially in its early stages. Without this oversight aspect, it is likely that many of the potential goals of the Program will not be achieved, particularly in the areas of quality assurance.

6.3.3 Policy Options

6.3.3.1 Exemptions and Waivers

Section 216 of NECPA generally prohibits utilities from either installing or financing the installation of any energy conservation or renewable resource measure. This prohibition is reflected in the Program. Certain exemptions are allowed, particularly for small loans and for furnace modifications. The Secretary is also given the discretion to waive the prohibition, based on certain findings about prices, interest rates, and competition.

Several existing utility programs which offer financing at low interest rates appear to stimulate increased purchases of conservation measures. Assuming that this apparent fact is verified, DOE could further encourage such programs by establishing specific criteria for exemptions or by waiving the statutory prohibition on financing, and by persuading utilities and States to begin or accelerate such activities. Similar encouragement could be offered for direct installation programs although the evidence for their effectiveness is less clear. Each of the positive and adverse effects described in Chapter 3 would be proportionately increased to the extent such a policy is successful. It is not believed such programs would either increase or decrease the relative magnitude of any particular environmental effect.

6.3.3.2 CPSC Standards

Any product covered by CPSC standard must be produced and/or installed according to such standard in every situation regardless of its relation to the RCS Program. The Consumer Product Safety Commission has worked with DOE in the development of material and installation standards; however, with the exception of cellulose insulation, no energy conservation or renewable resource measure is covered by a CPSC mandatory product standard.

A possible Program alternative would be to recommend to the CPSC that it establish mandatory product standards for those measures which DOE believes have substantial health and safety risks.* Such standards historically cover only material properties but could include installation quality as well. As discussed elsewhere in this Chapter, there is a risk that the RCS Program will both increase the installation of certain potentially hazardous materials and devices and provide inadequate procedures to reduce those hazards. For example, although the Program will promulgate material and installation standards for vent dampers, many homeowners may purchase them outside the coverage of the RCS

This action would occur after consultation with the Secretary of Commerce, acting through the National Bureau of Standards, and the Federal Trade Commission regarding product or material standards pursuant to Section 222 of NECPA.

Program inspection program. CPSC standards for the sale and installation of such devices would cover installation outside the RCS Program and would thus reduce even further the potential health and safety hazards. The additional incremental extent of such reduction cannot be quantified. It is likely that this alternative would entail some extra costs although the significance of such potential additional costs cannot be quantified.

6.3.3.3 State Standards

The RCS Program requires as a minimum that a participating State establish a system of post-installation inspections for measures installed "under the RCS Program." The Program requires that such inspections be required at least for those products whose installation is "arranged" by the utility. The definition of "arrange" is left to the States, within certain limits. Those installations which take place "outside" the RCS Program are not required to meet Program standards (or perhaps any standards) even though they may occur in connection with knowledge of RCS Program information and activities. However, to the extent that DOE encourages states to adopt and promulgate standards similar to or the same as Program standards, potential health and safety hazards associated with such measures would be further reduced. Where the State standards exceed Program standards, such potential hazards should be reduced even further. The magnitude of this additional reduction is uncertain. It would particularly depend on the resources devoted to enforcement and appropriate sanctions.

7.0 RELATION TO LAND USE PLANS AND POLICIES

7.1 Energy Conservation Measures

7.1.1 Primary Impacts

The energy conservation measures included in the RCS Program are to be installed on or within existing residential buildings. It is believed that all installations and uses will comply with State and local land use plans and policies. Certain measures will be installed within existing buildings, including furnace efficiency modifications, insulation, and clock thermostats and will not be visible on the outside of the building. Several of the Program's energy conservation measures will be visible from the street outside the residence. Measures of this type may include storm doors and windows, heat reflective and heat absorbing window and door material. Where local zoning provisions, covenants or building codes are concerned with the appearance or aesthetics of these items, it is anticipated that the building owner, in accordance with the local zoning authority, will exercise proper judgment in choices of materials and colors. Many of these devices are currently installed in residential buildings based on the judgment of the building owner regarding local requirements.

7.1.2 Secondary Impacts

Secondary land use impacts due to use of these energy conservation measures are those resulting from the manufacture of the energy conservation materials. Should any new manufacturing facilities (for example, a cellulose insulation plant) be constructed as a result of the RCS Program, it is expected that these facilities will be constructed in accordance with applicable land use plans and policies.

7.2 Renewable Resource Measures

7.2.1 Solar Systems

Application of solar technology requires exposure of the solar energy collection mechanism to the sun. This exposure, in turn, raises two potentially significant issues related to land use plans and policies: (1) conformance of the exposed solar collection surface, or solar collector, to local zoning and building covenants for appearance; and (2) solar access, or the capability of the solar collection surface, or collector, to achieve exposure to the sunshine.

7.2.1.1 Appearance of Solar Systems

The visual impacts of individual solar buildings will depend on the size, type, and location of the collector and on overall building design. For individual buildings, visual impacts will be the greatest for retrofit systems which are not integrated into the existing buildings and which contrast with the building style. Groups of buildings using solar systems may also produce a significantly different visual appearance from traditional landscapes.

Solar collectors installed in residential settings have stimulated some legal challenges. One case, currently in the Courts of Arizona, seeks injunctive relief against a solar collector in a housing development, on the grounds that the collector violated a restrictive covenant and that it was aesthetically objectionable, thereby reducing property values in the area [Solar Law Reporter, May/June 1979]. Several other cases have recently been reported [J. Wiley, July/August 1979] where architectural covenants have operated to inhibit the building owner from installing an active solar system.

In general, however, research and experience to date indicate that aesthetic considerations are not likely to be a significant barrier to widespread solar energy acceptance. Many architects have found solar systems to be compatible with traditional designs for both new and retrofit installations [Page, March 1973]. A study of early solar users by the American Institute of Architects (AIA) Research Corporation concluded that aesthetics appears to be among the least significant potential constraints to solar development [AIA Research Corp., August 1976].

Site inspections and DOE/HUD demonstration program records indicate that aesthetic considerations have been an issue in only a few cases and that the issue was satisfactorily resolved in each case. In several cases, rooftops have been designed with raised parapets to conceal collectors. In another, where rooftop collectors were completely forbidden by a subdivision ordinance, collectors were placed on the ground and screened from view on three sides by a redwood fence.

Only one manufacturer interviewed found aesthetic objections a major concern: it had been forced by the local community to orient two test collectors away from the south to accommodate building design. The most visually obtrusive solar project observed featured concentrating tracking collectors jutting vertically from the roofpeak of a conventional frame dwelling. Even in this case, the only aesthetic objections from neighbors concerned glare, which was corrected by applying a flat, transparent finish to the silvery surface.

Thus, in general, experience has shown that solar systems can be and are being adapted to existing visual tastes and aesthetic restrictions. Flat plate collectors integrated into the roof or mounted in a sawtooth configuration on a flat roof have produced almost no aesthetic problems. Solar-heated buildings have passed required architectural and cultural reviews in historic and other restrictive areas such as university campuses. A solar system employing flat plate collectors was recently installed in the White House. It is thus not believed that there will be significant numbers of cases where proposed applications of solar systems in connection with the Program will conflict with State or local land use restrictions governing appearance or aesthetics. Some site-specific problems may occur. They would have to be resolved on a case-by-case basis in compliance with applicable laws.

7.2.1.2 Solar Access

Solar access, or the ability to obtain direct and sufficient exposure of solar collectors to the sun, has become an issue of substantial governmental and legal deliberation and action. By a recent count, 18 states have passed solar access laws [Johnson, May/June 1979*]. Some states, including Colorado, California, and Illinois, have passed laws governing the content and recording of solar easements. Under California law, the Solar Rights Act (of 1978) defines solar easements as "the right of receiving sunlight upon or over land." Typically these laws specify the vertical and horizontal angles at which the solar easement extends over the real property subject to the easement.

Other States, including Connecticut, Minnesota, and Oregon, have passed laws incorporating solar considera-

**Much of this discussion of solar access is adapted from this source.*

tions into zoning and land use planning. Under such laws, local zoning bodies are authorized to use traditional land use controls (such as height, setback, bulk, size, and lot percentage regulations) for the purpose of assuring "access to direct sunlight." This protective mechanism is more easily applicable to new construction than retrofit solar applications.

Finally, the legislative definition of a public nuisance has been used to address access problems. California law, for example, declares the shading of solar collectors by trees to be a public nuisance. While recognizing that shade trees and shrubs can have beneficial effects upon energy conservation, the California law nevertheless provides for protection of existing solar collectors from new or subsequent shading of more than 10 percent of the absorption surface area between 10 a.m. and 2 p.m. The law provides this protection to both active and passive collectors.

In summary, solar access is an evolving area under Federal, State and local law. As described above, there has been substantial action at the State and local levels to ensure solar access. To that extent, traditional land use concepts, which may not have addressed solar access considerations, are being modified.* It is not believed that

**Alternative approaches to solar access law have been described to help facilitate action by States and local governments [Hayes, May 1979, and Wiley, July/August 1979]. These alternatives comprise both State and local government approaches, including a model solar access ordinance that could be used as the basis for action by a local government.*

any actions taken in connection with the RCS Program will conflict with land use considerations. However, because of the evolving nature of this area, some site-specific conflicts might occur and would have to be resolved on a case-by-case basis in compliance with applicable law.

7.2.2 Wind Systems

It is believed that the only substantial interaction of residential applications of small wind energy conversion systems with land use plans and policies would concern siting. The siting of wind systems installed for residential energy applications is generally controlled by local governments. Several local governments have adopted specific zoning standards and other provisions to regulate the installation of wind systems in residential areas. Other jurisdictions are considering wind system ordinances [Solar Law Reporter, July/August 1979].

State and local approaches to regulating residentially oriented wind systems are evolving and will likely reflect a broad range of criteria. In general, it is not believed that proposed applications in connection with the Program will conflict with land use plans, policies or controls. However, because of the evolving nature of this area, some site-specific conflicts might occur and would have to be resolved on a case-by-case basis in compliance with applicable law.

7.2.3 Secondary Land Use Impacts

The secondary land use impacts associated with the application of renewable resource measures are those associated with the manufacturing of the measures. As discussed above for the energy conservation measures, it is not believed that there will be any material zoning or land use issues regarding these activities.

REFERENCES - CHAPTER 7.0

American Institute of Architects Research Corporation, August 1976. Early Use of Solar Energy in Buildings, A Study of Barriers and Incentives to the Widespread Use of Solar Heating and Cooling Systems.

Hayes, G.B., et al., May 1979. Solar Access Law, Environmental Law Institute.

Johnson, Stephen B., May/June 1979. "State Approaches to Solar Legislation: A Survey," Solar Law Reporter, Volume 1, No. 1.

Page, Clint, March 1973. "New Concepts of Residential Use of Solar Energy," American Institute of Architects Journal.

Solar Law Reporter, May/June 1979, Volume 1, No. 1.

Solar Law Reporter, July/August 1979, Volume 1, No. 2.

Wiley, J. "Private Land Use Controls as Barriers to Solar Development: The Need for State Legislation." Solar Law Reporter, July/August 1979, Volume 1, No. 2.

8.0 OFFSETTING CONSIDERATIONS

The potentially adverse environmental impacts associated with the installation of energy conservation and renewable resource measures in households are discussed in Chapter 3. The most important of these potential adverse impacts are: (1) a slight increase in certain pollutant emissions associated with the production of conservation and renewable resources measures; and (2) certain health or safety risks in residential buildings due to the installation of certain measures. The Program includes several approaches to offset the second type of potential impacts. They include:

- Specific material standards for energy conservation and renewable resource measures
- Specific standards for the installation of energy conservation and renewable resource measures
- Random post-installation inspections for energy conservation and renewable resource measures that are judged to have some risk of minor adverse safety or health impact
- Mandatory post-installation inspection of energy conservation and renewable measures having some risk of a serious adverse safety or health impact
- Vigorous enforcement of State and local building codes and regulations.

In NECPA, Congress emphasized the national policy to reduce the growth in demand for energy.* At the same time, Congress emphasized that the RCS Program had to evaluate and integrate necessary standards to protect the public.** The Program has set forth analyses and options to meet these goals and to minimize or avoid potential adverse environmental impacts.

In accordance with the Congressional mandate, DOE assessed the requirements for safe and effective installation for each energy conservation and renewable resource measure. DOE evaluated existing standards in both the public and private sectors covering these measures in order to make a determination concerning their adequacy as assurance of safety and health. The potential for adverse impacts of several measures is uncertain. These uncertainties are listed in Chapter 6 (section 6.2.7) and are described in Chapter 3. In several instances, DOE determined that more stringent standards were called for. These standards, developed in compliance with Congressional direction, have been described in Chapter 3 in connection with the measure(s) to which they apply.

**NECPA, § 102*

***NECPA, §§212(b), 220 and 222*

APPENDIX A

METHODOLOGY FOR ASSESSING THE POTENTIAL POLLUTANT EMISSION IMPACTS ATTRIBUTABLE TO THE INSTALLATION OF ENERGY CONSERVATION MEASURES

APPENDIX A

METHODOLOGY FOR ASSESSING THE POTENTIAL POLLUTANT EMISSION IMPACTS ATTRIBUTABLE TO THE INSTALLATION OF ENERGY CONSERVATION MEASURES

The methodology used to estimate the pollutant emission changes associated with the decrease in demand for residential energy and the increase in demand for ceiling insulation, water heater insulation, and wall insulation consists of: (1) estimating the reduction in residential energy usage, (2) estimating the amount of materials required, (3) selecting pollutant coefficients for energy conversion/use and materials production activities and multiplying the amount of energy savings and materials needed by the pollutant coefficients, and (4) summarizing the results. Also included in Steps (1) and (2) are estimates of the percentage reduction/increase represented by the energy reduction and materials demand in relation to the total residential and national energy consumption and the total industry-wide materials production, respectively.

The energy required to manufacture ceiling insulation, water heater insulation, and wall insulation to accommodate the RCS Program market was also estimated. The methodology and assumptions used to estimate this energy requirement are presented in the last section of this Appendix.

This analysis was conducted assuming 35 percent of a utility's residential customers will request an energy audit under the RCS Program, i.e., 7 percent will respond each year for the estimated 5-year Program period. It was further assumed that 75 percent of the customers who receive this audit will actually purchase and install some energy conservation measures. This represents the maximum homeowner response expected from the RCS Program.

In estimating the pollutant emission changes, an attempt was made to make the emission reductions associated with the energy savings as small as reasonably possible and the emission increases associated with the materials production activities as large as possible. The purpose for this was both to understate the benefits and to overstate the adverse impacts resulting from this analysis. To obtain this worst-case condition, pollutant coefficients and assumptions were selected based on least polluting conditions for energy conversion/use activities and most polluting conditions for materials production activities whenever a choice was given.

The Regulatory Analysis of the RCS Program [DOE, April 1979 (c), October 1979] provided some of the information which was used as a basis for this analysis. This information, presented in Table A-1, consists of estimates of the reduction in residential energy usage and estimates of household participation levels for the 7 percent annual response rate for the energy conservation measures analyzed.

The following discussion presents the assumptions and methodology used to estimate the pollutant emission changes and manufacturing energy requirements based on the information presented in Table A-1.

A.1 Estimation of Reduction in Residential Energy Usage

The total reduction in residential energy usage for the energy conservation measures analyzed is presented in Table

TABLE A-1. TOTAL REDUCTION IN RESIDENTIAL ENERGY USAGE AND HOUSEHOLD PARTICIPATION LEVELS AT A 7 PERCENT ANNUAL RESPONSE RATE

[DOE, October 1979]

(1) Energy Conservation Measure	(2) No. of Households Installing Measure	(3) % of Households With Various Fuel Types: %	Type*	(4) No. of Households with Various Fuel Types	(5) Lifetime Energy Savings For Each Measure (Btu)[2]	(6) Total Energy Savings Btu x 10^9
Ceiling Insulation (From No insulation to R-19)	3,295,000	10	ERH	329,500	505,600,000	166,595.20
		5	EHP	164,750	337,000,000	55,520.75
		62	GH	2,042,900	815,400,000	1,665,780.66
		23	OH	757,850	732,800,000	555,352.48
		36	EAC	1,186,200	67,600,000	80,187.12
Subtotal						2,523,436.21
Water Heater Jackets	11,671,000	25.1	ERH	2,929,400	5,100,000	14,939.94
		0.7	CC[1]	---	---	---
		60.0	GH	7,002,600	15,000,000	105,039.00
		9.7	FO	1,132,100	17,350,000	19,641.94
		0.1	WOOD[1]	---	---	---
		0.2	OTHER[1]	---	---	---
		3.8	NONE[1]	---	---	---
Subtotal						139,620.88
Wall Insulation (From No Insulation to R-13)	10,813,000	10	ERH	1,081,300	316,000,000	341,690.80
		5	EHP	540,650	210,600,000	113,860.89
		62	GH	6,704,060	509,600,000	3,416,388.98
		23	OH	2,486,990	458,000,000	1,139,041.42
		36	EAC	3,892,680	49,000,000	190,741.32
Subtotal						5,201,723.41
TOTAL						7,864,780.50

Source: Regulatory Analysis of the RCS Program

**Type:* *ERH - Electric Resistance*; *EHP - Electric Heat Pumps*; *GH - Gas Heat*; *CC - Coal or Coke*; *OH - Oil Heat*; *EAC - Electric Air Conditioning*; *FO - Fuel Oil*

[1]*Energy savings data not available for these fuel types.*

[2]*The estimates assume a Program duration of five years.*

A-1. These energy usage reduction figures were disaggregated into three categories -- electricity, gas, and oil -- as follows [DOE, October 1979]:

Gas	-	5,215,987.80 x 10^9 Btu
Oil	-	1,695,009.80 x 10^9 Btu
Electricity	-	953,782.90 x 10^9 Btu

The breakdown of electricity production by fuel source was [DOE, April 1979(b)]:

Coal	-	44.4% or	423,479.61 x 10^9 Btu
Oil	-	16.5% or	157,374.18 x 10^9 Btu
Gas	-	13.8% or	131,622.04 x 10^9 Btu
Nuclear	-	12.5% or	119,222.86 x 10^9 Btu
Hydroelectric	-	12.8% or	122,084.21 x 10^9 Btu

This represents the current (January 1979) distribution of fuel sources for electricity generation. Projections of the future distribution indicate a greater reliance on coal and less reliance on oil and gas. The use of coal is projected to constitute from 52 to 58 percent of the fuel consumption by electric utilities in 1990. The corresponding ranges for oil and gas are: 7 to 12 percent and 1 to 2 percent, respectively [DOE, April 1979(a)].

The pollutant emission reductions estimated for the RCS Program are based on the current distribution of fuel sources rather than a projected distribution. This choice was made because of the variation in the projections available. The effect of this choice should be to produce a worst-case estimate of the net reduction in pollutant emissions. This is because the estimated emission reductions will be understated using the current distribution of fuel sources. Using any of the projected distributions, coal-fired power plants would realize an even greater portion of the RCS Program energy usage reduction than oil- or gas-fired power plants. Since coal as a fuel generates more pollutants than oil or gas, the associated pollutant emission reductions using one of the projected distributions should be greater than those estimated. Therefore, the net reductions due to the Program should also be greater.

As will be shown later in this section, the pollutant emission reductions associated with the reduced demand for energy exceed, by many orders of magnitude, the pollutant emission increases associated with the increased demand for energy conservation materials. Consequently, it was felt that a quantitative analysis based on a future distribution of fuel sources would not significantly change the overall results of the pollutant emissions analysis and would, therefore, not materially change the analysis of the environmental impacts of the RCS Program.

The total reduction in residential energy usage, as calculated from Table A-1, is 7.86 quads. This energy usage reduction will occur over a long period of time: from installation of the first energy conservation measure to the end of the useful life of the longest lasting measure. The useful life of the measures listed in Table A-1 ranges from 5 to 20 years [DOE, April 1979(c)]. Adding an additional five years to the twenty to account for the Program period, results in an average annual reduction in residential energy usage of 0.31 and 1.57 quads (over the 5 to 25 year period). The projected 1985 energy consumption is 12.23 quads for the residential sector and 72.29 quads nationally [DOE, April 1978]. The average annual usage reduction savings from the RCS Program should, therefore, be between 2.6 and 12.9 percent of the total residential energy consumption and 0.4 and 2.2 percent of the national energy consumption for 1985.

A.2 Estimation of Amount of Materials Required

Based on the household participation levels presented in Table A-1, the amount of materials needed for ceiling insulation, water heater insulation, and wall insulation were calculated as follows:

A.2.1 Ceiling Insulation

The distribution of ceiling insulation was assumed to be:

65 percent fiberglass
20 percent cellulose
15 percent rock wool

This was the estimated 1975 distribution of insulation for the retrofit market [ICF, June 17, 1977]. It is likely that this distribution will not remain constant but will vary with market conditions. The percentage that cellulose will represent of the future retrofit market may increase substantially over 20 percent; however, a more recent or projected retrofit insulation distribution was not found. Therefore, the 1975 distribution was used. Since fiberglass production generates more pollutants than cellulose production, the 1975 distribution represents a worst-case condition in terms of the total pollutant emission increases.

It was assumed that two-thirds of the total number of households would install the insulation on a do-it-yourself basis and would install batts. The remaining one-third would retain a contractor to install the insulation. This proportion is based on actual household response to one utility program [Booz, Allen, June 1978]. It was also assumed that the contractor would install batt insulation in 10 percent of the homes and loose-fill insulation in 90 percent of the homes [Communication, Nationwide Insulation Contractors].

Applying these assumptions to the total household participation levels for ceiling insulation results in the following retrofit distribution:

Fiberglass:			
Batts	-	1,874,031	households
Loose-fill	-	267,719	
Rock Wool:			
Batts	-	432,469	households
Loose-fill	-	61,781	
Cellulose:			
Loose-fill	-	659,000	households

In estimating the amount of insulation required for these homes it was assumed that: the average attic was 1200 ft^2; insulation could be installed in 80 percent of the attic area; homeowners were insulating from no insulation to R-19; the density of insulation averages 0.8, 2.0, and 2.6 lb/ft^3 for fiberglass, rock wool, and cellulose, respectively [DOE, June 1978]; and the depth of insulation needed for R-19 was 6.5 inches for fiberglass batts, 9 inches for fiberglass loose-fill, 5.25 inches for rock wool batts, 7 inches for rock wool loose-fill, and 5 inches for cellulose loose-fill [Predicasts, Inc., January 23, 1978]. Based on these assumptions, the amount of insulation needed per home was estimated at:

Fiberglass	-	Batts	416 lbs
Fiberglass	-	Loose-Fill	576 lbs
Rock wool	-	Batts	840 lbs
Rock wool	-	Loose-Fill	1,120 lbs
Cellulose	-	Loose-Fill	1,040 lbs

Multiplying the amount of insulation times the number of homes expected to install that type of insulation results in the following requirements for insulation:

Fiberglass:	batts	779,596,896 lbs
	loose-fill	154,206,144
	Total	933,803,040 lbs
Rock wool:	batts	363,273,960 lbs
	loose-fill	69,194,720
	Total	432,468,680 lbs
Cellulose:	loose-fill	685,360,000 lbs

A flame retardant is usually added to cellulose at a maximum rate of 25 percent by weight. The most common flame retardant used is boric acid [DOE, June 1978]. Assuming only boric acid is used and is added at the maximum rate, the amount of boric acid needed is estimated at:

$$25.\% \times 685{,}360{,}000 \quad = \quad 171{,}340{,}000 \text{ lbs}$$

This demand for insulation and boric acid will occur over the five-year RCS Program period (1980 to 1985). Averaged over this five-year period the demand for fiberglass, rock wool, cellulose, and boric acid would be 186.76, 86.49, 137.07, and 34.27 million pounds per year, respectively.

The projected 1980 demand for fiberglass, rock wool, and cellulose insulation for industrial equipment, industrial/commercial building, and new residential construction is 2.938, 0.920, and 0.058 billion pounds, respectively [ICF, June 17, 1977]. The baseline residential retrofit demand for ceiling insulation, water heater jackets, and wall insulation has been estimated at 4.025, 2.288, and 7.541 billion pounds of fiberglass, rock wool, and cellulose, respectively, during the program period.* Averaging this existing residential baseline demand over the five-year period and adding the projected demand for the other uses result in a total 1980 projected baseline demand of 3.743, 1.378, and 1.566 billion pounds for fiberglass, rock wool, and cellulose, respectively.

The 1978 production of boric acid was 0.386 billion pounds [D of C, Bureau of Census]. The residential baseline demand for boric acid was estimated at 1.885 billion pounds (25 percent of 7.541, the cellulose baseline residential retrofit demand). Averaging this baseline demand over the 5-year period and adding in the 1978 production results in a total estimated baseline demand for boric acid of 0.763 billion pounds/year.

The maximum RCS Program demand for ceiling insulation would therefore require an increase of approximately 5, 6, 9, and 4.5 percent in the production of fiberglass, rock wool, cellulose, and boric acid, respectively.

**This baseline residential retrofit demand was derived by estimating the number of households expected to install ceiling insulation, water heater jackets, and wall insulation regardless of the Program and applying the same methodology described in Sections A.2.1, A.2.2, and A.2.3 to obtain demand figures for fiberglass, rock wool, cellulose, and boric acid. The household levels used are 2,953,000 for ceiling insulation, 19,615,000 for water heater jackets and 24,029,000 for wall insulation [DOE, October 1979].*

A.2.2 Water Heater Insulation

Water heater jackets are made primarily out of fiberglass insulation. Assuming the average water heater is five feet tall, two feet in diameter, and is insulated only on the sides with 3.5 inches of fiberglass (R-11), the amount of fiberglass needed would be 7.3 pounds per water heater. Multiplying this insulation requirement by the total number of homes expected to install water heater jackets (11,671,000 homes) results in a total fiberglass requirement of 85,198,300 pounds.

This fiberglass demand averaged over a five-year period would be 17.04 million pounds per year and would require a fiberglass production increase of approximately 0.5 percent in 1980.

A.2.3 Wall Insulation

For purposes of the pollutant emissions analysis, the distribution of wall insulation was assumed to be:

35.9 percent cellulose
51.3 percent fiberglass
12.8 percent rock wool

This distribution is partially based on a field study conducted in Massachusetts [Burch, et al., September 1976]. It is recognized that urea formaldehyde may be used in a substantial number of households. The use of urea formaldehyde was not considered in the pollutant emissions analysis because of the unavailability of information relative to the amounts of the various ingredients in urea formaldehyde. The actual chemical mix of the ingredients is proprietary information.

The total number of households estimated to install attic insulation as a result of the RCS Program is 10,813,000. Distributing this number of households in accordance with the percentages presented above results in the following breakdown of households:

Cellulose	3,881,867
Fiberglass	5,547,069
Rock Wool	1,384,064

The amount of insulation needed per home was calculated assuming: an average floor area of 1200 ft^2 (25 ft by 48 ft), an average height of 8.5 ft, a wall space thickness of 3.5 inches, the window area is 10 percent of the floor area, an average of three doors per household with an area of 21 ft^2 each, and an average density of 0.8, 2.0, and 2.6 lb/ft^3 for fiberglass, rock wool, and cellulose, respectively [Predicasts, Inc., January 23, 1978].

The total wall area per household which could support insulation is:

$$[2(25)(8.5) + 2(48)(8.5)]-0.10(1200)-3(21) = 1,058 \text{ ft}^2$$

The estimated volume of insulation per household is:

$$\left(\frac{3.5}{12}\right)(1058) = 309 \text{ ft}^3$$

The amount of insulation needed per household and the total amount of wall insulation needed to accommodate the RCS Program is estimated at:

Insulation	Density (lb/ft^3)	Insulation per Household (lbs)	Total Amount of Wall Insulation Needed (lbs)
Cellulose	2.6	803	3,117,139,000
Fiberglass	0.8	247	1,370,126,000
Rock Wool	2.0	618	855,352,000

Assuming that boric acid is the only flame retardant used for cellulose and that it is added at a rate of 25 percent, by weight, the amount of boric acid needed would be:

$$(.25)(3,117,139,000) = 779,285,000 \text{ lbs.}$$

Averaged over the 5-year Program period the demand for wall insulation would be 623.43, 274.03, and 171.07 million pounds per year for cellulose, fiberglass, and rock wool, respectively. The demand for boric acid would be 155.86 million pounds per year.

Using the same baseline demand for these materials as was used in Section A.2.1, the RCS Program demand for wall insulation would require an estimated production increase in 1980 of approximately 40, 7, 12, and 20 percent for cellulose, fiberglass, rock wool and boric acid, respectively.

A.3 Selection of Air and Water Pollutant Coefficients and Estimation of Pollutant Emission Changes

A.3.1 Energy

A.3.1.1 Electricity

A.3.1.1.1 Hydroelectric Power Plants. Pollutant emission changes from hydroelectric power plants were not calculated because of the low level of air and water pollutant emissions associated with hydroelectric plants [DOE, January 1979].

A.3.1.1.2 Oil and Gas-Fired Power Plants

Air pollutant coefficients for oil- and gas-fired electric power plants are [EPA, June 11, 1979]:

Particulates: 0.03 lb/Btu x 10^6 of input - oil and gas

Sulfur Dioxide: 0.8 lb/Btu x 10^6 of input - oil and gas

Nitrogen Oxides: 0.2 lb/Btu x 10^6 of input - gas
0.3 lb/Btu x 10^6 of input - oil

Multiplying these coefficients by the reduction in energy usage for the gas and oil modes of generation and assuming an average power plant efficiency of 37.9 percent [FEA, April 1976] result in the following air pollutant emission reductions:

Particulates:
- Oil - 12,457,059 lbs
- Gas - 10,418,631

Sulfur Dioxide:
- Oil - 332,188,240 lbs
- Gas - 277,830,164

Nitrogen Oxides:
- Oil - 124,570,590 lbs
- Gas - 69,457,541

The wastewater effluent limitations for oil- and gas-fired power plants are [EPA, October 8, 1974]:

Bottom Ash: Total Suspended Solids: 30 mg/l
Oil and Grease: 15 mg/l

Fly Ash: Total Suspended Solids: 30 mg/l
Oil and Grease: 15 mg/l

Cooling Water: Free Chlorine: 0.2 mg/l

Bottom ash and fly ash water are discharged from oil-fired power plants. Cooling water is discharged by oil- and gas-fired power plants.

Average flow rates for these water usages are [Communication, John Lum]:

Fly Ash Water: 256.25 gallons per megawatt-hour
Bottom Ash Water: 145.83 gallons per megawatt-hour
Cooling Water: 12.5 gallons per megawatt-hour

Using these flow rates and conversion coefficients, the wastewater effluent limitations were converted to pounds per Btu x 10^9 as follows:

Bottom Ash:
Total Suspended Solids - 10.69 lbs/Btu x 10^9
Oil and Grease - 5.34 lbs/Btu x 10^9

Fly Ash:
Total Suspended Solids - 18.78 lbs/Btu x 10^9
Oil and Grease - 9.39 lbs/Btu x 10^9

Cooling Water:
Free Chlorine - 0.006 lbs/Btu x 10^9

Multiplying these limitations by the reduction in energy usage results in the following water pollutant emission reductions for oil- and gas-fired power plants:

Total Suspended Solids:

Oil:	Bottom Ash	1,682,330 lbs
	Fly Ash	2,955,487

Oil and Grease:

Oil:	Bottom Ash	840,378 lbs
	Fly Ash	1,477,744

Free Chlorine:

Oil:	944 lbs
Gas:	789

A.3.1.1.3 Coal-Fired Power Plants

The air pollutant coefficents for coal-fired power plants under the revised new source performance standards [DOE, January 1979] and the estimated air pollutant emission reductions are:

Pollutant	Coefficient (Tons/10^{12} Btu Produced)	Emission Reductions (Tons)
Particulates*	39.6	16,770
Sulfur Dioxide	169.1	71,610
Nitrogen Oxides*	791.6	335,226
Hydrocarbons	19.1	8,088
Carbon Monoxide	63.2	26,764
Arsenic	0.007	3
Beryllium	0.001	0.4
Cadmium	0.001	0.4
Flucrine	0.54	229
Lead	0.05	21
Mercury	0.005	2
Selenium	0.04	17
Manganese	0.14	59

The wastewater pollutant coefficients [DOE, January 1979] and the estimated pollutant emission reductions for coal-fired power plants are:

Pollutant	Coefficient (Tons/10^{12} Btu Produced)	Emission Reductions (Tons)
Biological Oxygen Demand	1.41	597
Chemical Oxygen Demand	137.18	58,093
Total Suspended Solids	0.33	140
Total Dissolved Solids	873.53	369,922
Aluminum	0.30	127
Chromium	0.01	4
Non-Ferrous Metals	110.79	46,917
Zinc	0.05	21
Sulfates	41.10	17,405
Nickel	3.62	1,533
Nutrients		
Nitrates	1.82	771
Ammonia	0.06	25
Phosphorous	0.17	72
Surfactants	0.39	165
Oil and Grease**	7.36	3,117
Free Chlorine**	0.003	1

* *Coefficients for particulates and nitrogen oxides were obtained from source [EPA, June 11, 1979] and were converted to tons/10^{12} Btu produced by assuming a power plant efficiency of 37.9 percent.*

***Coefficients for oil and grease and free chlorine were obtained using EPA's wastewater effluent limitations. These limitations are the same as for oil-fired power plants (Section A.3.1.1.2).*

A.3.1.1.4 Nuclear Power Plants

The air pollutant coefficients [DOE, January 1979] and the estimated pollutant emission reductions for nuclear power plants (assuming use of light water reactors) are:

Pollutant	Coefficient (Tons/10^{12} Btu Produced)	Emission Reductions (Tons)
Chromates	0.81	97
Zinc	0.15	18
Chlorides	3.3×10^{-3}	0.4

The wastewater polluant coefficients [DOE, January 1979] and the estimated pollutant emission reductions, assuming use of light water reactors, are:

Pollutant	Coefficient (Tons/10^{12} Btu Produced)	Emission Reductions (Tons)
Biological Oxygen Demand	0.09	11
Chlorine	1.05	125
Phosphate	1.65	197
Boron	13.10	1,562
Chromates	0.09	11
Acids	3.27	390
Organics	2.62	312

The air and water radiation residuals [DOE, January 1979] and the estimated reduction in radiation residuals assuming use of light water reactors, are:

Air	Coefficient (Curies/10^{12} Btu Produced	Reductions (Curies)
Kr-85	3.6	429
I-131	4.8×10^{-3}	0.6
Xe-133	2.11×10^{3}	256,560
Fission Products	6.0×10^{2}	71,534
H-3	1.26	150

Water	Coefficient (Curies/10^{12} Btu Produced	Reduction (Curies)
H-3	10.12	1,207.
CO-60	1.5×10^{-5}	0.002
Sr-90	2.1×10^{-5}	0.003
Ru-106	5.95×10^{-6}	0.0007
I-131	3.27×10^{-4}	0.04
Cs-134	1.28×10^{-3}	0.15
Cs-137	9.23×10^{-4}	0.11
Ce-144	1.5×10^{-5}	0.002
Fission Products	8.33×10^{-2}	10

A.3.1.2 Oil and Gas

Air pollutant coefficients for residential end use of distillate oil and natural gas are [EPA, May 1978(b)].

	Coefficient:	
Pollutant	Distillate Oil (tons/10^3 BBL)	Natural Gas (tons/10^6 SCF)
Particulates	0.230	0.005
Nitrogen Oxides	0.443	0.050
Sulfur Oxides	0.665	0.0003
Hydrocarbons	0.063	0.004
Carbon Monoxide	0.101	0.01
Aldehydes	0.042	0

Converting the reduction in energy usage for fuel oil and natural gas from Btus to barrels and cubic feet, repectively, (1 bbl distillate fuel oil = 5.83 x 10^6 Btu, 1000 ft^3 natural gas = 1.031 x 10^6 Btu [FEA, April 1976]) and multiplying the reduction in energy usage by the pollutant coefficients result in the following air pollutant emission reductions:

	Reductions (tons) from:	
Pollutant	Distillate Oil	Natural Gas
Particulates	66,870	25,296
Nitrogen Oxides	128,797	252,958
Sulfur Oxides	193,342	1,518
Hydrocarbons	18,317	20,237
Carbon Monoxide	29,365	50,592
Aldehydes	12,211	0

A.3.2 Materials

A.3.2.1 Fiberglass

The wastewater effluent limitation for the fiberglass industry is no discharge of process wastewater pollutants with the exception of the water used for some advanced air emission control devices. Water used for such purposes must meet the following limitations [EPA, January 1974(a)]:

Pollutant	Limitation (lb/ton)
Chemical Oxygen Demand	0.165
Biological Oxygen Demand	0.012
Total Suspended Solids	0.015
Phenols	0.0003

Air pollutant emission factors for the fiberglass industry without the use of air pollution control devices are [EPA, May 1978(b)]:

Pollutant	Emission Factors (lb/ton)
Particulates	83.9
Sulfur Dioxide	10.0
Carbon Monoxide	2.15
Nitrogen Dioxide	6.3
Fluorides	0.12

These air emission factors assume total use of regenerative glass furnaces to provide a worst case condition.

Applying these wastewater effluent limitations and air emission factors to the estimated total RCS Program demand for fiberglass (1,194,564 tons) results in the following pollutant emissions.

Water Pollutants	Emissions (lbs)	Air Pollutants	Emission (lbs)
Chemical Oxygen Demand	197,103	Particulates	100,223,920
Biological Oxygen Demand	14,335	Sulfur Dioxide	11,945,640
Total Suspended Solids	17,918	Carbon Monoxide	2,568,313
Phenols	358	Nitrogen Dioxide	7,525,753
		Fluorides	143,348

A.3.2.2 Rock Wool

There are no wastewater effluent limitations for the rock wool industry [Communication, Ronald Curby].

The air pollutant emission factors and the estimated emissions from producing the amount of rock wool to accommodate the RCS Program demand (643,910 tons) are [EPA, May 1978(b); EPA, April 1973]:

Pollutant	Coefficient (lb/ton)	Emissions (lbs)
Particulates	50	32,195,500
Sulfur Oxides	0.02	12,878

A.3.2.3 Cellulose

No air and water pollutant coefficients could be obtained for cellulose production. Cellulose is made by shredding newspaper and applying a chemical, usually boric acid, for flame retardant purposes [DOE, June 1978].

No air limitations have been developed for production of boric acid [Communication, Fred Dimmick].

Wastewater effluent limitations for producing boric acid and the estimated emissions caused by RCS Program demand (475,313 tons) are [EPA, May 1975]:

Pollutant	Limitation (lb/ton)	Emissions (lbs)
Total suspended solids	0.14	66,544
Arsenic	0.028	13,309

A.4 Summary of Pollutant Emission Changes

Table A-2 presents a summary of the pollutant emission changes.

Column (1) presents the pollutants which will be affected by energy conversion and use activities, and by production activities for ceiling insulation, water heater insulation, and wall insulation.

Column (2) presents the estimated pollutant emission reductions associated with the decrease in demand for residential energy. Only energy conversion and use activities were considered. These reductions will occur over a long period of time (i.e. from installation of the first energy conservation measure to the end of the useful life of the longest lasting measure). The useful life of the measures analyzed ranges from 5 to 20 years.

TABLE A-2. SUMMARY OF POLLUTION EMISSION CHANGES

(1) Pollutants	(2) Pollutant Emission Reductions (tons)	(3) Pollutant Emission Increases (tons)	(4) Net Difference (tons)	(5) Percent Decrease in Energy-Related Pollutant Emissions*
Air:				
Particulates	-120,374	66,210	-54,164	0.02-0.10
Nitrogen Oxides	-813,995	3,763	-810,232	0.14-0.68
Sulfur Oxides	-571,479	5,979	-565,500	0.08-0.38
Hydrocarbons	-46,637		-46,637	0.009-0.04
Carbon Monoxide	-106,721	1,284	-105,437	0.01-0.05
Aldehydes	-12,211		-12,211	ND
Fluorides		72	+72	ND
Arsenic	-3		-3	ND
Beryllium	-<1		-<1	ND
Cadmium	-<1		-<1	ND
Fluorine	-229		-229	ND
Lead	-21		-21	ND
Mercury	-2		-2	ND
Selenium	-17		-17	ND
Manganese	-59		-59	ND
Chromates	-97		-97	ND
Zinc	-18		-18	ND
Chlorides	-<1		-<1	ND
Water:				
Total Suspended Solids	-2,459	42	-2,417	ND
Total Dissolved Solids	-369,922		-369,922	0.4-2.0
Biological Oxygen Demand	-608	7	-601	ND
Chemical Oxygen Demand	-58,093	99	-57,994	ND
Organics	-312		-312	ND
Oil and Grease	-4,278		-4,278	ND
Chlorine	-127		-127	ND
Phosphorus	-72		-72	ND
Phosphate	-197		-197	ND
Arsenic		7	+7	ND
Phenols		<1	+<1	ND
Boron	-1,562		-1,562	ND
Chromates	-11		-11	ND
Chromium	-4		-4	ND
Aluminum	-127		-127	ND
Acids	-390		-390	ND
Nonferrous Metals	-46,917		-46,917	ND
Zinc	-21		-21	ND
Sulfates	-17,405		-17,405	ND
Nickel	-1,533		-1,533	ND
Surfactants	-165		-165	ND
Ammonia	-25		-25	ND
Nitrates	-771		-771	ND

Note: < means less than

**Energy-related pollutant emissions for the air pollutants include the projected 1985 emissions from exploration, development, extraction, processing, transportation, conversion, and combustion activities for all sectors (i.e., utility, industrial, residential, commercial, transportation) (DOE, April 1978). These emissions will comprise a major portion of the nationwide air emissions because of the dominant nature of energy-related air emissions in relation to other air emissions sources. The percentage decreases presented in Column (5) for the air pollutants should be roughly comparable to the percentage decrease in nationwide emissions.*

Energy-related pollutant emissions for total dissolved solids include only the emissions from stationary combustion sources (DOE and EPA, March 1978). Water pollutant emissions from stationary combustion sources do not comprise the major portion of nationwide pollutant emissions; consequently, the percentage decrease that the total suspended solids reduction would represent of the nationwide emissions should be considerably lower than presented in Column (5).

N.D. indicates that the percentage increases or increase have not been determined because of the lack of data concerning nationwide pollutant emissions.

The largest pollutant emission reduction is 813,995 tons for nitrogen oxides. Averaged over a 5- to 25-year period, this reduction would be between 32,560 and 162,799 tons per year, respectively. The projected 1985 nitrogen oxide emissions from all energy-related sources is 24 million tons [DOE, April 1978]. The RCS Program reductions for nitrogen oxides represent 0.14 and 0.68 percent of the energy-related nitrogen oxide emissions in 1985. The second largest reduction is 571,479 for sulfur oxides. Averaged over a 5- to 25-year period, this reduction would be between 22,859 and 114,296 tons per year, corresponding to 0.08 and 0.38 percent of the projected 1985 energy-related sulfur oxide emissions of 30 million tons [DOE, April 1978].

Column (3) presents the estimated pollutant emission increases from producing ceiling insulation, water heater insulation, and wall insulation. These pollutant emission increases will occur over the five-year program period. The largest pollutant increase is 66,210 tons for particulates. The projected 1985 energy-related particulate emissions (which represent a substantial portion of the total for nationwide particulate emissions) is 11,000,000 tons [DOE, April 1978]. The yearly increase in particulates, 13,242 tons, from producing the analyzed energy conservation materials, represents approximately 0.12 percent of the projected particulate emissions.

Column (4) presents the net difference between columns (2) and (3). The two largest net differences are nitrogen oxide and sulfur oxide reductions of 810,232 and 565,500 tons, respectively. Averaged over a 5- to 25-year period, these reductions would be between 32,409 and 162,046 tons per year for nitrogen oxides and between 22,620 and 113,110 tons per year for sulfur oxides. These yearly reductions represent between 0.14 and 0.68 percent of the 1985 nitrogen oxide emissions and between 0.08 and 0.38 percent of the 1985 sulfur oxide emissions for all energy-related activities.

In addition to the pollutant emissions reductions presented on Table A-1, there will be reductions in air and water radiation residuals associated with the reduced need for nuclear power generation. These reductions are estimated to be:

Air Residuals	Reduction (Curies)	Water Residuals	Reduction (Curies)
Kr-85	429	H-3	1,207
I-131	0.6	Co-60	0.002
Xe-133	251,560	Sr-90	0.003
Fission Products	71,534	Ru-106	0.0007
H-3	150	I-131	0.04
		Cs-134	0.15
		Cs-137	0.11
		Ce-144	0.002
		Fission Products	10

A.5 Estimation of Manufacturing Energy Requirement

The energy required to manufacture ceiling insulation, water heater jackets, and wall insulation was estimated by multiplying the RCS Program demand (in tons) for fiberglass, rock wool, cellulose, and boric acid by the total energy required to produce one ton of each material. These demand and materials energy estimates and the RCS Program manufacturing energy requirements are presented in Table A-3.

TABLE A-3. RCS PROGRAM MANUFACTURING ENERGY REQUIREMENTS

(1) Material	(2) RCS Program Demand (Tons)	(3) Material Energy Requirement (Btu/ton)	(4) RCS Program Manufacturing Energy Requirement (2) x (3) (Btu x 10^{10})
Fiberglass	1,194,564	1.07×10^{4}*	1.28
Rock Wool	643,910	1.07×10^{4}*	0.69
Cellulose	1,901,250	23.5×10^{6}**	4,468
Boric Acid	475,313	184×10^{6}#	8,746
Total			$13,216 \times 10^{10}$ Btus or 0.13 quads

*Source: [Hittman Associates, Inc., August 1974].
**Source: [Arthur D. Little, Inc., December 1976(b)].
#Source: [Arthur D. Little, Inc., December 1976(a)].

The energy figure for manufacturing fiberglass was obtained directly from the literature while the figures for rock wool, cellulose, and boric acid were estimated based on information obtained from the literature.

No energy-related information was obtained for manufacturing rock wool. The manufacturing process for rock wool is very similar to that of fiberglass [DOE, June 1978]. Therefore it was assumed that the energy requirements would be similar, and the fiberglass energy requirements were used to estimate the RCS Program manufacturing energy requirements for rock wool.

No information was found for producing cellulose insulation. Cellulose is made by shredding newspaper and applying a chemical for flame retardant purposes [DOE, June 1978]. An energy figure was obtained for pulping and paper making operations which should require considerably more energy than shredding operations. This figure was used to estimate the RCS Program manufacturing energy requirement for cellulose. It should be considered a worst case estimate.

Information on the energy used in boric acid manufacturing also was unavailable. Manufacturing boric acid is categorized under Standard Industrial Classification (SIC) 2819, Industrial Inorganic Chemicals Not Elsewhere Classified. It was noted in one report [Arthur D. Little, December 1976(a)] that phosphorus and phosphoric acid manufacturing is one of the leading energy consumers in this category. The energy consumption figure presented in this report for manufacturing phosphorus and phosphoric acid was used for estimating the RCS Program manufacturing energy requirement for boric acid and should be considered a worst case estimate.

The total energy requirement for manufacturing ceiling insulation, water heater insulation, and wall insulation is estimated at 0.13 quads. This energy requirement represents 1.6 percent of the expected reduction in energy usage (7.86 quads) resulting from installation of these energy conservation measures.

There will be pollutant emission increases associated with the increased demand for manufacturing energy. Some of these increases are included in the quantitative analysis of pollutant emission changes because the air pollutant emission factors which were used in estimating the emissions associated with manufacturing energy conservation materials take into account most of the energy conversion activities within the manufacturing facilities (e.g., the burning of gas or oil in a glass furnace). The emission factors do not, however, include the emissions associated with energy conversion activities outside of the manufacturing facilities (e.g., the electric energy purchased by the facility).

The emissions from energy conversion activities outside of the manufacturing activities were not included in the analysis because of lack of data concerning the distribution of energy sources for the manufacturing sectors which were quantitatively analyzed. The very small effect of this omission on the estimates of pollutant emission reductions can be indicated by the following worst-case analysis.

Within two other industries (i.e., glass and aluminum) the percentage of total energy usage that is purchased energy is 1 and 50 percent, respectively [Census, 1972]. Assuming (for a worst-case analysis) that 50 percent of all of the manufacturing energy for each of the analyzed materials is purchased electric energy, the amount of the manufacturing energy provided by purchased electrical energy is 0.065 quads (50 percent of 0.13 quads). The added emissions associated with the generation of this energy are not included in the analysis, therefore, some of the net pollutant emission reductions due to the Program would be less than estimated. The additional pollution emissions would be those associated with the generation of 0.065 quads of electricity. This amount of energy constitutes 0.8 percent of the energy usage reduction associated with the energy conservation measures analyzed (0.065 ÷ 7.86 quads); therefore, it is reasonable to assume that, if this additional source of air and water pollution were included, the estimates of net pollutant emission changes for electricity-related pollutants would be changed by a factor on the order of 0.008. A change of this magnitude in the estimates would not significantly alter the reported environmental impacts of the RCS Program.

REFERENCES - APPENDIX A

Arthur D. Little, Inc., December 1976(a). Environmental Considerations of Selected Energy Conserving Manufacturing Process Options; Volume II: Industry Priority Report, Industrial Environmental Research Laboratory, PB-264-268.

Arthur D. Little, Inc., December 1976(b). Environmental Considerations of Selected Energy Conserving Manufacturing Process Options; Volume V: Pulp and Paper Industry Report, Industrial Environmental Research Laboratory, PB-264-271.

Booz, Allen and Hamilton, Inc., June 1978. Utility Sponsored Home Installation Programs, U.S. Department of Energy, HCP/W/227-01.

Burch, et al. September 1976. Comparison of the Thermal Performance of Three Insulating Materials Commonly Used to Retrofit Exterior Frame Walls in Existing Residences. Center for Building Technology. International Institute of Refrigeration.

Communication between a member of the Nationwide Insulation Contractors Association and Lawrence Taylor (Hittman Associates, Inc.), March 1978.

Communication between Diana Oberg (U.S. Department of Commerce, Bureau of the Census) and Efim Livshits (Hittman Associates, Inc.).

Communication between Fred Dimmick (U.S. Environmental Protection Agency) and Efim Livshits (Hittman Associates, Inc.), April 18, 1979.

Communication between John Lum (U.S. Environmental Protection Agency) and Efim Livshits (Hittman Associates, Inc.), April 25, 1979.

Communication between Ronald Curby (U.S. Environmental Protection Agency) and Efim Livshits (Hittman Associates, Inc.), May 17, 1979.

Federal Energy Administration, April 1976. Final Assessment of the Environmental Impacts of the State Energy Conservation Program (Public Law 94-163, Title III, Part C).

Hittman Associates, Inc., August 1974. Technology Assessment of Residential Energy Conservation Innovations, U.S. Department of Housing and Urban Development.

Hittman Associates, Inc., May 1975. Technology Assessment of Residential Energy Conservation Innovation.

ICF, Inc., June 17, 1977. Supply Response to Residential Insulation Retrofit Demand. Federal Energy Administration.

Predicasts, Inc., January 23, 1978. Insulation and Energy Conservation in Housing, Special Study.

U.S. Department of Commerce, November 1978. Preliminary Forecast of Likely U.S. Energy Consumption/Production Balances for 1985 and 2000 by States, PB-287-486.

U.S. Department of Commerce, Bureau of the Census. Boric Acid Current Industrial Report, M28-A.

U.S. Department of Commerce, Bureau of the Census, 1972. 1972 Census of Manufactures; Volume II, Industry Statistics; Part 2, SIC Major Groups 27-34.

U.S. Department of Energy, April 1978. 1977 Annual Report to Congress, Volume II.

U.S. Department of Energy, June 1978. An Assessment of Thermal Insulation Materials and Systems for Building Applications.

U.S. Department of Energy, January 1979. Environmental Data for Energy Technology Policy Analysis. Volume I. Summary, HCP/EV-6119/1.

U.S. Department of Energy, April 1979(a). Analysis Report -- Energy Supply and Demand in the Midterm: 1985, 1990, and 1995, DOE/EIA-0102/54.

U.S. Department of Energy, April 1979(b). Monthly Energy Review, EIA-0035/4.

U.S. Department of Energy, April 1979(c). Review Draft Regulatory Analysis for the Residential Conservation Service Program.

U.S. Department of Energy, October 1979. Final Regulatory Analysis for the Residential Conservation Service Program.

U.S. Department of Energy and U.S. Environmental Protection Agency, March 1978. Energy/Environment Fact Book, EPA-600/9-77-041.

U.S. Environmental Protection Agency, April 1973. Compilation of Air Pollutant Emission Factors (second edition, with supplements).

U.S. Environmental Protection Agency, January 1974(a). Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Insulation Fiberglass Manufacturing Segment of the Glass Manufacturing Point Source Category.

U.S. Environmental Protection Agency, October 8, 1974. Effluent Guidelines and Standards for Steam Electric Power Generating, 40CFR423.

U.S. Environmental Protection Agency, May 1975. Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Significant Inorganic Products Segment of the Inorganic Chemicals Manufacturing Point Source Category, EPA-44011-751037.

U.S. Environmental Protection Agency, May 1978(a). 1975 National Emissions Report: National Emissions Data System of the Aerometric and Emissions Reporting System, EPA 450/2-78-020.

U.S. Environmental Protection Agency, May 1978(b). Compilation of Air Pollutant Emission Factors, (third edition, including supplements 1 through 8), Supplement 8.

U.S. Environmental Protection Agency, June 11, 1979. Regulations on Standards of Performance for New Stationary Sources, Subpart D: Standards of Performance for Electric Utility Steam Generating Units for Which Construction is Commenced After September 18, 1978, 44FR33612.

APPENDIX B

GLOSSARY

APPENDIX B

GLOSSARY

Active Solar Space Heating Systems - Equipment designed to absorb the sun's energy and to use this energy to heat living space by use of mechanically forced energy transfer, such as fans or pumps.

Caulking - Pliable materials used to fill small gaps at fixed joints on buildings to reduce the passage of air and moisture. Caulking includes, but is not limited to, materials commonly known as "sealants," "putty" and "glazing compounds."

Ceiling Insulation - A material primarily designed to resist heat flow which is installed between the conditioned area of a building and an unconditioned attic. Where the conditioned area of a building extends to the roofs, the term "ceiling insulation" also applies to such material used between the underside and upperside of the roof.

Changing Furnace and Air Conditioning Filters - The replacement of disposable filters, or the cleaning of permanent filters, in forced air heating and cooling systems when the filters are sufficiently clogged with dust or lint to restrict the free flow of air through the filter.

Clock Thermostat - A device which is designed to reduce energy consumption by regulating the demand on the heating or cooling system in which it is installed, and uses:

(1) A temperature control device for interior spaces incorporating more than one temperature control level, and

(2) A clock or other automatic mechanism for switching from one control level to another.

Closing Vents, Valves and Doors in Infrequently Used Rooms - Keeping vacant rooms from being needlessly heated or cooled by closing or blocking air vents from the furnace or central air conditioner or closing the radiator valves leading to the vacant rooms. Where the vacant rooms have individual cold air return vents, they are also closed or blocked. Doors to vacant rooms are also closed to keep the vacant rooms isolated from the rest of the housing having heated or cooled air.

Combined Active Solar Space Heating and Solar Domestic Hot Water System - Equipment designed to perform both of the functions described under "active solar space heating systems" and "solar domestic hot water systems" in this glossary.

Covered Utility - In any calendar year a public utility which during the second preceding calendar year had either:

(1) Sales of natural gas for purposes other than resale which exceeded 10 billion cubic feet, or

(2) Sales of electric energy for purposes other than resale which exceeded 750 million kilowatt-hours.

Critical Radiant Flux - Levels of incident radiant heat energy on the insulation below which flames will cease to propagate.

Devices Associated with Electric Load Management Techniques - Customer-owned or leased devices that reduce the maximum kilowatt demand on an electric utility and which are either:

(1) That part of a radio, ripple, or other utility controlled load switching system on the customer's premises;

(2) Clock-controlled load switching devices;

(3) Interlocks, and other load-actuated, load-limiting devices; or

(4) Energy storage devices with control systems.

Direct Gain Glazing Systems - The use of south-facing (+ or -45° of true south) panels of insulated glass, fiberglass, or other similar transparent substances that admit the sun's rays into the living space where the heat is retained. Glazing is either double-paned, or single-paned equipped with movable insulation.

Duct Insulation - A material primarily designed to resist heat flow which is installed on a heating or cooling duct in an unconditioned area of a building.

Electric or Mechanical Ignition System - A device which, when installed in a gas-fired furnace or boiler, automatically ignites the gas burner and replaces a gas pilot light.

Eligible Customer - A person who:

(1) Owns or occupies a residential building; and

(2) Purchases fuel from a covered utility or participating home heating supplier for use in such residential building.

Energy Audit - An on-site inspection of a residential building to determine:

(1) The estimated cost of purchasing and installing one or more suggested measures; and

(2) The estimated savings in energy costs that are likely to result from the installation of such measure(s).

Energy Conservation Measures - The following measures in a residential building: caulking, weatherstripping, furnace efficiency modifications, ceiling insulation, wall insulation, floor insulation, duct insulation, pipe insulation, water heater insulation, storm windows, thermal windows, storm or thermal doors, heat reflective or heat absorbing window or door material, devices associated with electric load management techniques, clock thermostats, and energy usage display meters. (The above terms are defined in this glossary.)

Energy Conserving Practices - Changing furnace and air conditioning filters, installing flow restrictors in shower heads and faucets, installing low-flow shower heads and faucets, sealing leaks in pipes and ducts, setting back thermostats in winter, reducing thermostat settings in winter, setting up thermostats in summer, reducing thermostat settings on water heaters, and closing vents, valves, and doors in infrequently used rooms, and such other practices designated by the Governor which save energy, do not require the installation of measures, and have an installed cost of less than $20.00. (The terms used above are defined in this glossary.)

Energy Usage Display Meter - A device the sole purpose of which is to display the cost (in money) of energy usage in the dwelling. It may show cost information for electricity usage, gas usage, oil usage, or any combination. The device may measure energy usage of the whole dwelling, or individual appliances or systems on an instantaneous or cumulative basis.

Floor Insulation - A material primarily designed to resist heat flow which is installed between the first level conditioned area of a building and an unconditioned basement, a crawl space, or the outside beneath it. Where the first level conditioned area of a building is on a ground level concrete slab, the term "floor insulation" also applies to such material installed around the perimeter of or on the slab.

Flue Opening Modification - An automatically operated damper (often called a vent damper) which:

(1) Is installed downstream from the drafthood in gas-fired furnaces or downstream from the barometric damper in oil-fired furnaces;

(2) Is installed on a furnace which is located in a heated part of the building; and

(3) Conserves energy by substantially reducing the flow of heated air through the chimney when the furnace is not in operation.

Furnace Efficiency Modifications - Replacement furnaces or boilers, furnace replacement burners (oil), flue opening modifications, and electrical or mechanical ignition systems. (The above terms are defined in this glossary.)

Furnace Replacement Burner (Oil) - A device which atomizes the fuel oil, mixes it with air, and ignites the fuel-air mixture, and is an integral part of an oil-fired furnace or boiler including the combustion chamber, and which because of its design, achieves a reduction in the oil used from that used by the device which it replaces.

Governor - The Governor or chief executive officer of a State or his designee.

Heat Reflective and Heat Absorbing Window or Door Material - A window or door glazing material with exceptional heat-absorbing or heat-reflecting properties; or reflective or absorptive films and coatings applied to an existing window or door which thereby result in exceptional heat-absorbing or heat-reflecting properties.

Home Heating Supplier - A person who sells or supplies home heating fuel (including No. 2 heating oil, kerosine, butane, and propane) to an eligible customer for consumption in a residential building.

Indirect Gain Systems - The use of panels of insulated glass, fiberglass, or other transparent substances that direct the sun's rays onto specially constructed thermal walls, ceilings, rockbeds, or containers of water or other fluids where heat is stored and radiated.

Installing Flow Restrictors in Shower Heads and Faucets - Placing a device in or on a shower head or faucet in order to limit the amount of water flowing through a shower head or faucet to a maximum of three gallons per minute.

Installing Low-Flow Shower Heads and Faucets - Replacing regular shower heads or faucets with those having built-in provisions for limiting the amount of water flowing through the shower head or faucet to a maximum of three gallons per minute.

Loose-Fill Cellulosic or Wood Fiber Insulation - Insulation composed of cellulosic or wood fibers or any combination thereof, suitable for pneumatic or poured application.

Nonregulated Utility - A public utility which is not a regulated utility.

Nonregulated Utility Plan - A plan developed pursuant to Subpart D of the proposed regulations.

Participating Home Heating Supplier - A home heating supplier that has elected to participate in a State Residential Conservation Service Plan which includes home heating suppliers.

Passive Solar Space Heating and Cooling Systems - Systems that make most efficient use of, or enhance the use of, natural forces -- including solar insolation, winds, night time coolness and opportunity to lose heat by radiation to the night sky -- to heat or cool living space by the use of conductive, convective, or radiant energy transfer. Passive solar systems include: direct-gain glazing systems, indirect-gain systems, solaria/sunspace systems, and thermal pond systems. (These terms are defined in this glossary.)

Pipe Insulation - A material primarily designed to resist heat flow which is installed on a heating or cooling pipe in an unconditioned area of a building.

Pollutant Emissions and Emissions - Emissions of air pollutants and the discharge of water pollutants.

Program Announcement - The document required to be sent by a covered utility or participating home heating supplier to each eligible customer by §456.306 of the proposed regulations.

Program Information - The program announcement and any information dissemination activities related to a Residential Conservation Service Program.

Program Warranty - A warranty which certifies that a suggested measure will have a useful life of at least three years.

Public Utility - Any person, State agency, or federal agency which is engaged in the business of selling natural gas or electric energy, or both, to residential customers for use in a residential building.

Rate - Any price, rate, charge, or classification made, demanded, observed, or received with respect to sales of electric energy or natural gas; any rule, regulation, or practice respecting any such rate, charge or classification; and any contract pertaining to the sales of electric energy or natural gas.

Ratemaking Authority - Authority to fix, modify, approve, or disapprove rates.

Reducing Thermostat Settings in Winter - Limiting the maximum thermostat control setting for the furnace to 68°F during the heating season.

Reducing Thermostat Settings on Water Heaters - The manual setback of the water heater thermostat control setting(s) to maintain the maximum water temperature at 120°F (140°F for homes with automatic dishwashers).

Regulated Utility - A public utility with respect to whose rates a State regulatory authority has ratemaking authority.

Renewable Resource Measure - The following measures in or with respect to a residential building: solar domestic hot water systems, active solar space heating systems, combined active solar space heating and solar domestic hot water systems, passive solar space heating and cooling systems, wind energy devices, and replacement solar swimming pool heaters. (The above terms are defined in this glossary.)

Replacement Central Air Conditioner - A central air conditioner which replaces an existing central air conditioner of the same fuel type and which reduces the amount of fuel consumed due to an increase in efficiency.

Replacement Furnaces or Boilers - A new furnace or boiler, including a heat pump, which replaces an existing furnace or boiler using the same fuel and which reduces the amount of fuel consumed due to an increase in combustion efficiency, improved heat generation, or reduced heat losses.

Replacement Solar Swimming Pool Heaters- Devices which are used solely for the purpose of using the sun's energy to heat swimming pool water.

Residential Building - Any building used for residential occupancy which:

(1) Is not a new building to which final standards under Sections 304(a) and 305 of the Energy Conservation and Production Act apply,

(2) Contains at least one, but no more than four, dwelling units, and

(3) Has a system for heating or cooling, or both.

Residential Conservation Service (RCS) Program - The program required to be implemented by covered utilities pursuant to an approved State Plan, an approved Nonregulated Utility Plan, or a Federal Standby Plan.

Sealing Leaks in Pipes and Ducts - The replacement of washers in leaking water valves, or the caulking of loose or poor-fitting joints in all ducts which permit the escape of conditioned air into unconditioned spaces; or the tightening, soldering, or plugging of leaking joints in hot water or steam heating pipes.

Secretary - The Secretary of Energy.

Setting Back Thermostats in Winter - Manually lowering the thermostat control setting for the furnace during the heating season to a maximum of 55°F during sleeping hours and at other times when no one is home.

Setting up Thermostat in Summer - Setting the thermostat control for the air conditioning to 78°F or higher during the cooling season and turning the air conditioning off when no one is home.

Smoldering Combustion - Combustion of solid materials without the accompaniment of flame.

Solar Domestic Hot Water Systems - Equipment designed to absorb the sun's energy and to use this energy to heat water for use in a residential building other than for space heating, including thermosiphon hot water heaters.

Solaria/Sunspace Systems - A structure of glass, fiberglass or similar transparent material which is attached to the south-facing (+ or -45° of true south) wall of a structure which allows for air circulation to bring heat into the residence, and which is able to be closed off from the residential structure during periods of low solar insolation.

State - A State, the District of Columbia, and Puerto Rico.

State Agency - A State, a political subdivision thereof, or any agency or instrumentality of either.

State Plan - A plan developed pursuant to Subparts B and C of the proposed regulations.

State Regulatory Authority - Any State agency which has ratemaking authority with respect to the sales of electric energy or natural gas by any public utility (other than by such State agency); except that in the case of a public utility with respect to which the Tennessee Valley Authority has ratemaking authority, such term means the Tennessee Valley Authority.

Storm or Thermal Door

(1) A second door, installed outside or inside a prime door, creating an insulating air space,

(2) A door with enhanced resistance to heat flow through the glass area by affixing two or more sheets of glazing material, or

(3) A prime exterior door with a R-value of at least 2.

Storm Windows - A window or glazing material placed outside or inside an ordinary or prime window, creating an air space, to provide greater resistance to heat flow than the prime windows alone.

Suggested Measures - Those energy conservation or renewable resource measures which the Secretary has by rule determined to be appropriate by climatic region and building category.

Thermal Pond Systems - Containers, such as tanks or water bags, filled with water or other fluids which, when placed on a roof-top, capture the sun's rays and radiate stored heat directly into the residence, and make use of movable insulation to regulate heat absorption and radiation.

Thermal Resistance - Resistance to the flow of heat.

Thermal Window - A window unit with improved thermal performance through the use of two or more sheets of glazing material affixed to a window frame to create one or more insulated air spaces. It may also have an insulating frame and sash.

Useful Life - The period of time during which a suggested measure performs the purposes for which it was designed at a level consistent with those purposes.

Wall Insulation - A material primarily designed to resist heat flow which is installed with or on the walls between conditioned areas of a building and unconditioned areas of a building or the outside.

Water Heater Insulation - A material primarily designed to resist heat flow which is in blanket form suitable for wrapping around the exterior surface of the water heater casing.

Weatherstripping - Narrow strips of material placed over or in movable joints of windows and doors to reduce the passage of air and moisture.

Wind Energy Devices - Equipment that uses wind energy to produce energy in any form for personal residential purposes.

APPENDIX C

COMMENTS AND RESPONSES

APPENDIX C

COMMENTS AND RESPONSES

Comments requiring response are reproduced in this appendix, with responses presented adjacent to the comments, in the following order: Federal agencies, State agencies and State-related organizations, and others (private industries, utilities, organizations, and individuals).

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LAWRENCE BERKELEY LABORATORY

LAWRENCE BERKELEY LABORATORY
Room: 3058 Bldg.: 90 Ext.: 6591

September 24, 1979

MEMORANDUM

TO: James Tanck, 376-4020
Howard Ross, 376-4672

FROM: Craig Hollowell, 451-6591
Anthony Nero, 451-6377

SUBJECT: Draft EIS for Residential Conservation Service Program

We have examined the portions of the draft EIS pertaining to indoor air quality as it may be affected by RCS Program measures that reduce the air infiltration rate. The result of this examination is to conclude that the present treatment seriously understates available indications of the potential impact of these measures on indoor air quality and, hence, on the health of the occupants. This is particularly true of the increased exposure to radon daughters that would result from installation of "weatherization" measures in houses that already have significant radon levels.

1. *DOE has reexamined carefully all indoor air quality issues and has substantially revised Section 3.2.2.1.11 in the FEIS. These issues will also be discussed in the Preamble to the Final Rule when it is published.*

Radon is the indoor pollutant that poses the greatest difficulty for the RCS Program, and the draft EIS does not indicate sufficient awareness of the main problem, i.e., that there appear to be several areas of the country where high indoor radon levels already occur and this includes areas other than the special areas noted in the EIS. The Colorado, Florida, and TVA cases are widely known examples of situations where lack of attention to the disposition of radium-bearing materials has led to indoor radon levels in excess of 3 or 4 pCi/l, which - for the Colorado and Florida cases - corresponds to the level at which remedial action has been recommended. What is less widely recognized is that - even in areas without such mining activities to fault - levels of a few pCi/l and sometimes much higher have been found. In such areas - and it is not known how many such areas exist in the United States - an RCS program that includes "weatherization" measures could significantly increase radon daughter exposures unless effective measures are taken to avoid this result. Judging from the fragmentary data available, reduced infiltration could even raise exposures to some house occupants to the vicinity of the occupational radiation dose limit.

What is required to avoid substantial increases in radon exposures is 1) a screening program to identify those areas with unusually high indoor radon levels and 2) specific monitoring of weatherized houses in these areas. The actual design of the screening and monitoring origrams can be left to the implementation phase of the RCS program. But the EIS must recognize the problem and indicate that appropriate measures will be taken to avoid undue risk to the public.

2. *DOE agrees with this suggestion and is considering how to carry out a screening and monitoring program through voluntary cooperation of States, utilities, and other interested persons.*

The insufficient radon discussion is a key deficiency that we have identified in the treatment of indoor air quality in the draft EIS. Other indoor pollutants, however, require more attention. In particular, there is no discussion of the indoor formaldehyde issue except for the case of formaldehyde release from urea-formaldehyde foam insulation. It is also well known that formaldehyde release is associated with a variety of consumer products and building materials (i.e., plywood and particleboard). Research has shown that elevated formaldehyde concentrations occur in buildings with low ventilation and using construction materials of plywood and particleboard. The formaldehyde levels in such cases may pose a health hazard.

Areas where the technical quality of the report could be improved include:

(p. 3-89). Remove "particulate sulfur" as an indoor-generated air pollutant of concern.

(p. 3-90). Remove the general terms "organics" and "hydrocarbons" from the list. Formaldehyde, fluorocarbons, vinyl chloride are specific organics of concern.

The discussion on technical approaches to indoor air quality (p. 3-101) fails to mention the use of sealants to reduce contaminants (i.e., radon and formaldehyde) at their source. More seriously, however, is the implication that heat exchangers "involve radical changes in the commonly accepted designs of residential ventilation systems" and that such equipment is expensive and "impractical" for the RCS program.

It should be noted that Sweden, Denmark, and West Germany have issued indoor air quality standards for residences and have installed ventilation systems to control potential pollutant problems. Foreign ventilation systems range in price from \$150 to \$2500 installed, with the higher priced units including installation of central ventilation systems, a feature that is probably unnecessary in the U.S. because of our preponderance of forced air heating systems. These units incorporate heat exchangers between the incoming and outgoing air streams thus saving energy. We estimate that such a unit installed in a U.S. home would currently cost between \$150 and \$500, making it practical in some circumstances.

There are additionally a number of places where minor changes could improve the general discussion of indoor air quality, largely to remove ambiguities, but also to correct errors. Of the latter variety are the statement that radon (should be "radon daughters") plates out (p. 3-93) and the statement that increased lung cancer has shown to occur among building occupants (p. 3-89) (this must be a misinterpretation of the EPA discussion). More in the nature of ambiguities are the use of the term "the infiltration situation" on p. 3-39 ff and the unnecessary "when installed concurrently" on p. 3-89 and elsewhere.

3. *DOE agrees with this comment and has re-evaluated indoor air pollutants. Section 3.2.2.1.11 has been revised accordingly. DOE leads an interagency task force on indoor air quality. This task force, which includes EPA, CPSC, HUD, and NBS, has devoted particular attention to indoor concentrations of formaldehyde.*

4. *Appropriate revisions have been made in response to these comments.*

5. *DOE agrees that sealants may be an effective approach to reducing contaminants at their source. This subject is discussed in Section 3.2.2.1.11 of the FEIS. With respect to heat exchange ventilation systems, DOE agrees that such systems are not necessarily "radical changes" in conventional ventilation. Present data indicates that these systems would involve significant changes in existing ventilation systems and would not be practical in the great majority of existing homes.*

6. *DOE agrees with these comments and has made appropriate revisions.*

LAWRENCE BERKELEY LABORATORY (CONTINUED)

The most unacceptable generalizations occur, however, in the summary paragraph of p. 3-102. A much improved paragraph would be: "The health effects of reducing the infiltration rate, to the extent that they exist, could be widespread, i.e., they could be experienced in many of the homes that are significantly tightened through the installation of weatherization measures. However, with the exception of radon and radon daughters, these health effects are not expected to be significant. The potential for adverse impacts as a result of radon accumulation will exist in all homes that now have radon and could be especially significant in homes that have materials, underlying soil, or water that has unusually high amounts of radon or radon precursers. For this reason, the program will include a screening element to identify high radon areas and a special monitoring provision for any such areas that are identified."

We are prepared to provide further comment and suggestions on the EIS.

CH/AN/rm

7. *DOE agrees with this comment and has modified Section 3.2.2.1.11 substantially. That section discusses the various steps DOE is taking to address indoor air quality concerns.*

U.S. ENVIRONMENTAL PROTECTION AGENCY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

11 JUN 1979

000107

OFFICE OF THE ADMINISTRATOR

Ms. Margaret W. Sibley
Office of Conservation and Solar Applications
Department of Energy - Room 3235
20 Massachusetts Avenue, N.W.
Washington, D.C. 20545

Dear Ms. Sibley:

In accordance with our responsibilities under Section 309 of the Clean Air Act, we have completed our review of the Department of Energy's (DOE) proposed rule, "Residential Conservation Service Program" (Docket No. CAS-RM-79-101). EPA would like to register its support for the Residential Conservation Service Program both as a means for reducing our dependence on foreign oil and as a means of reducing pollutants associated with energy development and consumption. The national effort to conserve energy, however, has raised concerns about the effects of energy conservation measures on indoor residential air quality. The indoor residential environment constitutes a major component of an individual's total exposure to air pollution. Indoor air pollution has not been studied as extensively as outdoor air pollution and has not been considered by EPA in setting regulatory standards for air pollution.

Recently, however, a series of inter-agency research efforts have been initiated to assess the effects of indoor air quality on human health. One of the more obvious findings is that the adverse impact of an indoor air pollution source is accentuated in residences with low air exchange rates. The air exchange rate, then, is the key issue that associates the Residential Conservation Service Program with air quality and human health.

1. *Responses to all of EPA's comments are set forth here. The comments and responses to them will all be addressed in detail in the Preamble to the Final Rule.*

Our enclosed detailed comments on the proposed rule are based in part on the December, 1978, document published jointly by the Department of Housing and Urban Development and EPA entitled, "Indoor Air Pollution in the Residential Environment," Volumes I and II (GEOMET STUDY). That report confirmed the following unique characteristics of indoor air quality that could have significant implications for Residential Conservation Service Program :

(1) Emissions from gas-fueled appliances and a variety of other household sources including building materials can add considerably to indoor pollutant levels;

(2) Measures taken to reduce the building air exchange rate tend to increase the persistence of indoor pollutant levels over time.

The GEOMET STUDY, as well as other on-going research, indicates possible conflicts between the objectives of energy conservation and public health. We believe, however, that both objectives can be realized if appropriate steps are taken. Our enclosed comments are intended to further these ends.

We appreciate the opportunity to comment on the proposed rulemaking. Please contact Thomas Pierce (755-0780) of my staff for further coordination on this rulemaking.

Sincerely yours,

William N. Hedeman, Jr.
Director
Office of Environmental Review (A-104)

Enclosure

U.S. ENVIRONMENTAL PROTECTION AGENCY, (CONT'D)

U.S. ENVIRONMENTAL PROTECTION AGENCY
DETAILED COMMENTS
RESIDENTIAL CONSERVATION SERVICE PROGRAM
DOCKET NO. CAS-RM-79-101

A. The energy conservation program outlined in the proposed rulemaking is intended to reduce air leakage into and out of residential buildings via infiltration and exfiltration. While the program will conserve energy, it may also affect residential air quality. Pollutants generated within residential buildings include many criteria pollutants which are a source of concern to EPA and public health agencies. In particular, CO and NO_2 levels may build up to dangerous levels in residential structures as a result of poorly ventilated space heaters and gas stoves. Levels of particulates from tobacco smoke may build up beyond the Significant Harm Level. Tobacco smoke is also a significant source of CO and NO_2. Hydrocarbon emissions from plastics may prove to be a problem in poorly ventilated dwellings. Concentrations of nitric oxide (NO), carbon dioxide (CO_2) and aldehydes are often higher indoors than outside. Radon and radon daughters emitted from building materials may build up to levels of concern. The proposed Residential Conservation Service Program (RCS) should recognize the above air quality concerns and take measures to control the concentrations of these and other indoor air pollutants.

B. EPA believes that ventilation requirements should be included as one of the required "items" about which all "eligible customers" must be informed. Appropriate measures to protect human health should be considered and included as part of the energy audit. Such measures would include:

Proper ventilation of gas appliances such as space heaters, cooling stoves, and clothes dryers.

Adequate air filtration in residences using forced air heating and cooling systems to reduce particulate levels generated by smoking, cooling or other activities that may result in the suspension of inhalable particles.

2. *Section 3.2.2.1.11 on indoor air quality has been revised materially in response to comments and as a result of additional investigation. Mitigating actions are analyzed in connection with installations of conservation measures and solar rock storage. An alternative to expand consumer audits to include identification of indoor air pollution potential is discussed in Section 6.2.4.*

3. *Ventilation and filtration, including heat exchangers and electronic air cleaners, are potential mitigating actions discussed in Sections 6.2.4 and 3.2.2.1.11.*

U.S. ENVIRONMENTAL PROTECTION AGENCY, (CONT'D)

-2-

- The possible use of electrostatic filters which may be more efficient than panel filters in removing particulates as well as airborne viruses, bacteria and pollen grains.

C. We are concerned that the standard for free formaldehyde content of the resin used in Urea-Formaldehyde (UF) foam insultation be sufficiently stringent to assure protection of human health in the indoor environment. Recent studies, including the GEOMET STUDY have cited elevated levels of aldehydes in indoor air. It is significant that several sources of aldehydes have been identified, including particle board and carpets, in addition to Urea-based insulating materials. We cannot be certain from our reading of subpart N that the multi-source nature of aldehyde emissions was considered adequately in establishing the 1 percent free formaldehyde standard. We request that you clarify this point prior to the final rulemaking.

D. DOE's April 1979 Environmental Assessment on the Weatherization Assistance Program for Low Income Persons raised the issue of indoor concentrations of radon and radon daughters. This issue was also discussed in EPA's November, 1976, publication entitled, "A Preliminary Evaluation of the Control of Indoor Radon Daughter Levels in New Structures" (EPA-520/4-76-018). Special attention should be directed to dwelling units located on or adjacent to reclaimed phosphate lands, near uranium mill tailing piles or which have building materials which may contain radium. Unless proper ventilation is provided, reduced air infiltration could increase the concentration of radon and radon daughters to harmful levels. On-going inter-agency research should be taken into account in developing appropriate safeguards. An August 1978 publication from the Lawrence Berkeley Laboratory may be helpful in this regard. It is entitled, "Human Disease from Radon Exposures: The Impact of Energy Conservation in Buildings," by Budnitz, Berk, Hollowell, Razaroff, Nero and Rosenfeld.

4. *Discussion of the problem of formaldehyde release into indoor air can be found in Sections 3.2.2.1.8 and 3.2.2.1.11, accompanied by proposed mitigating actions. DOE has carefully considered the multi-source nature of aldehyde emissions in homes.*

5. *The potential hazards of indoor concentrations of radon and radon daughters are addressed in Section 3.2.2.1.11.*

-3-

E. Section (e), "Ventilation Requirements," in the "Technical Issues" section should be expanded to provide further guidance on specific health requirements. We are concerned that if the ventilation measures are not installed at the same time as insulation measures that the former measures may be put off or in some cases never installed because the cost savings of improved health may not be as obvious to residential occupants as the cost savings stemming from reduced fuel bills.

F. The model energy audit procedures and post-installation inspection procedures should include requirements to ensure proper ventilation.

G. Section 213(a)(6) of NECPA requires a State Plan to assure RCS Program coordination with other State and Federal energy conservation programs. We would recommend that the requirement for coordination be extended to include coordination with appropriate State health agencies to ensure that adequate standards have been accounted for and that ventilation precautions have been taken.

H. We recommend that materials used for thermal insulation meet requirements not only for the already listed criteria of: thermal resistance, fire safety, non-corrosiveness, resistance to moisture absorption, odor emissions and fungi; but also for possible air pollution emissions such as formaldehyde vapor which is sometimes emitted from Urea-Formaldehyde Insulation.

I. Certain conservation measures can generate significant benefits in soundproofing dwellings from intrusive external noise sources. If these measures are incorporated in dwellings where noise is a problem, significant environmental noise benefits can be achieved at little or no extra cost. We have recently completed a joint DOE/EPA project resulting in a publication entitled, "Energy Conservation and Noise Control in Residences", a copy of which will be sent to you under separate cover. We urge you to consider possible noise benefits in the RCS Program.

6. *EPA's comment E mistakenly assumes that this section of the Preamble of the NOPR dealt with indoor ventilation rates. In fact, this section dealt with attic ventilation. Attic ventilation will be addressed in the Preamble to the Final Rule.*

7. *DOE agrees with the suggestion in comment F and is considering including such procedures.*

8. *Regarding comment G, no measure installed under the Program may violate State or local law, including any health or safety regulations. Thus, DOE does not believe it is necessary to mandate additional coordination, since the State Lead Agency will need to confer with appropriate building code or health agencies to assure compliance with State and local laws.*

9. *The only insulation which DOE is aware that has this problem is urea-formaldehyde foam. DOE will soon reissue its proposed revised standard for urea-formaldehyde foam to address this problem and will solicit information from any interested persons.*

10. *Regarding EPA's comment I, DOE recognizes these soundproofing benefits, and intends to discuss them in materials provided to States and other participants.*

NEW YORK DEPARTMENT OF PUBLIC SERVICE

STATE OF NEW YORK DEPARTMENT OF PUBLIC SERVICE

THE GOVERNOR NELSON A. ROCKEFELLER
EMPIRE STATE PLAZA ALBANY 12223

~~AUG 31 1979~~

August 29, 1979 AUG 30 1979

Ms. Margaret W. Sibley
Office of Conservation and Solar
Applications
20 Massachusetts Avenue, N.W.
Washington, D.C. 20585

431

Re: Residential Conservation Service Program [Dock. No. CAS-RM-79-101]

Dear Ms. Sibley:

This letter transmits the comments of the New York State Department of Public Service, regarding the draft Regulatory Analysis and the draft Environmental Impact Analysis for the Residential Conservation Service Program. The Department has been designated by Governor Hugh L. Carey as Lead Agency for the purpose of implementing this program.

In our review of these documents we found little information that would sway our opinion of the proposed rules, which we transmitted to you on July 9, 1979. However, we do have a few specific comments.

The use of Washington, D.C. data in the Regulatory Analysis as "representative" of energy conservation measures, energy savings and their payback periods makes the study inappropriate for New York State. In fact, our analysis shows that differences in fuel costs, installation costs and climate require that calculations be made for various geographic areas <u>within</u> the State in order to determine the cost effectiveness of particular energy conservation measures. Because of this use of "representative" data, the draft regulatory analysis does not provide adequate support for the imposition of the regulations in New York. We urge the Department of Energy to reperform the cost-benefit analysis on which the proposed rules are based, using more appropriate local parameters.

1. *This issue has been addressed in the Regulatory Analysis, Part 3, Chapter I.*

NEW YORK DEPARTMENT OF PUBLIC SERVICE, (CONT'D)

Ms. Margaret W. Sibley
August 29, 1979
Page 2

Our primary concern with regard to the Draft Environmental Impact Statement involves the various discussions of land use and aesthetic impact of the renewable resource measures. As a general matter, we do not believe that local zoning and planning procedures can be relied upon to minimize or eliminate potential land use and aesthetic concerns involved with active solar systems and windmills. Many communities in this and other states do not have comprehensive local zoning laws or building codes, and, even where these laws exist, they are in many cases not effectively enforced.

It has been our experience generally that aesthetic considerations have been a significant barrier to the widespread use of residential solar systems. The aesthetic and land use concerns involve both the appearance of the substantial collectors themselves and the more fundamental issue of an owners' "right to light."

With regard to wind energy systems, we do not believe the DEIS is reasonable in concluding that "small WECS are not likely to meet resistance" (page 3-133). Based on our experience in siting electric transmission towers, it is our opinion that aesthetic objections to windmills will be more troublesome than the DEIS contemplates.

In addition to the specifics noted above, we believe the DEIS generally fails to adequately address a number of potential environmental impacts. For example, the DEIS offers only conclusory statements on the potential noise impact of wind systems and on the program's impact on indoor air quality. We are not suggesting that the NECPA program is unacceptable based on these impacts, but rather that the DEIS contains inadequate analysis of the potential impacts. We recommend that the DEIS be redrafted and reissued for comment prior to adopting a final statement.

We appreciate the consideration given to these comments and to our earlier comments on the proposed rules for the Residential Conservation Service Program. We look forward to seeing the effect of these comments on the final rules, which we understand are to be published in October.

Respectfully submitted,

PETER H. SCHIFF
General Counsel

by

CHARLES R. GIBSON
Deputy General Counsel

2. *In fact, local citizen and governmental bodies have been actively developing and implementing controls on solar and wind system applications where the installation of these systems is perceived to present problems of land use or aesthetics. A number of such situations have been described in references cited in Chapter 7.0.*

3. *The increasing number of active solar system installations have stimulated restrictive reactions in a number of locations. These restrictions have been presented in the form of zoning ordinances and architectural covenants. A number of these cases were discussed in the DEIS, and references to their particulars were cited there. See Chapter 7.0 for further examples of such restrictions.*

4. *Available evidence from recent surveys on public attitudes toward wind energy systems indicate little opposition to wind system use on aesthetic grounds. (See Section 3.3.4.3.3). While it is realized that a rapid growth in wind turbine installations might lead to different results, the relatively small size and distributed nature of small wind system installations are not likely to pose a significant barrier to wind system implementation.*

5. *The only formal measurement programs conducted on wind turbine noise by the NASA/Lewis Research Center and Sandia Laboratories indicated only modest increases in sound levels above ambient levels. Furthermore, the potential adverse effects of small wind systems are not considered significant with respect to noise. The DOE Rocky Flats Facility is conducting a sound level measurement program on currently available small wind energy systems to provide quantitative evidence in this regard. Even if operational wear and tear leads to an increase in sound levels, appropriate maintenance activities can ameliorate this problem.*

6. *As stated in regard to EPA's comments, Section 3.2.2.1.11 on indoor air quality has been substantially revised as a result of additional comment and analysis.*

OTHERS

AMERICAN ELECTRIC SERVICE CORPORATION

Department of Energy
Docket # CAS-RM-79-101
Residential Conservation Services Program

PREPARED STATEMENT

OF

WILLIAM R. COLEMAN

DIRECTOR OF RESIDENTIAL AND COMMERCIAL SERVICES

CUSTOMER SERVICES DEPARTMENT

AMERICAN ELECTRIC POWER SERVICE CORPORATION

August 14, 1978

Washington, D.C.

TESTIMONY OF WILLIAM R. COLEMAN

Good morning. My name is William R. Coleman; I have been an employee of American Electric Power (AEP) for 31 years and presently serve as Director of Residential and Commercial Services for the American Electric Power Service Corporation. AEP is an investor-owned public utility holding company, owning the common stock of seven operating electric company subsidiaries. The major electric facilities of the seven operating companies--their power plants and principal transmission stations--are inter-connected and their operations coordinated so that they function as a single, integrated utility system. As such, we supply electricity to 6,418,000 people (1,976,964 customers) in 2,939 communities covering 41,670 square miles in portions of seven states-- Michigan, Indiana, Ohio, Kentucky, W. Virginia, Virginia, and Tennessee.

Based on the latest available national statistics, we supply about 3.65% of the nation's residential electric energy supplied by Investor-Owned Utilities. (1,751,452 residential customers with an average customer density of 42 customers per square mile).

Essentially, AEP is considered to be a coal-burning system-- 83.3% coal, 11.7% nuclear, 3.6% hydro, and 1.4% oil (based on installed generating capability nameplate data). Proposed near term capacity additions are also to be fueled with coal.

Each AEP System operating company has long practiced and encouraged energy conservation. Energy efficiency on both sides of the meter has been a stated company goal. On the company side-of-the-meter, this is accomplished by our attempt to design and operate some of the nation's most efficient electric generation, transmission, and distribution systems. On the customer side-of-the-meter, we strive for balanced, efficient, load growth by encouraging improved insulation levels and higher efficiency, end-use, customer-owned energy conversion equipment--particularly heat pumps and load management devices. In the past, electric heating was an imprortant system load management concept. Our 21%+ saturation of electrically heated homes (about 380,000 homes) has been an important load management tool to balance summer/winter system capacity requirements. This has resulted in high annual system load factors (historically in the order of 70%+) and efficient heat rates (usually in the order of 9500 to 9850 Btu/kWh generated).

The purpose of this discussion has been to demonstrate our past customer and company conservation efforts. Conservation practices for electric living have long been a requirement, if only to satisfy customer economic requirements. However, customer conservation can also benefit the company. Therefore, because of past efforts, we feel we are qualified and experienced to comment on many of the conservation activities contained in the proposed Residential Conservation Services (RCS) Program.

Before offering specific comments, may I say that each AEP operating company supports the intent of RCS and has pledged to make every effort to comply with and carry out all RCS rules and regulations. I believe this support is documented by our 75 pages of written comments relative to the Proposed RCS Program Rules. The essence of our comments, past and present, are directed toward simplifying the RCS program requirements and to institute procedures that would assure program operating efficiency. A rather thorough review of the RCS

1. These comments have been addressed in the Regulatory Analysis, Part 3, Chapter I.

Proposed Rules, Draft Environmental Impact Statem-nt (EIS) and Review Draft Regulatory Analysis (DRA) causes us to question some of the basic assumptions which affect the cost-effectiveness of the total program. Certainly, the details of our concerns are far too extensive to discuss here. However, several basic economic assumptions are worthy of note. For example, the program assumes an annual response rate of 7% for 65.4 million households and that 75% of those receiving audits will purchase at least one energy conservation measure. Tables 3-7, A-1, and pages 3-26 of the EIS, predict an energy savings of about 1.21 Quad over the lifetime of all energy measures installed. Yet, page ES-15 of the DRA predicts a lifetime energy savings of 8.2 Quad. This appears to be a major difference in anticipated program benefits. Roughly speaking, these values represent an expected lifetime energy savings of 52,875,395 Btu to 358,235,030 Btu per requested audit based on the suggested 7% response rate. The effective life of all energy conservation measures used in the energy DRA appears to be 21.57 years, which seems impossible as the quoted useful life of all conservation measures is between 5 and 20 years. (Page 3-21 EIS)

Based on DRA and EIS data, the average RCS participant installing conservation devices will spend about $390 to achieve the benefits ($292.70 per audit request).

Table IIB-2 of the DRA and EIS Table 3-7 predicts a total RCS program cost of $2.54 Billion to administer and carry out the RCS program--about $110.96/audit request. Of this 2.54 Billion, it is projected that utilities will spend $1.667 Billion (65.6% of total RCS program cost) which represents a cost to the utilities and/or

See response No. 1 above.

their ratepayers, of $72.83 per audit request.

Based on these DRA and EIS estimates, the expected cost benefit would be that $403.66 would be invested to save 52,875,395 Btu (EIS estimated lifetime energy savings which was judged to be more realistic)--or, an equivalent energy cost of $7.63 per million Btu. This is approximately equivalent to a present day cost of $1.07 per gal. #2 oil, 76¢ per therm of natural gas, and 8¢ per kWh of electricity. Cost justification of these energy conservation investments is questionable, i.e., the benefits may or may not equal the projected energy cost savings over the expected life of the conservation measures to be installed.

I am of the opinion that these cost benefit estimates are probably very optimistic. For example, based on the proposed RCS rules, a conservative estimate of our cost per audit request is in the order of $130 (levelized 5 year cost)--almost twice the DRA estimate for an average utility. Also, our experience does not indicate a 75% installation rate of suggested conservation measure. Based on our experience a 40-45% value would be more realistic. The anticipated energy savings expected for improved ceiling insulation appears unrealistically high as they are based on going from zero insulation levels to R-11 values. I feel that very few homes in the AEP seven state service area have ceiling insulation levels below R-11. Our 380,000 electrically heated homes have installed levels far better than R-11.

The DRA and EIS estimates seem to make no allowance for duplicate efforts and/or associated costs by gas or electric utilities or home heating suppliers. This duplication of effort is an inefficiency that the RCS program and our customers can ill afford. We feel the

See response No. 1 above.

simplest way to eliminate this duplication is to make the audit the responsibility of the home's heating energy supplier. Present DRA and EIS estimates also seem to seriously underestimate RCS program information and communication costs.

In summary, AEP system companies support DOE conservation efforts; but, we feel the RCS program must be made simpler, more flexible, and efficient. In this way, our company, the nation, and the homeowners will receive maximum benefits at the lowest possible costs.

Before writing the final RCS program rules, I feel further cost benefit analyses, based on more realistic operating results and cost (six year rather than lifetime payback periods), are necessary if RCS is to make a positive contribution to national conservation efforts.

AMERICAN GAS ASSOCIATION

American Gas Association

1515 Wilson Boulevard, Arlington, Va. 22209
Telephone (703) 841-8473

Benjamin Schlesinger, Ph.D.
Vice President
Planning and Analysis

August 30, 1979

AUG 30 1979

Ms. Margaret Sibley
Office of Conservation and
Solar Applications
Mail Stop 2221C
Department of Energy
20 Massachusetts Avenue, N.W.
Washington, DC 20545

Subject: Draft Environmental Impact Statement on Residential Conservation Service Program (Docket No. CAS-RM-79-101)

Dear Ms. Sibley:

The American Gas Association, representing some 300 natural gas transmission and distribution companies serving over 44 million homes and 160 million customers, is pleased to present our comments and recommendations in connection with DOE's Draft Environmental Impact Statement (DEIS) on the proposed Residential Conservation Service (RCS) Program. The A.G.A. has been actively involved in behalf of our gas industry member companies in the development and implementation of regulations for DOE's proposed RCS Program.

As A.G.A.'s oral and written comments submitted to DOE previously on this issue point out (see enclosed oral statement), the gas industry has a number of serious reservations with regard to the proposed RCS Program. We are concerned with the considerable cost of the program, both in dollar and in manpower resources. In particular, it remains unclear at the present time which segment of society will have to bear these costs -- our member natural gas distribution companies, the gas customers (ratepayers), or society as a whole (the taxpayers). Resolution of this important issue will strongly influence the shape, scope and impacts of the RCS Program. We are also especially disturbed that these kinds of alternatives, together with their program penetration impacts, are not addressed in the DEIS.

An entire class of environmental impacts appears to have been omitted from consideration in the DEIS; namely, the

1. *The costs of the proposed RCS Program are addressed in the Regulatory Analysis. The costs of alternatives to the proposed RCS Program were addressed in the Draft Regulatory Analysis.*

2. *Sections 3.2.2 and 3.3.4 address health and safety issues related to each specific measure. Material and installation standards are proposed as mitigating*

Ms. Margaret Sibley
August 30, 1979
Page 2

impact on homeowner health and safety in connection with installation and operation of the numerous kinds of conservation devices and materials which could come into widespread use as a result of the RCS Program. Furthermore, we believe that the DEIS's overemphasis on air contaminants for which EPA standards now exist masks a deeper concern over the introduction of new potentially toxic substances, and new potential dangers into the household environment.

Our concerns lead us to conclude that this DEIS is deficient in the respects we have outlined. We recommend strongly that the document be revised to focus on the kinds of home environment issues we have raised, in addition to the direct pollutants and emissions, so that the decision to proceed with this massive and costly RCS Program can be made with a proper reflection upon all the environmental, health, and safety impacts that may arise.

Moreover, A.G.A. is concerned with the following procedural matter. This DEIS was available to the public in mid-July, two months after the Draft Regulatory Analysis was released, and four months after the proposed regulations were published in the Federal Register. We feel this sequence is inconsistent with the provisions contained in Executive Order 12044, as outlined in our attached oral testimony.

Following are several additional specific comments we would offer to assist DOE in finalizing this DEIS:

- Page 3-36:

  The DEIS section on Site-Specific Impacts inadequately treats the implications of failure to enact timely and specific health and safety standards for the residential conservation measures that would be stimulated by the RCS Program. For such factors as the proper manufacture and installation of certain potentially hazardous conservation measures, e.g., inflammable insulation and/or toxic materials, DOE and other agencies may indeed currently be developing safety standards, but there is no indication in the DEIS as to when these standards will become effective.

- Page 3-89:

  The potential health hazards arising from air contaminants in the home environment have not yet been fully researched to the satisfaction either of EPA or the gas industry. Possible air quality problems

actions for all measures potentially affecting residential health and safety. No measures shall be adopted in connection with the Program until appropriate environmental standards have been met, and material and installation standards are formally adopted.

3. *Air pollutants or contaminants addressed in Chapter 3 and Appendix A include a full range of hazardous and toxic substances, not just those for which EPA standards exist. As noted previously, the EIS thoroughly discusses the potential problems associated with each conservation or solar measure in the Program as well as indoor air quality.*

4. *Measures for which standards for safety and effectiveness are necessary will only be retained in the Program if such standards are completed and formally adopted prior to the approval of State Plans. See also response No. 1 to L. Spielvogel, p. C-33.*

5. *Indoor air pollutant problems, including excessive humidity, are not the result of "over-insulated structure(s)." The potential problem exists whereever a source of a pollutant is found in a home. The problem arises where infiltration is reduced and the pollutant is allowed to accumulate to unhealth concentrations. Infiltration reduction, not insulation, is the contributing factor. Indoor air contaminants are discussed in Section 3.2.2.1.11 and mitigating actions are proposed for each identified pollutant. With respect to humidity, installation of vapor barriers will be required in conjunction with insulation in those northern areas of the country where moisture accumulation may be a problem.*

Ms. Margaret Sibley
August 30, 1979
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arising from energy conservation practices should be described in the DEIS, such as the effect on housing materials of excessive humidity build-up resulting from an over-insulated structure.

- Page 3-103:

  The DEIS does not quantitatively evaluate the environmental impacts potentially attributable to the installation of renewable resource measures, although the proposed rule indicates that utilities could be required to offer a renewable resource audit as part of the RCS Program. As pointed out in Section 3.3, the lack of verifiable published market penetration estimates for either wind or passive solar resource measures prevents the development of a valid quantitative analysis of the environmental impacts of renewable resource measures attributed to the RCS Program. This may prove to be a significant deficiency in the DEIS in light of the cost burden this provision could place on gas utilities.

- Page A-2:

  A.G.A. has the following serious reservations about a key methodology assumption needed to assess the potential pollution emission impacts attributable to the RCS Program, as outlined in Appendix A of the DEIS. The analysis assumes a 35 percent response rate, i.e., 7 percent per year for the 5 year Program period, which represents the maximum homeowner response to the proposed program. This reference case response rate is based on the assumption that the energy audit, the basic mechanism of the RCS Program, will be offered free of charge to homeowners.

  - Section 215 (c)(1)(c) of the NECPA explicitly provides that state Public Utility Commissions shall determine whether the energy audit costs will be the responsibility of the homeowner or the utility. Since the proposed RCS Program would obviously impose a substantial cost burden on gas utilities, it is likely that many states may elect to have customers directly meet the

6. DOE disagrees with AGA's comments regarding 3-103. As noted in the DEIS, quantitative analyses of the environmental impacts of renewable resource measures have been made, but DOE concluded they could not be segmented with regard to the RCS Program with precision. The costs of audits of renewable resource measures are addressed quantitatively in the Regulatory Analysis.

7. The EIS considered what was believed to represent the highest likely response rate, i.e., the greatest change from existing or expected conditions. Any lesser response would result in fewer benefits both in energy savings and pollutant reductions. It is not believed that lower response rates cause

AMERICAN GAS ASSOCIATION, (CONT'D)

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cost of the audit, which could greatly reduce the assumed 35% participation rate to a much smaller figure.

The DEIS, however, fails to consider the potential environmental impacts of alternative program response rates, i.e., less than or greater than 7 percent annually. A sensitivity analysis is required as part of the final EIS to show possible adverse effects on the environment at different levels of program responses.

On behalf of the American Gas Association and its member companies, I would like to thank you in advance for your careful consideration of our views on this very important matter. Please do not hesitate to call on me if I can provide additional assistance. We look forward to the opportunity for further substantive involvement in implementation of the proposed RCS Program.

Sincerely,

Benjamin Schlesinger

BS:kg

Enclosure

7. (Continued)

more adverse impacts than those analyzed in the EIS. Higher response rates would raise proportionately both the environmental benefits and risks associated with the Program. Based on the experience of existing utility conservation programs, however, DOE believes that a 7 percent response rate is the highest achievable without further unforseeable stimulus of demand. The response rate is also discussed in the Regulatory Analysis.

DALLAS POWER AND LIGHT COMPANY

TESTIMONY OF

C. C. BENSON

Director, Program Development

Dallas Power & Light Company

1506 Commerce Street

Dallas, Texas 75201

214-747-4011 X-647

C-23

Re: Residential Conservation Service

(Docket No. CAS-RM-79-101)

August 14, 1979

Mr. Chairman, members of the panel, I appreciate the opportunity to visit with you today concerning Dallas Power & Light Company's interest in the Residential Conservation Service. As you know, our company serves approximately 250,000 customers in the metropolitan Dallas, Texas, area and together with Texas Electric Service Company and Texas Power & Light Company provide electric service to more than one million customers spread over approximately one-third of the State of Texas.

Most of DP&L's uncertainties with RCS revolve around a situation which was explained by President Carter on July 15 this way:

"Good evening. This is a special night for me. Exactly three years ago on July 15, 1976, I accepted the nomination of my party to run for president of the United States. I promised you a president who is not isolated from the people, who feels your pain and who shares your dreams, and who draws his strength and his wisdom from you.

"During the past three years, I've spoken to you on many occasions about national concerns: the energy crisis, reorganizing the government, the nation's economy, and issues of war and especially peace.

"But over those years, the subjects of the speeches, the talks and the press conferences have become increasingly narrow, focused more and more on what the isolated world of Washington thinks is important. Gradually you've heard more and more about what the government thinks, of what the government should be doing, and less and less about our nation's hopes, our dreams of the future."

DALLAS POWER AND LIGHT CO., (CONT'D)

- 2 -

We view the President's pledge to the American public favorably and think it reinforces the position we have been suggesting to D.O.E. since early this year . . . we have experience, we have programs, we have enthusiasm, and we are willing, ready and able to move forward with the RCS Program if it provides for flexibility and adaptation to the peculiar needs of individual utilities and their customers.

The objective of the legislation was to conserve energy in residential structures, and Congress included certain measures and activities which they considered important. Our difficulty in understanding D.O.E.'s position, as reflected in the proposed rule, is understanding the need for such voluminous requirements. Congress wanted a program presented to all customers which would aid them in making intelligent energy decisions, not, in our judgment, a program which is so specific that it removes virtually all latitute in discussions between the energy supplier and the customer who is paying for the assistance.

We think D.O.E. would agree that utilities have a great deal of control over potential response rates through the audit charging policy they employ, through the separation or non-separation of conservation measure and renewable resource measure audits, sophistication or lack thereof in the announcement materials, and indeed in the degree of effort a customer must expend to request an audit - for instance, simply returning a preprinted coupon will elicit far more responses than a statement such as, "Simply drop us a line requesting an audit."

What I'm suggesting is that there are innumerable ways to scuttle this or any program, but utilities don't want that . . . if they did they wouldn't have spent the time they have in suggesting workable alternatives to the proposed rules.

1. *DOE agrees that flexibility is desirable consistent with appropriate environmental safeguards.*

2. *These following issues have been addressed in the Regulatory Analysis, Part 3, Chapter I.*

DALLAS POWER AND LIGHT COMPANY, (CONT'D)

- 3 -

We have suggested many changes which are minor in nature but which allow flexibility in dealing with situations we know will occur. In other cases we have suggested that the proposed rules do not appear to have followed conventional engineering logic; and in others, may work an undue hardship on certain customers.

For example, in an area where 95 percent of the homes are air conditioned, it's a disservice to customers not to be able to recommend that when their existing equipment fails they should get the most efficient replacement equipment available.

When D.O.E.'s own analysis indicates that "very few regions demonstrate sufficient economic benefits to justify the investment in a wind system," we find it hard to be enthusiastic about wind system inclusion in the program in light of the fact that we're specifically prohibited from suggesting that a customer plug the holes in his broken windows and walls prior to insulating his attic.

When Congress has determined that a fuel imbalance exists, it's hard to understand a prohibition of fuel switching which will ease the problem, particularly when D.O.E. has admitted there is no legislative history to such a prohibition and the President has endorsed the concept - including a subsidy to increase its acceptance.

We realize that many of these problem areas may be resolved satisfactorily when the final rule is issued, but I hope you appreciate our concerns. The whole comment process has been one approaching adversary proportions from the beginning and it wasn't necessary, as we are now beginning to realize. That's water under the bridge . . . maybe we've all learned from the process. We certainly hope so.

2. *High efficiency replacement air conditioners and furnaces are conservation measures under the Final Rule.*

3. *Replacement air conditioners are addressed in Section 3.2.2.1.7.*

4. *Regarding the issues of flexibility and adaptability, consistent with environmental safegyards, see response No. 1 to Laclede Gas Company, page C-32.*

With respect to the Draft Regulatory Analysis, most of our comments are covered in our written testimony submitted on July 6, 1979. I would, however, like to point out that in our opinion the Analysis is somewhat confusing and does not adequately address the impact of the proposed rules. Specifically, we feel the Regulatory Analysis should be revised to include:

1. All measures required by Public Law 95-619.
2. All rules as published in the March 19, 1979, Federal Register at 10 CFR 456.
3. A comprehensive study of all programs now in use by utility companies to determine the actual level of current energy conservation activities.
4. Program development costs including the estimated cost of analyzing the Proposed Rules, the DRA, the EIS, and the Urban and Community Impact Analysis.
5. The estimated cost of compliance with all rules and specifications not currently required by D.O.E. or other regulatory agencies.
6. A simple, bottom-line cost-benefit analysis similar to that shown in our written comment so consumers may readily evaluate the total impact of the program in understandable terms.

I would like to compliment D.O.E. on the completeness and conciseness of the Environmental Impact Statement prepared for the Residential Conservation Service. It's an excellent document, and we feel it should be used as a model for future analysis efforts.

Our comments on the Urban and Community Impact Analysis (UCIA) will be limited to generic statements about areas we have difficulty understanding.

1. Since the principal thrust of the RCS program revolves around the installation and financing of energy conservation measures in residential structures, it seems that the UCIA devotes a disportionate amount of energy in the renewable resource area.

5. These issues have been addressed in the Regulatory Analysis, Part 3, Chapter I.

6. These following issues have been addressed in the Regulatory Analysis, Part 3, Chapter H.

This is particularly evident in the "Projected Changes in Employment" section at the back of the report. All employment changes listed refer to the solar component of RCS and neglect the most important portion of the program.

2. We question the wisdom of using this BLS I/O model for forecasting employment changes when its use produces such distorted results as a decrease of 52 to 94 jobs in hosiery and knit goods employment and an increase of 92 to 106 jobs in ship and boat building and repair. Likewise, this model forecasts an increase of 22 to 26 local and intercity bus drivers as a result of the RCS solar initiative. Surely there is room for improvement in such a forecasting model.

3. We would also question the absence of any data concerning the inflationary impact the RCS program will undoubtedly have on our urban and community environment.

4. We have extreme difficulty understanding the position shown on page VI-49 of the UCIA when it states:

> "Projecting from experiences in energy conservation programs, and from field studies of present solar commercialization efforts, and depending on the cost of the audits, it appears that there will be a response rate of no higher than 10 percent per year per 100,000 residential utility customers, within the tenure of this initiative. In other words, there would be 10,000 audits per 100,000 residential customers.
>
> "At one-half day per audit, again an upper bound, there would be 5,000 person-days of work or 25 jobs created per 100,000 residential customers. An additional 10 management positions will be needed, which result in a projection of 35 jobs per 100,000 residential customers.

"It is clear from these projections that the impact of the audit program on the overall national employment picture is insignificant. No effects will be felt in the disadvantaged areas; little impact is anticipated even among the professional groups."

For DP&L this analysis suggests that as many as 67 jobs and 25 management positions may be needed. If we multiply this requirement by all covered utilities, the number is astronomical, not "insignificant," and the cost to customers is totally beyond comprehension.

5. There is a complete absence of Bibliography listings of reference materials used in the preparation of Sections A and B, while Section C, Renewable Resource Component of the Proposed RCS Program, contains thirty (30) references.

Briefly, we would like to comment on three other issues which impact the entire RCS program.

First is the distinct possibility of additional requirements being added after the final rule is published as a result of Executive or Congressional initiatives which are now being discussed. It would seem that additional requirements can be fitted in easier if the original rules are flexible and allow utilities maximum leeway in deciding how to accomplish the requirement. In other words, after due deliberation and consultation, tell us what is to be done and not how to do it.

Second, I'd like to point out the results of a recent survey conducted by the Library of Congress' Congressional Research Service.

See response No. 4 above.

"Federal regulations are unfair, costly, and confusing, according to a massive, nationwide canvass carried out by an independent Washington-based organization in cooperation with the Library of Congress' Congressional Research Service.

"The Forum on Regulation survey was distributed to 25 million people by members of Congress, trade associations, farm and trade journals, and the media. More than 2.2 million people responded.

"Findings included:

. 82 percent believed federal regulations were not fair to the people affected.

. More than 94 percent agreed that products "cost more" because of regulation.

. 95 percent felt federal regulations were "complicated and confusing."

. 82 percent said they "were not" confident that new regulations were based on facts."

Finally, as an indication of our concern, support, and continuing desire for the development of workable, realistic, and meaningful energy conservation initiatives in this country, I would like to submit the following Resolution of Commitment which was endorsed on Sunday, August 12, 1979, by 12 utilities in a meeting held in Ft. Worth, Texas.

RESOLUTION OF COMMITMENT

WHEREAS, the United States faces an energy imbalance arising from increasing demand for energy, particularly for oil and natural gas; and

WHEREAS, the United States has insufficient domestic supplies of oil and natural gas to satisfy that demand; and

WHEREAS, effective measures must be taken to reduce the rate of growth of demand for oil and natural gas in order to reduce the dependence of the United States on the world oil market and its increasing vulnerability to interruptions of foreign oil supplies; and

WHEREAS, the installation and maintenance of selected energy conservation measures in residential structures is a proven method for reducing the demand for all forms of energy; and

WHEREAS, investor-owned utilities have extensive experience in energy conservation programs; and

WHEREAS, investor-owned utilities are desirous of implementing further residential energy conservation programs; and

WHEREAS, detailed, specific and pervasive rules applied to residential energy conservation activities may be counter-productive; and

WHEREAS, the Department of Energy is charged with the development of regulations to facilitate the implementation of Public Law 95-619, The National Energy Conservation Policy Act; and

WHEREAS, investor-owned utilities have devoted considerable time and resources to assist the Department of Energy in the development of its regulations;

THEREFORE, now, the undersigned investor-owned utility companies, while recognizing that the proposed rules for the implementation of a Residential Conservation Service contain numerous unresolved issues, resolve that:

> THEY will continue to enthusiastically implement energy conservation programs which are consistent with the welfare of the utilities' customers and investors; and
>
> THEY will cooperate with the Department of Energy and other governmental agencies to the maximum extent practicable in developing programs and implementation methods which maximize customer participation at minimum cost; and
>
> THEY will seek mutual understanding of unique problems and situations which effectively limit or prevent implementation of some programs; and
>
> THEY will suggest constructive alternatives which will serve the objectives of the Congress, the needs of consumers, and the expectations of investors.

We are sincere in trying to make energy conservation work. Let's work together to show what can be done through cooperation.

Thank you for the opportunity to participate in today's meeting. I'd be glad to try and answer any questions you may have.

LACLEDE GAS COMPANY

SEP 5 197

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UNITED STATES OF AMERICA

DEPARTMENT OF ENERGY

COMMENTS OF LACLEDE GAS COMPANY IN RESPONSE TO THE NOTICE OF AVAILABILITY OF DRAFT ENVIRON-MENTAL IMPACT STATEMENT FROM THE DEPARTMENT OF ENERGY IN REGARD TO THE RESIDENTIAL ENERGY CONSERVATION PROGRAM	)	Docket No. CAS-RM-79-101 (DEIS)

COMMENTS OF LACLEDE GAS COMPANY

The following comments and suggestions are submitted by Laclede Gas Company (Laclede) pursuant to the Department of Energy's (DOE's) July 16, 1979 Notice of Hearing, Availability of Draft Environmental Impact Statement (DEIS) and Reopening of the Comment Period on the Proposed Rule for the Residential Conservation Service (RCS) Program.

I

Laclede is a corporation organized and existing under the laws of the State of Missouri with its principal offices at 720 Olive Street, St. Louis, Missouri 63101. It distributes gas to over one-half million customers in the City of St. Louis, St. Louis County and much of Southeastern Missouri. Laclede's annual sendout of natural gas exceeds 100 billion cubic feet.

The names, titles and mailing addresses of persons to whom correspondence or communications concerning these comments and recommendations should be addressed are as follows:

Mr. Lee M. Liberman
President and Chairman
Laclede Gas Company
720 Olive Street
St. Louis, Missouri 63101

Howard Elliott, Jr., Esquire
Vice President-Administration
Laclede Gas Company
720 Olive Street
St. Louis, Missouri 63101

II

The Draft Environmental Impact Statement (DEIS) addresses the RCS Program as promulgated for comment on March 19, 1979 (44 FR 16546). The program specifically prohibited fuel switching as a matter of policy and did not address the question of the inclusion of conservation measures other than those specifically set forth in Section 210(11) of the National Energy Conservation Policy Act (NECPA).

Laclede was alarmed when it learned at a meeting on June 5, 1979 between the American Gas Association Conservation Task Force and Mr. James R. Tanck, Director of the RCS Program, and other DOE officials accompanying him, that the DOE was seriously considering changing its no-fuel switching policy from that set forth in the Proposed Rules of March 19, 1979, and that it intended to include additional energy conservation measures other than those set forth in the NECPA in the RCS Program.

If the DOE intends to pursue this course of action, the Draft Environmental Impact Statement is statutorily deficient in that it does not address the environmental impact of the proposed changes in the RCS Program outlined above, specifically switching to electric heat pumps as a substitute for gas and electric furnaces, which as Laclede has also heretofore pointed out does not conserve energy. (See National Environmental Policy Act of 1969 [NEPA], 42 U.S.C. 4321, et al.)

Moreover, the environmental impact of the proposed changes in the RCS Program would have a significant environmental impact in Laclede's service area and substantially exacerbate a situation wherein state environmental standards have yet to be enforced after seven years of litigation.(1) This is because coal would be used to generate the power required for the heat pumps resulting in additions to the stack emissions of the powerplants in the St. Louis area.

CONCLUSION

A policy promoting fuel switching and the inclusion of the heat pump as a conservation measure under the Proposed RCS Program requires that the environmental impact of such measures be thoroughly examined and the DEIS does not address either the policy or the measure.

Respectfully submitted,

Howard E. Elliott Jr.

Howard Elliott, Jr., Esquire
Vice President-Administration

(1) See Union Electric Co. vs. Environmental Protection Agency, et al, 427, U. S. 245 (1976); Union Electric Company v. Environmental Protection Agency, 450 F. Supp. 805 (1978) and 593 F. 2d 299 (1979)

1. *The DEIS addressed the inclusion of measures pursuant to State action. The FEIS addresses that option in more detail, focusing upon allowing flexibility consistent with appropriate environmental safeguards.*

LAWRENCE G. SPIELVOGEL, INC.

LAWRENCE G. SPIELVOGEL, INC. CONSULTING ENGINEERS

WYNCOTE HOUSE • WYNCOTE, PENNSYLVANIA 19095 215-887-5600

July 30, 1979

0409 AUG 1 1979

Ms. Margaret Sibley
Office of Conservation & Solar Applications
Mail Stop 2221C
Department of Energy
20 Massachusetts Avenue, N.W.
Washington, D.C. 20545

Re: Docket No. CAS-RM-79-101

Dear Ms. Sibley:

Following please find my comments on the Draft Environmental Impact Statement for the Residential Conservation Service Program.

I am very much concerned that the Environmental Impact Statement identifies a number of environmental and safety problems yet provides no answers for them. A frequent comment is that research is being done.

I fail to see how you can presume the outcome of this research.

Therefore it must be concluded that the Residential Conservation Service Program will at least in some instances have a substantial environmental and safety impact on the American Public.

How therefore can you proceed to a final rule on the Residential Conservation Service Program where these environmental and safety problems exist?

While you indicate that DOE intends to withdraw any measure for which safety and environmental standards have not yet been completed at the time the program announcements are sent, it is not indicated that these pronouncements will be publicly available. It is therefore recommended that the results of the research on every one of these problems be announced in the Federal Register.

Regarding the determination that reduction of air exchange rates within houses may not cause problems, there have been legal cases in which homeowners have been awarded damages when builders have failed to provide adequate air exchange rates. Therefore the conclusion of DOE on this matter is challenged. If builders can be found liable for minimizing air exchange rates then I should certainly think that DOE could be found liable, or at least the contractors who participate in this program could be found liable.

Very truly yours,

LAWRENCE G. SPIELVOGEL, INC.

L. G. Spielvogel, P.E.

LGS:bhs

1. *DOE has conducted substantial research on environmental issues to help assure that appropriate environmental considerations are made in the decision-making process. Where DOE has determined standards are necessary for the general safety and effectiveness of any measure, DOE has developed such standards or will not include a measure in the Program until they are developed.*

2. *If DOE determines to withdraw any proposed measures from the National Program, public announcements will be made. The Program intends to effect widespread public dissemination about its activities to facilitate public participation.*

3. *The EIS does not conclude that "reduction of air exchange rates within houses may not cause problems." In fact, it reaches the opposite conclusion. This subject is addressed in Section 3.2.2.1.11.*

MOUNTAIN FUEL SUPPLY COMPANY

SEP 5 1979

440

MOUNTAIN FUEL SUPPLY COMPANY

[illegible] East First South • P. O. Box [illegible] • Salt Lake City, Utah [illegible] • Phone (801) [illegible]

August 30, 1979

Ms. Margaret Sibley
Office of Conservation
and Solar Applications
Mail Stop 2221C, DOE
20 Massachusetts Avenue
Washington, DC 20545

Re: Docket No. CAS-RM-79-101
Residential Conservation Service Program Supporting Documents

Dear Ms. Sibley:

Enclosed herewith are ten (10) copies of Mountain Fuel Supply Company's comments on the Draft Environmental Impact Statement, Draft Regulatory Analysis, and Draft Urban and Community Impact Assessment published under the above referenced docket. These comments are intended to supplement and support those submitted on June 8th and those presented at the public hearing in Denver on May 14th by Lynn H. Bringhurst.

Mou tain Fuel appreciates the opportunity to comment on these documents, and hopes that the comments will prove to be useful in developing effective and practical rules to implement the RCS program.

If there should be any questions concerning the comments of Mountain Fuel, please direct them to me by telephone or letter.

Sincerely,

Lynn H. Bringhurst

Lynn H. Bringhurst, Director
Codes and Standards

LHB/cs

MOUNTAIN FUEL SUPPLY COMPANY, (CONT'D)

UNITED STATES OF AMERICA
DEPARTMENT OF ENERGY

Draft Environmental Impact Statement	)	Docket No.
Draft Regulatory Analysis	)	CAS-RM-79-101
Draft Urban and Community Impact Assessment	)	

Written Comments of Mountain Fuel Supply Company

Mountain Fuel Supply Company's interest in the RCS program has been stated in our June 8 filing on the Proposed Rule under this docket. Our purpose in the current filing is to comment on the Draft Regulatory Analysis (DRA), Draft Urban and Community Impact Assessment (DUCIA) and Draft Environmental Impact Statement (DEIS) insofar as these documents represent a logical basis for the promulgation of the Proposed Rule implementing the RCS Program.

The status and rationale of the three documents under consideration are different. The DUCIA and DEIS are intended to assess the impact of the proposed regulation after its development, whereas the DRA, according to DOE policy (at 44 FR 1041-2), is intended to be developed concurrently with the proposed regulations. It is apparent to Mountain Fuel that the most important reasons for concurrent development of the DRA are the DOE requirements (at 44 FR

1041, Section 9d (3, and (5)) for inclusion therein of "a description of the major alternatives, including nonregulatory alternatives, for dealing with the problem and achieving the policy objectives" and "an explanation of the reasons for choosing the preferred alternative." It is also apparent to Mountain Fuel that the DRA considered herein fails to meet both these criteria, and we will provide evidence to support this contention. We will also comment on the DUCIA and DEIS as they bear on the feasibility of the proposed regulation.

As a preliminary matter, DOE policy stated at 44 FR 1041 directs that a DRA will be prepared by the lead office, members of the working group within DOE, and other parties within ERA and DOE only. The DRA herein considered, however, was prepared for DOE under Union Carbide Corporation Subcontract No. 86X-423537C by Hittman Associates, Inc., of Columbia, Maryland. This is an apparent violation of DOE policy, and may be the cause of the disparity between alternatives posed (or ignored) in the DRA by the subcontractor and the proposed regulation as promulgated by DOE. We will now address specific topics of concern within the DRA as well as the DUCIA and DEIS.

State Participation in RCS

The DRA fails to address the alternative scenario wherein a state declines to participate in the RCS program, and DOE is forced to fund and manage a program for that state. The DRA does note that in the

1. *These comments address the Draft Regulatory Analysis. These issues have been addressed in the Regulatory Analysis, Part 3, Chapter I and H.*

absence of federal funding, states will be required to provide funding for the RCS Program at the expense of other state programs or as a result of more revenue; the DRA notes further that the cost impact on small population states will be more substantial than on those with larger populations (DRA, page ES-16 and DUCIA, page VI-13). The DUCIA estimates that the RCS program represents 0.009 percent of a state's expenditure (DUCIA, page VI-12), based on national averages. In Utah, however, 0.009 percent of the annual state budget is approximately $90,000 and the Utah Energy Office estimates a minimum RCS program cost of $1 million over the five years, or $200,000 annually (see the testimony of the Utah Energy Office given at Denver on May 14 under this docket). It is not surprising that the State of Utah stated in its Denver testimony that:

> The Department of Energy should begin planning now to develop an implementation plan for the State of Utah because we are seriously considering not participating in the RCS program. It is our current assessment that our participation would not result in a significant improvement over a DOE developed and implemented plan. Because of this, we cannot justify a $1,000,000 budget request to run DOE's prescriptive program. Two changes would be required to modify our position.
>
> The first would be changes in these regulations to give States considerably more flexability in developing and

See response No. 1 above.

MOUNTAIN FUEL SUPPLY CO., (CONT'D)

administering State plans. The second would be grants to cover 100% of the cost for plan development and program implementation. Without these two items the chances are excellent that the Utah Energy Office will choose not to submit an RCS plan.

Mountain Fuel asserts, therefore, that the DRA is inadequate in failing to consider the major alternative of DOE managed RCS programs in small states necessitating funding at the federal level. Mountain Fuel takes obvious note of the fact that such federally generated funds for an RCS program could be more efficiently used in funding a state plan.

See response No. 1 above.

Incremental Effect of Energy Conservation Measures

Perhaps the most glaring omission in the DRA selection of major alternative scenarios is that of an optimum cost-benefit or least-cost scenario. The inclusion of either alternative would have lent a more pragmatic aspect to an otherwise utopian document. Plainly stated, the RCS program will fail utterly if the average citizen does not see an economic benefit to be derived from the installation of energy conservation measures (ECM's); and virtually nowhere in either the proposed rules or the three supporting documents under comment is the consumer shown to be benefited economically. On the contrary, following are examples of selected alternatives which impose an economic disbenefit upon the consumer.

Alternatives for the required scope of the ECM audit were considered: (1) only those measures that pay for themselves in energy savings within six years, (2) only those measures that pay for themselves in energy savings over their useful life and (3) all ECM's suggested in the legislation. The DRA notes on pages II-16 and II-17 that "previous experiences of utilities with audit programs indicate that, regardless of response rate, homeowners are reluctant to purchase any conservation measure which has a payback period of more than six years. Therefore, the benefits in energy savings from increasing the required content of the conservation measures audit for either alternative are likely to be minimal." In total disregard of

See response No. 1 above.

this strong statement, the proposed regulation unaccountably opted for the useful life payback alternative, at an incremental cost of $405 million over the six year payback alternative. DOE thus violated its own policy by not giving "an explanation of the reasons for choosing the preferred alternative" in the DRA, as required at 44 FR 1041 (9d(5)), and moreover, selected a more expensive option that was strongly discouraged in the DRA. One wonders if the DOE authors of the regulations in fact were familiar with the DRA. Mountain Fuel recommends that the proposed rule be changed to reflect a six year payback as recommended by the DRA.

The DRA does not address the cost effectiveness of solar or wind energy device audits. While certain regions of the country are likely candidates for such audits, the proposed rule dictates that all regions must include them. Since these audits comprise a major audit expense, they must be considered under major alternatives. As stated earlier, the RCS program fails or succeeds according to consumer response; expensive mandatory solar audit forced upon a resident of Seattle will discourage his participation. Mountain Fuel recommends that the DRA deal with solar and wind audits on a cost-effective basis in its alternative analysis.

Certainly the most obvious alternative not considered in the DRA is a comparison of incremental cost versus incremental benefits of the suggested ECM's and alternatives in the nonregulatory environment.

See response No. 1 above.

Nowhere in the DRA are suggested ECM's discussed from the standpoint of how much energy savings could be expected and for what consumer cost. It may be possible, for example, that the money spent to audit for and install an expensive and sophisticated ECM's could, when aggregated across the country, fund research and development of coal gasification that could produce the incremental energy supply needed to offset the energy saved by installing such ECM's. From the standpoint of a natural gas utility such as Mountain Fuel, this liklihood is even greater, since the DEIS (page 3-144) concedes that "based on a review of the suggested measures in the proposed rule, and the economics of the suggestions, it appears that [the reduction in non-renewable energy use] will be the greatest in electricity, smaller in oil consumption with the least reduction being that of natural gas usage" (emphasis supplied). The DEIS (page 3-26) at least estimated that with an assumed response and installation rate over only three ECM's (ceiling insulation, water heater insulation and storm windows), that about 62.4 percent of the energy saving estimated possible under the entire RCS program could be achieved. The cost required to exceed that percentage might well fund energy research that would pay back energy savings far in excess of that possible within the remaining bounds of the RCS program. The DRA should address itself to this issue.

The DRA does not consider the nonregulatory alternatives to the RCS program. Among the items not addressed directly are personal

See response No. 1 above.

living habits. Mountain Fuel has found this factor to be a major influence in achieving energy conservation. Many consumers have not waited for federal legislation to tell them how to be conservation conscious: in the Mountain Fuel service area over 14,000 homes have had ceiling insulation installed through a Mountain Fuel program. Considering the first energy savings for minimal cost derived from ceiling insulation, it is likely that these 14,000 homeowners may choose to not participate in the RCS program. Moreover, the homes built to EPCA standards since 1975 are not eligible for RCS inclusion, nor are residences over four-plex size. The DRA has not considered what impact existing and on-going conservation measures may have on consumer participation in the RCS program. At the rate of new home construction and renovation, it is quite possible that the RCS program could be a monumental, expensive white elephant costing the states, utilities and federal government great sums of money to keep in place over the next five years and longer. The DRA has not considered this scenario of large scale non-participation caused by conservation efforts outside the RCS program.

Development of Standards

A major fault of the DRA is its failure to consider the manner in which standards are developed in the RCS program. As a result, the standards (or lack of them) in the proposed rule may be very costly to the consumer and detrimental to the RCS program. Standards for such

See response No. 1 above.

MOUNTAIN FUEL SUPPLY CO., (CONT'D)

primary conservation measures as ceiling insulation (electrical wire barriers) and vent dampers may not be in place at the inception of the RCS program, thus hampering program announcement and effective audits and delaying installation.

Electrical wire barriers are of particular concern, as the requirement that they be installed in ceiling insulations applications will preclude the "blow-in" technique of installation which will greatly increase labor charges for installation quite apart from increased materials expenses for the barriers themselves. It is worth noting that contractors in Mountain Fuel's service area are not familiar with any product that can serve as a wire barrier; it is clear that DOE did not consult with manufacturers or venders in the development of this standard, as was recommended by the Conference Committee Report (page 94) on the Act.

DOE has chosen to reject ANSI standards for vent damper installation. This action apparently ignores the caution imposed upon DOE by Congress in the Conference Report on the Act (page 94) wherein the Secretary is admonished to proceed cautiously in establishing specificity in rules with respect to standards, and that the authority granted the Secretary should not be interpreted as requiring him to establish comprehensive federal standards for any specific ECM. Mountain Fuel recommends that the DRA examine consensus development of standards including manufacturers, vendors, and appropriate standards

See response No. 1 above.

MOUNTAIN FUEL SUPPLY CO., (CONT'D)

organizations, as well as American Gas Association (AGA), in the process.

Post Installation Inspections

We refer to our June 8 filing on the proposed rule for our specific comments on the feasibility and desirability of post installation inspections. We take issue with the DRA (page II-17) assertion that elmininating the requirement for post installation inspections "might reduce" the demand for services under the RCS program. There is no foundation for this allegation. On the contrary, there is no evidence that elimination of this costly provision might not reduce the demand for services under the RCS program. In formulating the proposed rule, DOE has drawn an unsupported conclusion, where in fact the inclusion or elimination of post installation inspections have not been shown to have any effect on customer participation.

Moreover, if the inspection burden is placed upon the utility, the cost and liability implications noted in our June 8 filing may erode the utility public image, as conceded by the DRA at page V-10:

> Utilities which are already the target of consumer activity because of high energy rates may find their public relations

2. *These issues pertain to the Regulatory Analysis.*

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problem further aggravated if a rate increase must be requested to cover the costs of implementing the RCS Program.

Arranging Function

The DEIS asserts at page 1-10 that "DOE believes that a substantial percent, if not a majority, of the measures installed will not be 'arranged' by a utility, however, 'arranging' may be defined by a state." Mountain Fuel believes this to be further evidence that maximum flexibility be given to the state in development of its plan, and that the utility be relieved to the maximum extent of the burden of arranging.

Indoor Air Quality

The DEIS proposes at page 6-18 that the auditor use a checklist to assess air pollution sources within the home he audits. The idea of making a utility auditor responsible for a domestic emission inventory is far outside his authority under the Act and places him in an untenable public relations role. Does he inform a home's occupants that they are smokers and hence run a risk of high carbon monoxide levels? Does he inform the occupants that their dog's shedding will raise the ambient particulate level to a hazardous level? The Act says an auditor is to deal with energy conservation. Mountain Fuel recommends he be required to do no more.

3. *Options to increase the Program's flexibility were addressed in the DEIS and are discussed further in the alternatives section, Chapter 6.0, of the text.*

4. *The implications of current studies, as reflected in the FEIS, show that indoor air pollutants can be a potential serious problem. The analysis indicates that the potential problems would be aggravated without the benefits of the Program since increasing numbers of persons would weatherize or tighten up their homes, often without awareness of the relevant safety and health considerations which would be communicated in connection with this Program.*

MOUNTAIN FUEL SUPPLY CO., (CONT'D)

Sunset Provisions

The DRA concedes at page V-13 that additional congressional action may be required to resolve the ambiguity of RCS program termination with respect to DOE, the state and covered utilities. Mountain Fuel believes that the growing number of homes constructed under energy efficient codes such as mandated by EPCA will render the RCS program an expensive, white elephant by 1984. Mountain Fuel refers to DOE's policy of regulatory reform (44 FR 1042 Section 13) wherein DOE states it will republish within five years all regulatory programs, including RCS, for review in such areas as termination, ambiguities, actual impacts, and changes. Mountain Fuel believes that after five years experience with the RCS program, DOE will not find supportive evidence to continue it.

Relative Cost of RCS Program to Mountain Fuel

Mountain Fuel agrees with AGA in recommending that the DRA assess RCS program costs by comparing average program costs with a utility's net income in order to determine the real cost burden of the program to the utility. In Mountain Fuel's case, a conservatively estimated 340,000 customers will be eligible for the RCS program without consideration of EPCA restrictions. Using an estimated AGA audit cost of $86.25 per customer-audit, this could represent an RCS program cost of $29,325,000 if all eligible customers particpated over five years.

5. This issue relates to the Regulatory Analysis.

If 7 percent participated each year, the total RCS cost would be $10,263,750. Mountain Fuel's net 1978 utility income of $6,253,865 extended over five years amounts to $31,269,325. Thus, Mountain Fuel's estimated total RCS program cost could be approximately 33 percent of the utility income. Even if DOE's estimate of $5.3 million for a utility of Mountain Fuel's size is used, the total RCS program cost could amount to approximately 17 percent of the utility's income. It is clear that this is a very large burden for a corporation that depends upon stockholders, or must go to a public utility commission and face public ire at financing a mandatory program through increased rates that is ostensibly for the public good. Mountain Fuel recommends that the DRA use the cost accounting procedure outlined above.

Respectfully submitted,

Lynn H. Bringhurst, Director
Codes and Standards

Stephen K. Schroeder
Attorney for Mountain Fuel

PEOPLES GAS LIGHT AND COKE COMPANY

THE PEOPLES GAS LIGHT AND COKE COMPANY
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August 28, 1979

AUG 30 1979

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Ms. Margaret Sibley
Office of Conservation
and Solar Applications
Mail Stop 2221C
Department of Energy
20 Massachusetts Avenue, N.W.
Washington, D. C. 20545

Re: "Residential Conservation Service Program" (Docket No. CAS-RM-79-101)

Dear Ms. Sibley:

These comments are submitted by The Peoples Gas Light and Coke Company (Peoples) relative to the Draft Environmental Impact Statement (DEIS) for the Residential Conservation Service Program.

Peoples is a public utility engaged primarily in the purchase, storage, production, distribution and sale of natural gas at retail to approximately 900,000 residential, commercial and industrial customers in the City of Chicago. Peoples supports the use of conservation measures as a means of ensuring adequate energy supplies for the future.

Peoples has reviewed the DEIS and hereby submits comments on one section of the DEIS, the section relating to electric and mechanical ignition systems, which contains inaccurate and misleading statements. Peoples' comments on only one section should not be considered to be an indication of Peoples' agreement with or approval of the remaining sections of the DEIS.

In Paragraph 3.2.2.1.10 entitled "Electric and Mechanical Ignition Systems" (p. 3-87 of the DEIS), D.O.E. makes reference to the consequences of failure of the safety feature which is designed to shut off the gas supply in the event that the pilot and/or main burner fails to ignite in gas-fired furnaces or boilers and states: "If

1. *This statement was presented as a possibility. No probability level was assigned or intended and a revision has been made to eliminate this ambiquity. It is believed that adoption of the ANSI product standard would mitigate potential adverse impact.*

Ms. Margaret Sibley
August 28, 1979
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this feature should fail to operate properly, it is likely that unburned gas will escape into the furnace room and/or building, creating a significant hazard to health and safety." This is an inaccurate statement.

The gas-fired furnace or boiler must be vented to an active chimney. In the remote event of failure of the ignition device to light the pilot or main burner, and corresponding failure of the safety feature (flame-proving device), unburned gas will pass through the burner. However, in most cases, this unburned gas will be harmlessly vented out of the building via the vent connector and chimney. It will not "likely" escape into the furnace room and/or building. In order for the gas to escape into the building, the chimney would have to be blocked, or there would have to be internal flue blockage in the appliance.

The consequences of chimney or internal flue blockage are not unique to electric and mechanical ignition devices. There is no more likelihood of hazard from electric and mechanical ignition systems than there is from conventional standing pilot ignition systems. Certainly the probability of an accident that affects the health of a building's occupants which would occur as a result of either type ignition system installation is very remote. Peoples believes that D.O.E. has overstated the relationship between health and safety hazards and electric and mechanical ignition systems.

The reference to electric or mechanical ignition systems in Paragraph 6.2.7 (p. 6-24) also gives the misleading impression that the risk of explosion or suffocation exists only with electric or mechanical ignition systems. D.O.E. must recognize that these risks are also present with conventional pilot ignition systems and that the possibility of the occurrence of these hazards is extremely remote regardless of what type of ignition system is used.

Respectfully submitted,

W C Holder
W. C. Holder
Vice President

2. *The gas could vent through furnace air intakes if the flue was cold and was not generating a draft.*

3. *Section 3.2.2.1.10 has been revised to clarify that the potential hazard is not unique to electric and mechanical ignition systems, but that it also exists regarding conventional pilot ignition systems.*

4. *The potential for risk exists, and until standards have been accepted to preclude or reduce the risk, this recognition must remain so stated.*

PUBLIC SERVICE COMPANY OF COLORADO

Public Service Company of Colorado
P.O. BOX 840 · DENVER, COLORADO 80201

SEP 4 1979

August 31, 1979

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TO: Department of Energy - Conservation Staff
FROM: Public Service Company of Colorado

We'd like to clarify and expand on one suggestion included in our written testimony submitted on June 8, 1979, and add another conserving measure.

(ADDITION to 456.105 (d) "measures")

[Our concern about the possible bad effects of "tightening-up" homes with caulking and weatherstripping was brought about by our experience that spillage of furnace combustion products into occupied areas of the home often causes illness. The situation often arises after infiltration routes into the house are blocked. Our strong suggestion is to introduce air for combustion into a furnace area isolated from the occupied areas of the residence. The probability, or even possibility, of this type of situation occurring is denied by some, who claim this problem is "only reported in Denver". Discussion with building code officials, and reference to new combustion air requirements nationwide, should effectively remove that doubt of nationwide applicability. However, we'd like to support our original statement with local field data just analyzed. In a small, representative sample of 72 of our residential gas customers, we found six heating units spilling products of combustion into the living area due to faulty venting systems. The next logical step, that is assuming that the hazard to occupants would be higher in a tighter house, is not a hard one to take. We again suggest that the introduction of outside air for combustion is a life-safety consideration, as well as an economical one. With outside combustion

DOE appreciated this comment. Additional material regarding the potential hazard of reduced air infiltration in homes with faulty heating systems is reflected in Section 3.2.2.1.11.

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DOE
August 31, 1979

air added, there would also be no advantage to retrofitting a vent damper, a suggested measure.]

[In the course of the same project analyzed above, we obtained another set of data that has implications for the RCS energy audit. In the same sample of 72 homes, we found 11 in which the heating unit had a faulty heat exchanger or seal which caused leakage of products of combustion into the warm air distribution system. Again, you would expect the health effects of this situation to be worse in a "tight" house (recommended by the RCS) than in a "loose" house. In this case, the situation would not be helped by the introduction of outside combustion air to the isolated furnace area. Instead, if in the RCS program we are going to block the routes of infiltration into a house, we need to design the program in such a way that it will address at least the large known contaminants or pollutants. These preliminary data suggest that the gas furnace is potentially a large contributor.

We would rest easier thinking that the furnace efficiency modification facet of the program would uncover the unsafe conditions. But we understand that in order to keep the audit time within a reasonable range, the "furnace audit" is being proposed as a "cursory" examination. We strongly object to that proposal. The ethical standards of this Company and of the RCS program would be seriously compromised if life-safety were given that secondary position.

Our technical support group tells us that a complete safety check of the furnace, in conjunction with a furnace-only audit, would take an average of three hours on-site. A tune-up of the furnace could take place at the same time, giving some tangible value for

2. *As noted previously, Section 3.2.2.1.11 has been substantially revised to address indoor air quality. If a particular utility believes that the minimum requirements of the Program are inadequate to assure safety, nothing prevents that utility from adding additional procedures to reduce perceived risks. The particular solution proposed here is entirely within the scope of the Program.*

PUBLIC SERVICE COMPANY OF COLORADO, (CONT'D)

the expense. While we can emphathize with the complications this proposal causes, we believe that an course less safety-conscious than this poses some danger to our consumers and, in fact, to the success of the RCS program.]

Your attention to these matters is appreciated. If we can supply further information, please feel free to call or write.

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FO:TP:sk

PUBLIC SERVICE COMPANY OF OKLAHOMA

PUBLIC SERVICE COMPANY OF OKLAHOMA
A CENTRAL AND SOUTH WEST COMPANY

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ARCH LITTLE
Manager of Conservation Services

AUG 30 1979

August 22, 1979

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Ms. Margaret Sibley
Office on Conservation & Solar Applications
U. S. Department of Energy
20 Massachusetts Avenue N. W.
Washington, D. C. 20545

Re: Docket No. CAS-RM-79-101
RCS Program Draft Environmental
Impact Statement

Dear Ms. Sibley:

The following comments on the docket subject above referenced are submitted on behalf of Public Service Company of Oklahoma.

We have completed review of DOE/EIS-0050-D, the Draft Environmental Impact Statement dated July, 1979. Our review of this document confirms and strengthens our belief in the appropriateness of our comments submitted on June 5, 1979, directed toward the proposed rules for the RCS program.

For instance, we take issue with certain criteria for additional measures as set out in Section 6.2.3 of the DEIS. Specifically, we refer to subparagraphs (3) and (5). Subparagraph (3) states "The measure must not increase consumption of non-renewable energy in typical houses in a substantial portion of the United States. That is, measures will not be added which would save energy in houses in some areas of the country but would increase energy use if installed in houses in other areas;" (underlining added). Subparagraph (5) prohibits fuel switching from one non-renewable fuel to another.

We object to the concept inferred in subparagraph (3) that substantial sections of the United States should be denied the energy saving of a conservation measure simply because the same saving might not occur in other sections. There is no "National Climate". Vast areas in the South, mid South, Southwest and West have climatic characteristics which permit the heat pump to operate with high seasonal operating efficiency resulting in substantial savings in basic resource consumption. Furthermore, these same climatic characteristics cause the greatest use of energy for air cooling purposes. We suggest that these facts support maintaining complete flexibility in the design of a RCS program and that each state should maintain the right to design the plan which best suits the conditions found within its boundaries.

CENTRAL AND SOUTH WEST SYSTEM

These comments most appropriately address the proposed rule. DOE agrees that substantial sections of the country should not be denied the use of an energy conservation measure just because the same savings might not occur in other parts of the country. These criteria are being reassessed.

PUBLIC SERVICE COMPANY OF OKLAHOMA, (CONT'D)

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Section 3.2.2.1.11 of the DEIS addresses Indoor Air Quality and expresses concern for indoor generated air pollutants. We suggest that inclusion of the heat pump as a conservation device would effectively eliminate several of the sources of indoor air pollutants.

We urgently request your consideration of these comments in conjunction with those we submitted on June 5, 1979. Your careful attention will be appreciated.

AL:ch

2. *Section 6.2.3 addresses heat pumps. Replacement of a faulty gas furnace with a heat pump might reduce potential hazards. However, to the extent a heat pump reduces air infiltration, it may also increase whatever potential hazard may exist from other indoor air pollutants.*

SOUTHWESTERN ELECTRIC POWER COMPANY

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AUG 29 1979

JOHN O. HAYTER, Vice President
Marketing Services and Area Development

421 August 27, 1979

Ms. Margaret W. Sibley
Office of Conservation and
Solar Applications
Department of Energy
20 Massachusetts Avenue, N. W.
Washington, D. C. 20545

Dear Ms. Sibley:

RE: Residential Conservation Service Program - Docket No. CAS-RM-79-101
Draft Environmental Impact Statement
Draft Regulatory Analysis

In my oral comments dated April 9, 1979 and my written comments dated June 4, 1979 relative to the RCS Program, I requested that these comments remain open until our company had had a chance to review the Draft Environmental Impact Statement and the Draft Regulatory Analysis for the Residential Conservation Service Program. We have reviewed these documents and believe the material they present reinforces the comments that we made in the earlier presentations. Please include the earlier comments as a part of our comments concerning the impact and analysis statements.

The following are additional comments relative to the Draft Environmental Impact Statement and the Draft Regulatory Analysis.

(1) The National Energy Act relates to the overall conservation of energy which includes a minimum of two areas--the saving of energy and the substitution of coal and nuclear energy for the critically short supply of oil and gas energy. The present RCS Program relates to saving energy but

1. *This comment addresses the Proposed Rule rather than the EIS.*

Ms. Margaret W. Sibley -2- August 27, 1979

is very weak in any attempt to use coal or nuclear as a preferred source of energy. For the RCS Program to accomplish its objectives, it must include methods whereby the consumer can switch to the preferred fuels in this country. An immediate example of this is the heat pump which is an excellent energy saving device, and within the very near future it will be fueled by coal or nuclear produced electrical power throughout the U. S.

> In its 1978 annual report to Congress, the Energy Information Administration says utilities will depend on coal for nearly two-thirds of their fuel supply by 1995. Coal's share of generation was about 37% in 1977 and is forecast to rise to 50% by 1985 and 63% by 1995. Over that same time span, oil and gas use is expected to dwindle to 2% of all generation. Nuclear's share in 1995 is projected to be 25%, double the 12% share for 1977.

By 1985, 73% of SWEPCO's total generating capacity will be coal or lignite fired (see attached Exhibit No. 1). If there is to be an effective impact on the conservation of oil and gas, the heat pump needs to be placed as a high priority item in the current RCS Program.

(2) The Environmental Impact Statement goes into great length concerning various pollutants and makes no reference to reducing pollutants which are produced at the residential level from the burning of oil or natural gas. Pollutants can only be kept to the minimum by burning fuel in a power plant where expensive equipment can provide maximum control of combustion emissions. This is an important fact and lends credibility to recommending a heat pump as a high priority item in the RCS Program.

(3) One of the greatest energy losses in the residential home is heat loss by infiltration. This was proven by detailed air infiltration studies made by Texas Power and Light (see attached Exhibit No. 2). Many existing homes can be made much more energy efficient by reducing infiltration to minimal levels and installing a heat pump which creates no combustible gases;

2. *The effects of conservation measures on ambient air pollution from gas and oil furnaces are addressed in Section 3.2 of the text. Heat pumps are addressed in Section 6.3.2. As described in Section 3.2.2.1.11, to the extent a heat pump reduces air infiltration, it may aggravate any potential hazards associated with indoor air pollutants.*

SOUTHWESTERN ELECTRIC POWER COMPANY, (CONT'D)

therefore, there is no need for large quantities of infiltration.

More consideration needs to be given to this problem as infiltration is one of the major sources of energy lost in the home.

(4) Throughout the impact statement, references were made to studies that are continuing relative to various standards for energy conservation features. We do not believe any features should be included that do not have adequate standards as it will be extremely difficult for an inspector to evaluate the installation if there are no standards to follow.

(5) The Environmental Impact Statement discussed tax credits and their positive effect on the RCS Program if additional credits were made available. We submit that should DOE ask Congress for additional tax credit that these credits be based on a sliding scale. For instance, one energy conservation feature would receive a 20% credit. For two conservation features, a 30% credit would be given. For three energy conservation features, a 40% credit would be given. In this manner, large amounts of energy can be conserved because the residential customer will have an incentive to make his home as energy efficient as possible.

All of the comments submitted by Southwestern Electric Power Company have been intended to make the RCS Program more acceptable to the residential customers, since they are a voluntary part of the program.

Sincerely,

John O. Hayter

John O. Hayter, Vice President
Marketing Services and Area Development

ngc

Attachments: Exhibits

3. *DOE concurs with comment No. 4 and has so stated.*

C-59

TEXAS ELECTRIC SERVICE COMPANY

TEXAS ELECTRIC SERVICE COMPANY

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August 28, 1979

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Ms. Margaret W. Sibley
Office of Conservation and Solar Applications
Mail Stop 2221C
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20 Massachusetts Avenue, N.W.
Washington, D. C. 20545

RE: Residential Conservation Service Program
(Docket No. CAS-RM-79-101)

Review Draft Regulatory Analysis,
Urban and Community Impact Analysis
and Draft Environmental Impact
Statement

Dear Ms. Sibley:

We have studied the three above listed documents in reference to the Residential Conservation Service Program and are prompted to respond with the attached written comments due to inconsistencies between the content of the documents and the intent of Congress in passing the National Energy Conservation Policy Act, Public Law 95-619, dated November 9, 1978.

In addition to the study of the proposed rules and supporting documents, we have also attended several meetings on this program, including the one held in Washington, D. C. this month.

These comments are submitted in true interest of cooperation as we are fully aware of the Nation's need to conserve energy, and we would like for the RCS to be a workable program toward achieving the goals of the Act.

We will be glad to further discuss any comment that may need clarification.

Yours very truly,

R.B. Morris Jr.

R. B. MORRIS, JR.
Marketing Services

chc
Attachments

TEXAS ELECTRIC SERVICE COMPANY, (CONT'D)

UNITED STATES OF AMERICA

DEPARTMENT OF ENERGY

Review Draft Regulatory Analysis for the "Residential Conservation Service," Urban and Community Impact Analysis and Draft Environmental Impact Statement	)	Docket No. CAS-RM-79-101

Specific Comments From

Texas Electric Service Company

Review Draft Regulatory Analysis for the Residential Conservation Service

The "analysis" is a very difficult and confusing document due to its length and especially its redundancy of the material presented.

According to the statements on page IV-I of this analysis, the Department of Energy was required by Executive Order 12044, and its own Interim Management Directive dated April 25, 1978, to conduct economic impact estimates, projections of the impact of regulatory alternatives on the goals of the National Energy Plan and on institutional issues created by the proposed regulations.

Also found on page IV-I is the following quote "The results of this analysis were used by DOE in its rulemaking activity." This direct quote is very alarming in that it destroys the credibility of this analysis and the proposed rules of the RCS program. The proposed rules were issued March 19, 1979, and the analysis is dated April, 1979. According to the proposed rules on pages 16585 and 16586 'DOE has determined that the Proposed Rule is a major policy and program initiative which requires formal urban and community impact analysis. The analysis will be incorporated into the regulatory analysis required under Executive Order 12044."

1. *These issues addressed by this section refer to the Draft Regulatory Analysis and have been addressed in the Regulatory Analysis, Part 3, Chapter I.*

The June 25, 1979, Federal Register announced that the draft of urban and community impact assessment is now available.

The economic burden of the RCS program under the proposed rules is going to fall on utility companies and their ratepayers. The fact that the proposed rules were developed without study of the regulatory analysis or study of urban and community impact assessment is a frightening realization of the inaccuracies of cost projections.

In the "Draft Regulatory Analysis" program costs are increased by $500 million, professional positions are almost doubled, clerical positions are increased by 1000, and still costs are grossly understated.

The "Analysis" seems to be based on a reference program and a response rate based on the experience of a utility which offered free audits as part of a retrofit program that was similar to the proposed RCS Program. To base an "Analysis" of a program of this magnitude on the experience of one utility is a serious breach of faith that Congress placed in the Department of Energy in developing a program under the NECPA.

Contrary to the conclusion of the "Analysis" there are many utilities, expecially in our area, that have over the years developed conservation programs for all classes of customers.

The final rules should be preceded by a statement of accurate costs of the program as related to the DOE, states and covered utilities, based on all items covered under the NECPA and not just items with payback of six years or less.

If this is not feasible, then the final rules regarding audits and program announcements should be based on requirement of these items only.

See response No. 1 above.

Urban and Community Impact Analysis

The UCIA is based on only five items of energy conservation measures, whereas the proposed rules of suggested measures cover sixteen items. It is very difficult to obtain a true analysis of the impact of such a program when DOE's analysis does not cover all items as listed in the NECPA.

The statement "All employment generated will be temporary...." is most disconcerting. It will be very difficult to employ clerical, professional and auditor positions of qualified personnel on a "temporary" basis. Five-year employment in the private sector could hardly be considered temporary, considering unemployment benefits, retirement benefits, etc. It is extremely difficult to imagine that any federal, state or local position created as a result of the RCS Program would be temporary.

Based on the information in the Draft Regulatory Analysis concerning 7% response rate, number of workdays, hours per audit, etc., projected to our 380,000 residential dwellings that qualify under RCS, we would need to employ a minimum of 35 auditors and three arrangers. We feel that this estimate is low due to the size of our service area, which is approximately 120 miles wide by 400 miles long. This estimate does not take into consideration supervisory or other clerical employees. Of course, 250 productive workdays as established in the DRA is unrealistic. We feel 220 productive workdays would be a more realistic estimate due to inclement weather, sickness, vacation and additional training.

On page VI-47 concerning impact on utilities regarding Renewable Resource Component of the proposed RCS Program, it states in part "each utility company will require a program staff of between 10 and 20 people for its implementation." Further on page VI-48, a statement is made that

See response No. 1 above.

"these will not be permanent additions to the employment base."

As stated before, we feel it will be difficult to employ qualified conservation audit personnel on a temporary basis. It will be even more difficult to employ highly technical solar-wind auditors for just a five year program.

If the estimates concerning solar auditors needed by utilities is accurate on page VI-4, it should certainly not be considered insignificant.

Based on estimates of 10,000 solar audits per 100,000 residential customers projected to our 380,000 residential customers, we would need to employ 95 solar auditors (25 per 100,000 customers x 3.8) plus 38 management positions. This is more auditors than is needed for conservation audits.

The estimate of personnel required to do solar audits and conservation audits for our company based on the formulas found in the ORA and UCIA is 171 new positions. If this number is multiplied by the number of covered utilities of our size in the country, this should not be considered "insignificant" as quoted in the last paragraph on page VI-49.

To further add to the concern of the credibility of the analysis is The Bureau of Labor Statistics I/O model to reflect jobs created by solar investments. This model shows decreases in jobs in the electric utility industry, state and local government enterprises, all of which are directly connected with all phases of the RCS Program.

The UCIA devotes over 50% of the analysis to renewable resource component of the proposed RCS Program while stating on page VI-25 that "This study was done too soon to benefit from definitive studies on social effects of residential applications of solar energy." And to further add confusion, the majority of page VI-26 is devoted to uncertainties about solar applications, labor projections, assumptions and biases of

See response No. 1 above.

the writers, as well as on their varying methodologies.

Most of the above concerns point to an underestimate of total costs associated with the RCS Program.

It is suggested that a more realistic cost estimate be provided for each segment of the program and for each affected industry when the final rules are published.

Draft Environmental Impact Statement

While disagreeing with some of the methodologies and conclusions arrived at in this document, it is a very well prepared analysis. It is understandable, concise and complete. The DEIS would have been very helpful in preparing our written comments on the proposed rules.

The DEIS does at least approach the subject of added costs if all energy conservation measures are audited which are listed in the legislation. The cost of the program is increased by $568 million. This is the type of important information that should have been provided with the proposed rules. Legislation states that audits must cover these items listed and to base costs on anything less is deceiving Congress, utilities and our ratepayers.

Summary

These comments are submitted in the true interest of cooperation. It is vitally important that the final rules of the RCS are acceptable and workable at all levels to obtain the goals of the NECPA.

To this end we recommend that:

(1) The final rules of the RCS Program give maximum flexibility to the states in development of their plans.

(2) The rules establish broad conservation goals and not be prescriptive in nature.

2. *While this comment suggests disagreement with certain aspects of the DEIS, it does not give specifics to which responses can be made.*

(3) DOE fully study the economic impact of each final rule as it affects the Nation's goal to conserve energy resources, the utility in carrying out the program and the ultimate costs to the ratepayers.

(4) DOE seek assistance and guidance from utilities, manufacturers and others directly involved in the RCS Program.

R. B. Morris, Jr.
Marketing Services
August 28, 1979

TEXAS POWER AND LIGHT COMPANY

TESTIMONY
OF
LEO STAMBAUGH
TEXAS POWER & LIGHT COMPANY
DALLAS, TEXAS

REGARDING
RCS PROGRAM OF NECPA
INCLUDING RCS, DRA, DEIS
PRESENTED AT
DOE HEARINGS
AUGUST 14, 1979
WASHINGTON, D.C.

TEXAS POWER AND LIGHT COMPANY, (CONT'D)

My name is Leo Stambaugh and I'm glad to get to be here. I am Assistant to the Manager of Customer Services at Texas Power & Light Company in Dallas. The Company serves over 650,000 residential customers in the North Central part of the state. Our reputation for being competent in serving these customers may be seen in the latest findings of Central Surveys, Inc. which states that over 90% of our customers feel they can believe what we tell them about the wise use of energy; that 98% are favorable about the Company's reliability and dependability of service; and that half of the customers would want TP&L to conduct a free home energy inspection. (Only 9% said they would spend $40 for an audit, which indicates that cost will severely inhibit requests for audits - and we don't yet know the opinion of our PUC concerning customers bearing the cost of such a service.)

We were also pleased to see that the Company's research has been recognized by the Congress' Office of Technology Assessment. Page 229 of their book Residential Energy Conservation states that infiltration accounts for 20% to 40% of all heat loss through the building envelope - in both old and new construction. This reinforces one aspect of our concern for the RCS Program. Even the DEIS almost ignores this important factor of energy waste by overshadowing the few paragraphs on the importance of reducing air leaks by spending more than twelve pages on Radon gas accumulating due to tightening up homes.

If your home leaks, you're wasting money and energy plus being uncomfortable. If you correct air leaks, you are then at liberty to select where air will enter and exit. You may intentionally raise or lower a window to control tobacco smoke, moisture, or even radioactive gases. You may even warm, cool, or filter this air since you would know where to treat it.

DOE does not agree that the DEIS "almost ignores" heat loss by infiltration. The DEIS focused properly upon the environmental impacts of tightening up homes.

TEXAS POWER AND LIGHT COMPANY, (CONT'D)

Page 2

Yet the DEIS skirts the infiltration issue, and even the RCS Program Draft confuses <u>everyone</u>. The RCS requires caulking before the recommended floor insulation is added, but then contradicts itself by stating that we are <u>not</u> to recommend caulking and weatherstripping.

Probably everyone here can tell the tonnage of their air conditioners, the area of their homes, the temperatures they maintain - but no one in here knows how much air leagage they have. Even a home with gaskets on every switch plate (as accompanies these comments) will not enable you to guarantee that the leakage will be any particular amount. So until the RCS Program resolves this infiltration measurement question, which accounts for up to 40% of the homes' heat gains or losses, then the impact on energy usage can't be answered, nor can the environmental effect be determined. Even worse, adding ceiling insulation will not reduce a customer's bill if the equivalent of two windows are still open to allow energy loss. Just last week, I saw a report showing that caulking the soleplate of a 2,000 square foot home near Dallas would reduce its annual operating costs by $140. That's a lot of results for little cost from something RCS implies to be not worth discussing.

As some of our past actions may indicate, TP&L does want a good vehicle to use in delivering conservation messages to our customers. We want good programs in <u>other</u> states, too, so that customers moving to the Sunbelt will be preconditioned for conservation. At the conclusion of this talk we will repeat the request for a properly directed workable - acceptable - affordable program. One of your members confidentially asked me why the electric utilities were so negative about the RCS. I hope this attitude will be seen as a barometer to indicate that the RCS, the DRA, and then the DEIS, unless you have made a number of improvements, have been voted to be "not effective" by those regularly working with customer oriented programs.

2. *The EIS does not simply "skirt" the infiltration issue. It addresses both the energy savings from reduced infiltration and its relation to indoor air quality.*

TEXAS POWER AND LIGHT COMPANY, (CONT'D)

We are also concerned about the rumor that the draft of the final RCS rules are already circulating within your offices even before the conclusion of this hearing and its written comment period...

Since there has been additional time to produce the DEIS, we might assume it still indicates the thinking of DOE. It still acknowledges (on Page 3-148) that "...there are also a number of...alternatives...in the RCS Program regarding such things as...the number of inspections required to be made by participating utility companies...". We must worry and even doubt the accuracy of the DEIS when it is contrasted with the NECPA and its vivid statement in Section 215 saying "...that a utility shall be required to make only one inspection of a residence...".

It's good to see the DEIS authors acknowledge the value of HUD's Minimum Property Standards, as they did on Pages 3-106, 3-107, 3-109, 3-112, and the statement on 3-113 that "There are no known significant controversies regarding the effectiveness of the MPS in protecting public health". The comment on 3-61 accepted the opinions of business by saying "...affected industries have reported having no knowledge of any such failures". And based on this, the "...hazard is thus not considered" by DOE. Now, regarding the RCS, business has repeatedly stated that the wiring troughs are not needed for attic insulation. HUD does not feel that it is needed in their MPS. The test method for wire temperatures referred to on Page 3-49 is not typical. Even the DEIS comment lower on that page states that "The probability that surrounding an attic wire with thermal insulation will cause it to overheat to the extent that it will start a fire is not known". We do know this - cost increases deter acceptance - and known needless cost increases will remove the conviction from the presentations of the auditors. This will weaken the RCS acceptance.

TEXAS POWER AND LIGHT COMPANY, (CONT'D)

Page 4

We will also ask that you review Pages 3-34 and 3-35. Both pages allude to savings from cooling, and the value to the South by reducing summertime demand. It is hard to cross-reference this to the RCS plans since high efficiency air conditioners were not addressed, nor was reducing infiltration included in most of the Appendix I (A) suggested RCS measures. So rather than changing the DEIS, we ask - urge - that the RCS rules be modified to improve cooling performance, thus achieve the DEIS expected conditions.

You will also want to review the assumption on Page 3-65 "that all electrical equipment in the building is grounded..." or else not install reflective aluminum foil insulation. (Why not also include foil-faced batts?) Either that writer, too, is misinterpreting the proposed rules or else he may have seen an example of what we have been worried about.

Representatives of the Edison Electric Institute have testified several times about a program parallel to this - the Energy Extension Service. The EES in test programs has been offering home audits and conservation advice. Such duplication by DOE programs will be counter-productive unless their advice and savings predictions parallel data provided by the RCS covered utilities. Last week I was told that an EES staff member was not even aware of the RCS activities. It will be good if the DRA and the DEIS both consider what would occur if such specialized applications as the Solar and Wind Activities were transferred to the Energy Extension Service for them to promote - design - and inspect. This won't hurt energy use according to the comment on DEIS 3-117 that says "Because the total energy expected to be displaced by renewable resources measures as a result of the RCS Program is small, the benefits resulting...will also be small".

3. *Section 456.908 of the Proposed Rule required that all electrical equipment in a building be grounded before reflective foil insulation was installed.*

Page 5

Page 6-15 of the OEIS locks in on the part of the Act regarding Program changes. In light of the President's encouragement in July to use heating sources other than distilled imported oils, you may want to attempt to get item (5) changed. And while you're asking for changes - go ahead and ask for the ability to allow regional differences. Maintaining on paper a nationwide uniformity may be wasteful at some local level. Regions are different, and the Appendix shows you've started to agree to local variations.

The DEIS is not clear as to whether they considered actual wind data or your 40% enhanced data in their evaluations. Using the plus 40% would have been wrong, and using the actual data would be inconsistent with the proposed rules. Which did they consider?

We remain less than satisfied with the incremental revelations of the total RCS package. Even the last to emerge, the July 1979 DEIS - on almost every other page still conveys the message "incomplete" when it says things like:

"The proposed rule does not establish specific standards...at this time." 3-113

"DOE...reserves the right to develop or prescribe appropriate standards at some future time." 3-114

"...the program has not yet determined..." 3-115

"(Reserved)" 3-125

"...will be defined by October 1979." 3-141

"These interim Standards...will be provided...in late 1980." 3-140

"Standards for use by...utilities to guide utility line maintenance and regulate the related SWECS-grid intertie equipment will be prepared by DOE for distribution in late 1980." (Much could be said about this!) 3-141

. See response No. 1 to Laclede Gas Company, page C-32 with respect to fuel-switching and State measures.

5. The enhanced wind data are not relevant to the concerns addressed in the EIS.

6. The DEIS stated accurately the facts as of the publication date. These matters were discussed in the Preamble to the NOPR and DOE has acted accordingly.

Page 6

"DOE is preparing...", "...will be developed...", "...work will start soon...", and "...DOE will consider...when the criteria becomes available." 3-143

We cannot find fault with the idea on DEIS (Page 3-120). It indicates that in extreme cases of solar collector over-temperature conditions, a fire may occur at which time it would require evacuation of the area.

Until the RCS rules are clarified or corrected, the regulatory analysis can't be that helpful to us in anticipating manpower nor budget needs. It also appears that the DRA differs from our views as to the human factors - the ability to package the RCS in a form that will inspire customers to accept it. You've heard enough of us state that we doubt the RCS acceptability in its present form.

We will not ask that the program be dropped. We do ask that you re-form the plans with much greater consideration of the people that will be involved with it. Remove those elements which neither you nor I believe in enough to do to our own homes. Now that the major portions of the program are out (DRA, RCS, DEIS, UCIA), go back over them slowly to obtain a consistency.

We still think the National Energy Watch could be modified to satisfy NECPA, the utilities, and our customers. But there is still enough controversy to indicate that the RCS will satisfy no one. Let's produce a program that in five years will achieve both conservation and satisfied participants.

APPENDIX D

DISTRIBUTION

APPENDIX D

DISTRIBUTION

This Final Environmental Impact Statement is being sent to the following persons, agencies, and organizations:

Each State Clearinghouse for environmental review

Each witness who testified at the August 14, 1979, hearing on the Draft EIS

Each person who submitted comments on the DEIS

The U.S. Environmental Protection Agency

The Council on Environmental Quality

The U.S. Consumer Product Safety Commission

The U.S. Department of Health and Human Services

The U.S. Department of Housing and Urban Development

The National Bureau of Standards (U.S. Dept. of Commerce)

The Oak Ridge National Laboratory

The Lawrence Berkeley Laboratory

Any other person requesting a copy in writing from:

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