REPORT TO THE CONGRESS

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

Nuclear Energy's Dilemma: Disposing Of Hazardous Radioactive Waste Safely

The unsolved problem of radioactive waste disposal threatens the future of nuclear power in the United States. Nuclear critics, the public, business leaders, and Government officials concur that a solution to the disposal problem is critical to the continued growth of nuclear energy.

The Energy Research and Development Administration has begun a program to demonstrate by the mid-1980s the feasibility and safety of placing radioactive wastes in deep geological formations. GAO points out that not only has progress been negligible to date, but that future program goals are overly optimistic because the Energy Research and Development Administration faces many unsolved social, regulatory, and geological obstacles.

GAO also discusses the progress and problems the Energy Research and Development Administration faces in managing its radioactive waste and how the Nuclear Regulatory Commission is handling the problem of large amounts of spent nuclear fuel now accumulating at nuclear powerplants, and makes a number of recommendations for regulatory and program management changes.

EMD-77-41

SEPTEMBER 9, 1977

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

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To the President of the Senate and the
Speaker of the House of Representatives

This report discusses the Energy Research and Development Administration's and the Nuclear Regulatory Commission's efforts to solve the critical problem of disposing of radioactive wastes generated from commercial and military nuclear operations, including a related problem of how the Commission is handling the large backlog of spent nuclear fuel--potential radioactive waste.

We made our review pursuant to the Budget and Accounting Act of 1921 (31 U.S.C. 53), the Accounting and Auditing Act of 1950 (31 U.S.C. 67), and as part of our evaluation of the effectiveness of the Commission's regulatory activities as required by the Energy Reorganization Act of 1974 (42 U.S.C. 5876).

We are sending copies of this report today to the Chairman, Nuclear Regulatory Commission, the Acting Administrator, Energy Research and Development Administration, and the Secretary of Energy.

Elmer B. Staats

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

NUCLEAR ENERGY'S DILEMMA: DISPOSING OF HAZARDOUS RADIOACTIVE WASTE SAFELY

Energy Research and
Development Administration
Nuclear Regulatory Commission

D I G E S T

Growth of nuclear power in the United States is threatened by the problem of how to safely dispose of radioactive waste potentially dangerous to human life. Nuclear power critics, the public, business leaders, and Government officials concur that a solution to the disposal problem is critical to the continued growth of nuclear energy.

Radioactive wastes being highly toxic can damage or destroy living cells, causing cancer and possibly death depending on the quantity and length of time individuals are exposed to them. Some radioactive wastes will remain hazardous for hundreds of thousands of years. Decisions on what to do with these wastes will affect the lives of generations to come.

To safeguard present and future generations, locations must be found to isolate these wastes and their harmful environmental effects. A program must be developed for present and future waste disposal operations that will not create unwarranted public risk. Otherwise, nuclear power cannot continue to be a practical source of energy.

GAO found:

--Public and political opposition to nuclear waste disposal locations.

--Gaps in Federal laws and regulations governing the storage and disposal of nuclear waste.

--Geological uncertainties and natural resources trade-offs encountered when selecting "permanent" disposal locations.

--Lack of the Nuclear Regulatory Commission regulatory criteria for orderly waste management operations, such as solidification of waste, designing proper waste containers, and transporting nuclear waste.

--Overly optimistic schedules for demonstrating the safety of the Energy Research and Development Administration's proposed waste disposal locations and waste management practices.

--Lack of demonstrated technologies for the safe disposal of existing commercial and defense high level waste.

Now that commercial reprocessing of spent fuel has been indefinitely deferred, finding solutions to problems in storing and/or disposing of nuclear spent fuel will become a top priority matter.

GAO's report discusses these findings and proposes recommendations to improve Federal nuclear waste management and provide additional assurance that the public health and safety is considered in all matters of nuclear waste disposal. These matters are summarized in the following sections.

SOURCES OF RADIOACTIVE WASTE

Nearly all operations that produce or use nuclear materials generate radioactive waste. Most waste comes from the Energy Research and Development Administration's military reactors, commercial nuclear powerplants (spent fuel elements)* and Federal and commercial fuel cycle activities--mainly fuel fabrication and reprocessing facilities.

This report discusses (1) high level waste, (2) transuranic contaminated waste, and (3) reactor spent fuel. All these materials contain transuranic** elements which determine to a large extent the degree of long term hazard associated with them because some of these isotopes remain hazardous for hundreds of thousands of years.

High level waste--has extremely high radioactivity--as much as 10,000 curies*** per gallon. This waste is characterized by high levels of penetrating radiation, high heat generation rates, and a long toxic life. High level waste is created when reactor spent fuel elements are dissolved in acid to recover unused uranium and plutonium for reuse as nuclear fuel. It is the acid solution remaining that is referred to as high level waste. It contains virtually all the fission products**** and small amounts of transuranics--such as plutonium--which are not recovered during the reprocessing operations. It is one of the most hazardous and complex of all radioactive wastes to manage.

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*Spent fuel has not yet been defined by the Nuclear Regulatory Commission as high level waste and may not be, because of its potential value as a source of fuel if reprocessed. This report will consider spent fuel as a "potential" high level waste.

**Transuranic elements are man-made, long-lived, and extremely toxic. These elements--such as plutonium--are created during the normal nuclear reaction process. They are found in several nuclear fuel cycle operations and are contained in nuclear waste in varying concentrations.

***Curie--a measure of the quantity of radioactive material.

****Fission products--those isotopes formed during the nuclear reaction process that are not part of the transuranic elements. Some of these isotopes are hazardous for hundreds of years.

Transuranic contaminated waste--contains much lower concentrations of radioactivity than high level waste. It is generated by plutonium fuel fabrication and fuel reprocessing facilities and laboratories using transuranic elements. This waste generally consists of absorbent tissues, clothing, gloves, plastic bags, equipment, filters from effluent treatment systems, and fuel hulls which remain after fuel reprocessing.

Spent fuel--contains all the fission and transuranic elements that are found in high level waste and all the uranium and plutonium not used during the nuclear reaction. Spent fuel is characterized by high levels of penetrating radiation, high heat generation rates, and a long toxic life.

Until the 1960s, little effort was made to develop technologies for the long term storage or "permanent" disposal of hazardous radioactive waste. The production of atomic weapons materials and development of commercial nuclear powerplants received the highest priority. Decisions as to the management of military waste were based on short term expediency rather than long term considerations.

Even if all activities which generate radioactive waste were stopped today, the United States still would be faced with a major radioactive waste disposal problem. Radioactive waste has been accumulating for decades from the Energy Research and Development Administration's military and research and development efforts, fuel reprocessing activities, and commercial nuclear powerplant operations.

Today about 71 million gallons of high level waste produced by the Energy Research and Development Administration's plants, which reprocess spent fuel from production reactors used for the weapons program, is "temporarily" stored in steel tanks at the Hanford facility in Richland, Washington (50 million gallons) and at the Savannah River facility in Aiken, South Carolina (21 million gallons).

In addition, approximately 3 million gallons are stored in underground tanks and bins at the Idaho National Engineering Laboratory at Idaho Falls, Idaho.

About 13 million cubic feet of transuranic contaminated waste from military and research activities either has been buried or stored retrievably at five principal shallow-land burial sites of the Energy Research and Development Administration. This waste is contaminated with about 1,000 kilograms of plutonium. Some of the 1.3 million cubic feet of radioactive

waste generated by the Energy Research and Development Administration each year is contaminated with transuranic elements. About 7 million cubic feet of commercial transuranic contaminated waste is expected to accumulate by the year 2000.

About 600,000 gallons of high level waste has been generated from commercial reprocessing activities and is currently stored at West Valley, New York. Should commercial reprocessing operations resume, estimates are that through the year 2000, an additional 152 million gallons of high level waste would be generated.

Commercial reactor spent fuel is accumulating at nuclear powerplants because there are no commercial reprocessors now operating in the United States. Resumption of reprocessing does not seem probable in the near future since President Carter has indefinitely deferred commercial reprocessing of spent fuel.

If it is finally decided that there will be no further commercial reprocessing, spent fuel elements from existing and future civilian power reactors probably will have to be managed as high level radioactive waste. Meanwhile, nuclear powerplants have had to store their spent fuel in storage pools at the reactor sites. As a result, a backlog of spent fuel is accumulating at the powerplants. (See pp. 51 to 52.)

The Energy Research and Development Administration estimates that 1985 is the earliest possible date a geological waste disposal facility or other storage facility to receive spent fuel could be ready. By this time the nuclear industry could be faced with a severe shortage of storage capacity. (See p. 11.)

Spent fuel and transuranic contaminated waste could be as hazardous to the public health and safety as high level waste. While the Federal Government requires extensive regulatory and public oversight over most nuclear plant operations because they use nuclear materials, the same degree of public protection and independent oversight is not currently required for the storage and/or disposal of these hazardous nuclear materials. This situation needs to be changed.

Tear Sheet

THE NUCLEAR REGULATORY COMMISSION LACKS AUTHORITY OVER ALL WASTE STORAGE AND DISPOSAL ACTIVITIES

The Congress provides for an independent review of nuclear activities, including waste disposal by the Nuclear Regulatory Commission. Under the Energy Reorganization Act of 1974, the Commission has specific responsibility for licensing and regulating all Energy Research and Development Administration facilities used for storage of commercial high level waste. It has similar authority for retrievable surface storage facilities and other long term storage facilities for the Energy Research and Development Administration's high level waste. This does not include authority over the agency's facilities which are used for or are part of research and development activities.

The act does not specifically give the Commission licensing authority over the Energy Research and Development Administration's

- --research and development facilities or full-scale facilities for the temporary storage and/or long term storage or disposal of commercial and its owr transuranic contaminated waste,

- --facilities for the temporary storage of its own high level waste, or

- --research and development facilities or full-scale facilities for temporary storage and/or long term storage or disposal of commercial spent fuel.

The Congress either should give the Commission authority over those Energy Research and Development Administration facilities--including research and development facilities--intended for the storage and disposal of its own high level waste, or provide for other independent oversight and assessment of these facilities. The Congress should also either give the Commission authority over the storage and disposal of transuranic contaminated waste and spent fuel, or provide for an alternate means of independent oversight and review. (See pp. 23 to 27.)

DISPOSAL OF MILITARY- AND RESEARCH-RELATED WASTES

After several decades of work, the Atomic Energy Commission did not, and its successor--the Energy Research and Development Administration--has not yet: demonstrated acceptable solutions for long term storage and/or disposal of defense- and research-related high level waste, or satisfied the scientific community that present storage sites are suited geologically for long term storage or disposal.

The Energy Research and Development Administration is investigating several alternatives for managing its military and research wastes, including

--immobilizing in place,

--solidifying and disposing at Hanford and Savannah River, and

--solidifying and shipping to a Federal geological repository.

Before this high level waste can be moved to a repository, however, major questions involving retrievability from its temporary storage tanks at Hanford and Savannah River must be resolved.

The Energy Research and Development Administration does not now have the technological capability to extract all of this waste from the storage tanks. The waste stored at Hanford and Savannah River makes up 94 percent of the total volume of waste. This waste has been converted into a chemical form that may be unsuitable for long term storage. (See pp. 39 to 45.)

The Energy Research and Development Administration is testing methods which may make possible the extraction of up to 99 percent of the high level waste from most storage tanks. However, these methods may not work with some older tanks because of their poor condition. The remaining 1 percent of the waste would contain long-lived toxic radionuclides such as plutonium and strontium-90. The costs of extracting and preparing all of the waste for geological disposal are uncertain. Estimates range from $2 billion to $20 billion. (See pp. 39 to 45.)

The Energy Research and Development Administration is exploring alternatives for long term storage or disposal of the waste at Hanford and Savannah River. Alternatives include entombment in the existing tanks if the waste cannot be removed, and removal of the waste and burial at the site, either in near-surface facilities or in deep geological formations. These

alternatives present still other questions such as the suitability of these sites for geological disposal. Any facility for long term storage or disposal of the waste at these sites will require licensing by the Nuclear Regulatory Commission. (See pp. 45 to 49.)

MANAGEMENT OF COMMERCIAL SPENT FUEL

Since a tremendous backlog of spent fuel (potential high level waste) exists at nuclear powerplants because no commercial reprocessors are operating in the United States, utilities are adopting several options to increase their storage capacity. These capacities are being modified at existing reactors and larger storage facilities are being planned for new reactors. Spent fuel shipment to storage pools within a utility's nuclear powerplant system is another plan that utilities are considering.

As of January 1977, utilities operating 36 of the 63 present nuclear reactors have notified the Commission of their interest to increase storage capacities at their reactor pools by reducing the amount of space between stored fuel elements (compaction).

The safety of such action has been questioned by the Natural Resources Defense Council. In response, the Commission has undertaken a generic environmental impact statement on the storage of fuel elements. While the statement has not been completed, the Commission has allowed compaction on a case-by-case basis. According to the Commission, before allowing compaction the safety concerns raised by the Natural Resources Defense Council are addressed in each request for increased storage capacity.

According to the Commission staff there are no significant environmental or safety impacts associated with these individual actions. As of January 1977, compaction has been approved for 14 of the 36 reactors. (See pp. 52 to 53.)

The Commission has, in part, justified allowing compaction for utilities which have shown an immediate need for additional storage capacity in order to maintain electrical generating capability. However, some utilities were allowed compaction without demonstrating such an immediate need. (See p. 58.)

GAO believes that until the Commission completes its generic environmental impact statement, it should limit through license restrictions, the amount of spent fuel that can be put in storage pools to no more than the amounts for which the storage pools were designed and authorized under the initial operating license. Compaction should only be allowed if the utility can prove to the Commission's satisfaction that (1) it would be forced to shut down operations if increased storage at that site was not allowed, and (2) such action would not increase the safety risk to the public or environment. It is of the utmost importance that the Commission complete and issue the generic environmental impact statement as soon as possible so

that unanswered questions can be resolved concerning increased fuel storage at reactor pools.

OBSTACLES TO GEOLOGICAL WASTE DISPOSAL

The Energy Research and Development Administration has begun an ambitious program to demonstrate the safety of placing commercial and military wastes in deep geological formations. It is seeking seven sites for facilities in widely separated areas in the country.

The Energy Research and Development Administration has set 1985 as the year for completing two geological disposal facilities for commercial high level and transuranic contaminated wastes and spent fuel (if and when it is defined as a waste). It also plans to complete four more geological disposal facilities for commercial waste between 1987 and 1991.

Furthermore, the Energy Research and Development Administration plans to build a separate disposal facility by 1983 for its own transuranic contaminated waste, generated by military and research activities. At this facility, it intends to have the experimental capability to determine site suitability for high level waste disposal.

One of the potential geological disposal sites which may be used for the 1983 facility is being developed in New Mexico. This facility might eventually be used for routine high level waste storage; however, the Energy Research and Development Administration has no established date for storing such waste.

The Energy Research and Development Administration's position has been that the New Mexico location is for its transuranic contaminated waste and to provide experimental capability to determine whether or not the site is suitable for high level waste disposal. (See p. 21.)

Since public and official sentiment in New Mexico appears favorable to a waste disposal facility and the project is further advanced than the commercial waste repository program--which may not have a site ready by 1985--this site may also serve the needs of the commercial nuclear industry by becoming the first commercial waste repository. (See pp. 21 to 23.)

Because the President has indefinitely deferred commercial reprocessing of nuclear spent fuel, the Energy Research and Development Administration has decided to initiate a project to store spent fuel in a proposed Surface Unreprocessed Fuel Facility. In the event the President and the Congress ultimately decide against commercial reprocessing, spent fuel--if defined as waste--might have to be disposed of in the geologic repositories. This will affect the six commercial waste repositories

currently being planned by the Energy Research and Development Administration.

The six repositories were arrived at mainly to spread nuclear waste regionally throughout the Nation, and minimize any setback to the program should a potential site(s) prove unacceptable. Storage and/or disposal of spent fuel in geological formations requires more acreage than is needed for storage and/or disposal of high level waste.

While the precise number of repositories which will be needed is not known, officials of the Nuclear Regulatory Commission and the Energy Research and Development Administration indicate that three of the size currently being planned may be all that will be needed. In view of the $200 million cost per repository, plus questions of excess capacity, public opposition to nuclear waste disposal locations, and security needs, the Energy Research and Development Administration should evaluate the number of repositories currently planned, and justify on a cost-benefit basis, the number they finally believe will be be necessary. (See pp. 32 and 33.)

The obstacles

The program for commercial radioactive waste repositories which was supported by the Federal Energy Resources Council*, faces many obstacles. The most serious and critical is public and political opposition to waste disposal sites. The success of this program depends to a great extent on whether the Energy Research and Development Administration can demonstrate to the public and elected officials that it has a sound waste management program and that the risks associated with the storage and/or disposal of radioactive waste in geological formations are low.

The Energy Research and Development Administration twice has been unsuccessful in developing potential waste disposal sites

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*The Federal Energy Resources Council had the responsibility for coordination of Administration policies and programs relating to energy. The Council participants included: Council on Environmental Quality, Department of Commerce, Department of Interior (U.S. Geological Survey), Environmental Protection Agency, Federal Energy Administration, and Energy Research and Development Administration. The Council's function's were recently transferred to the newly created Department of Energy under President Carter's reorganization plan for the Executive Office of the President.

because of insufficient attention to the factor of public acceptance--in Kansas and in Michigan. (See p. 15.)

Other obstacles in the Energy Research and Development Administration's geological waste disposal program include

--geological uncertainties and natural resource tradeoffs,

--questionable demonstration time period estimates,

--undemonstrated technology for preparing radioactive waste, and

--lacking Nuclear Regulatory Commission criteria for orderly waste management operation.

The Energy Research and Development Administration is aware of these obstacles and is addressing them. For a discussion of these obstacles see pages 17 to 23 and 29 to 32.

Another aspect of the waste repository program which is not, in our opinion, based on realistic appraisals is the goal of building six waste repositories in the stated time period. This goal appears overly optimistic in estimating the time required to identify, study, design, construct and confirm the feasibility of the repositories. Such an unrealistic schedule could further decrease the public's confidence in the Energy Research and Development Administration's waste management program.

RECOMMENDATIONS

To better insure public health and safety the Congress should amend the Energy Reorganization Act of 1974 to provide for independent assessments of the facilities of the Energy Research and Development Administration--including research and development facilities--intended for the temporary storage and/or long term storage or disposal of commercial and its own transuranic contaminated waste; the temporary storage of the Energy Research and Development Administration's high level waste; and the temporary storage and/or long term disposal of commercial spent fuel.

To provide such an independent assessment Congress should adopt one of three alternatives:

--Give the Nuclear Regulatory Commission the authority and responsibility for establishing policies, standards, and requirements in cooperation with the Energy Research and Development Administration for carrying out these assessments.

--Retain this repsonsibility and authority within the Energy Research and Development Administration, subject to certain statutory provisions, to insulate the oversight activities.

--Authorize the Nuclear Regulatory Commission to assess periodically the Energy Research and Development Administration's facilities and annually report the results to the agency and the Congress.

In testimony before congressional committees, GAO has stated a preference for the first alternative.

GAO also recommends that the Congress closely scrutinize, through the annual authorization and appropriation process, the progress of the Energy Research and Development Administration's program for long term waste management.

The Administrator of the Energy Research and Development Administration should:

--Proceed to reevaluate the impact that spent fuel storage and/or disposal will have on its commercial repository program.

--Reconsider the need for six high level waste repositories in view of disposal requirements through the year 2000 and justify on a cost-benefit basis the number it finally believes will be necessary.

--Reevaluate plans for completing the first two repositories by 1985, considering realistically all social, geological, and regulatory obstacles.

--Consider the appropriateness of using the New Mexico location also as a commercial waste disposal site, since by 1985 no other facilities may be ready to receive these wastes and public utilities may no longer be able to store them at the reactor sites unless other facilities are constructed. This should be done without sacrificing or impairing the mission of the site to receive Energy Research and Development Administration transuranic contaminated waste.

The Chairman of the Nuclear Regulatory Commission should:

--Proceed on a priority basis to complete its waste repository licensing procedures.

--Proceed on a priority basis to include in its waste performance criteria, criteria for the storage or disposal of spent fuel.

--Complete and issue the generic environmental impact statement on spent fuel as soon as possible, and in the interim, limit through license restrictions the amount of fuel which can be stored in reactor pools to no more than what was originally licensed for, unless the reactor would be forced to shut down operations.

AGENCY COMMENTS AND GAO'S EVALUATION

The Nuclear Regulatory Commission disagreed with GAO's recommendation that pending issuance of the generic environmental impact statement on spent fuel, the amount of spent fuel that can be stored in a reactor pool be restricted to the amount for which it was originally designed and licensed unless the reactor would be forced to shut down. The Nuclear Regulatory Commission cited several operational and procedural reasons for its position.

While GAO does not take exception to the Commission's reasons, it still believes the recommendation should be implemented. The Commission has not fully determined the overall environmental effects from these individual licensing actions nor has it compared these actions to other alternatives for spent fuel storage, such as storage at centralized storage facilities away from nuclear powerplants. Such an assessment is the objective of the generic statement now being prepared by the Nuclear Regulatory Commission. Until this assessment is completed, GAO believes the Commission should restrict the amount of spent fuel to be stored in a reactor pool. To do otherwise may raise public suspicion and concern that the Nuclear Regulatory Commission has made prejudgmental findings on the overall environmental effects of such individual licensing actions, and as such, could possibly cast doubt on the integrity of the generic statement when issued. Furthermore, these individual actions could potentially foreclose the adoption of other storage alternatives that may be as good or better than allowing each utility to increase their storage capacities at the reactor site.

The Nuclear Regulatory Commission did not disagree with the recommendation to the Congress which could broaden its authority over Energy Research and Development Administration waste storage facilities.

The Energy Research and Development Administration generally concurred with the recommendations concerning its activities and stated that work was already underway. Regarding the recommendation to the Congress, the Energy Research and Development Administration agrees that an independent assessment within its organization has merit from the standpoint of assuring the Administrator and the public as to the adequacy of its nuclear operations. However, it does not consider that the first and third alternatives which would place this responsibility within the Nuclear Regulatory Commission are viable since either would, in its view, impose extraordinary burdens on both organizations without commensurate benefit. It believes such a recommendation would be tantamount to requiring its facilities to be licensed by the Nuclear Regulatory

Commission. Further, the Energy Research and Development Administration contends that added Nuclear Regulatory Commission activities at its facilities could result in the Commission having to acquire expertise they do not now have and which would, to a large extent, be duplicative of the Energy Research and Development Administration. It stated, however, that it has undertaken a comprehensive study to determine how its current assessment activity could be restructured within its organization to provide greater independent assurance to the general public.

GAO doubts that the Energy Research and Development Administration can in fact, structure an organization within itself to independently assess its waste operations without statutory provisions designed to insulate oversight activities from development functions. Some possible legislative actions that would insulate the Energy Research and Development Administration oversight activities from developmental functions are listed on pages 37 to 38 of this report.

(See apps. III and IV for agency comments received.)

Tear Sheet

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Contents

ABBREVIATIONS

ACRS	Advisory Committee on Reactor Safeguards
AEC	Atomic Energy Commission
EPA	Environmental Protection Agency
ERDA	Energy Research and Development Administration
GAO	General Accounting Office
NAS	National Academy of Sciences
NRDC	Natural Resources Defense Council
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratories

RSSF	Retrievable Surface Storage Facility
SURFF	Surface Unreprocessed Fuel Facility
USGS	United States Geological Survey

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CHAPTER 1

INTRODUCTION

The future of nuclear power is threatened by the still unresolved problem of how to safely dispose of radioactive waste. Utilities have cited the disposal dilemma as one reason for delaying or abandoning construction of nuclear plants. The problem has also been a factor in retarding the nuclear fuels reprocessing industry.

Some critics contend that nuclear power growth should be curtailed until some safe method for disposing of high level waste is developed. And indeed, one State has restricted and others are considering whether to restrict, nuclear power until the problem can be solved. Even if all activities that generate radioactive waste were stopped today, we would still be faced with a major radioactive waste disposal problem because of the large volumes of waste generated by this country's nuclear defense and research programs.

The waste disposal question has been debated and explored for the past 20 years. However, no solution has been found--in part because of the former Atomic Energy Commission's (AEC's) limited research funding. AEC was convinced that the disposal problem was technically solvable and therefore not urgent. AEC's successor agency, the Energy Research and Development Administration (ERDA), believes that the basic scientific and technical knowledge needed for safe disposal of waste is at hand and only needs to be successfully demonstrated.

ERDA has increased its efforts to come up with a solution. Accordingly, the agency's waste research and development and waste management operations budgets have greatly increased as follows:

	1975	1976	1977 (note a)	1978 (note a)
		(millions)		
Commercial waste research and development	$ 9.4	$ 9.5	$ 65.6	$116.1
Military waste research and development	9.0	13.2	24.3	37.3
Military waste storage operations	45.1	55.9	67.6	74.3
Totals	$63.5	$78.6	$157.5	$227.7

a/Estimates

SOURCE AND HAZARDS OF RADIOACTIVE WASTE

Nearly all operations that produce or use nuclear materials generate radioactive waste. Most of the waste comes from ERDA's military reactors, commercial nuclear powerplants, and Federal and commercial nuclear fuel cycle activities--mainly fuel fabrication and reprocessing facilities. No commercial reprocessing facility is currently operating, but ERDA has four reprocessing facilities, three in operation and one on standby.

Radioactive waste can be generally classified as "high level" and "low level" waste.* High level waste is created during the reprocessing of spent nuclear fuel. In one reprocessing scheme spent fuel elements are dissolved in nitric acid to recover the unused uranium and plutonium for reuse as nuclear fuel. The remaining solution is high level liquid waste.

This waste contains many fission products and small amounts of transuranics**, such as plutonium, which are not recovered during reprocessing operations. Its radioactivity

*Low level waste is a subject of a GAO report entitled "Improvements Needed in the Land Disposal of Radioactive Wastes--A Problem of Centuries" (RED-76-54, Jan. 12, 1976).

**There are 11 transuranic elements which have atomic numbers greater than 92, are artificially produced, and contain some isotopes which have radioactive half-lives of thousands of years.

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is measured in thousands of curies* per gallon (as much as 10,000 curies per gallon). This waste is considered one of the most hazardous and complex of all radioactive wastes to manage. It is generally characterized by high levels of penetrating radiation, high heat generation rates, and a long toxic life. Strontium-90 and cesium-137 require about 600 years to decay to 1/1,000,000 of their original level of radioactivity. This decay process takes about 500,000 years for plutonium-239. The radioactivity produced by these materials can damage or destroy living cells, causing cancer and possibly death, depending on the quantity and length of time individuals are exposed to it. Therefore, disposal techniques must be developed to assure that the radiation and toxicity from the wastes will not effect either present or future generations.

Besides being found in high level waste, transuranic materials in varying concentrations are also found in other wastes. This transuranic contaminated waste contains much lower concentrations of radioactivity than high level waste. It is generated by plutonium fuel fabrication and fuel reprocessing facilities and laboratories using transuranium elements. This waste generally consists of expendable items, such as absorbent tissues, clothing, gloves, plastic bags, and equipment; ion exchange resins or filters from effluent treatment systems; and fuel hulls which remain after fuel reprocessing.

Spent fuel--a potential high level waste--contains all the fission and transuranic elements that are found in high level waste and contains all the uranium and plutonium not used during the nuclear reaction process. Spent fuel, like high level waste, is characterized by high levels of penetrating radiation, high heat generation rates, and a long toxic life. Therefore, spent fuel can be as hazardous to public safety as high level waste and will require the same degree of careful management.

QUANTITIES OF SPENT FUEL AND HIGH LEVEL AND TRANSURANIC CONTAMINATED WASTES

Nuclear Fuel Services, Incorporated, in West Valley, New York, was the only commercial fuel reprocessing plant to

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*A curie is a measure of the quantity of radioactive material. It is the quantity of material in which 37 billion atoms disintegrate per second.

operate in the United States.* The plant processed 640 metric tons of spent fuel from April 1966 to early 1972, generating about 600,000 gallons of neutralized high level liquid waste. This waste is stored in underground steel tanks at the West Valley site. In early 1972 the plant was shut down to improve radiation and contamination control, reduce radioactivity in liquid and gaseous effluent releases, and increase production capacity. In September 1976 the company decided to quit the nuclear fuel reprocessing business because of stiffer regulations (mainly more stringent criteria to protect the plant from earthquakes). According to the company, the new requirements would cost up to $615 million to implement and would make the plant uneconomical to operate.

The amount of commercially generated high level waste at West Valley is relatively small compared to the 230 million gallons produced by ERDA's fuel reprocessing plants for military programs. This waste volume has been reduced through evaporation to about 71 million gallons.** ERDA has generated and stored this waste at its Hanford facility in Richland, Washington, and its Savannah River facility at Aiken, South Carolina. Both installations produced nuclear materials for the Nation's nuclear weapons program. Additional high level waste--about 3 million gallons**--is stored in underground bins and tanks at the Idaho National Engineering Laboratory at Idaho Falls, Idaho, ERDA's main site for reprocessing fuel from experimental and naval reactors. ERDA estimated that all this waste--74 million gallons--when solidified, will total 7,000,000 cubic feet. By the year 2000, ERDA estimates that its reprocessing operations could generate another 4,000,000 cubic feet of high level waste. (Management of ERDA's waste is discussed in ch. 4.)

More potential commercial high level waste, in the form of spent reactor fuel from nuclear power reactors, is accumulating yearly. (Management of spent fuel is discussed in ch. 5.) According to the Nuclear Regulatory Commission (NRC) and ERDA, this discharged fuel will have to be managed as high level waste if it is finally decided that there will be no further commercial reprocessing in the United States. An October 1976 Presidential policy statement by former President Ford postponed commercial reprocessing pending a decision on whether it

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*Nuclear Fuel Services' high level waste is a subject of a GAO report entitled "Issues Related to the Closing of the Nuclear Fuel Services Incorporated, Reprocessing Plant at West Valley, New York" (EMD-77-27, March 8, 1977).

**As of January 1, 1977.

is consistent with the U.S. goal of nuclear nonproliferation. In addition, commercial reprocessing does not seem probable in the near future because President Carter has deferred commercial reprocessing indefinitely.

NRC projects that there will be about 500 large nuclear power reactors operating by the year 2000. These reactors would discharge an estimated 127,000 metric tons of spent fuel through the year 2000. About 115,000 metric tons of this fuel could be reprocessed through that date. 1/ Reprocessing would result in some 152 million gallons of high level liquid waste. This future commercial waste will not be neutralized (as at Hanford, Savannah River, and West Valley) but instead will be kept as an acid waste and greatly concentrated before transfer to stainless steel storage tanks. Tentative plans provide that as the waste is generated it will be further concentrated and finally reduced to a solid form and shipped to a Federal repository. The total volume of all high level waste generated during this period, once solidified, would equal about 230,000 cubic feet--the size of a cube measuring about 61 feet on a side.

About 13 million cubic feet of transuranic contaminated solid waste from military and research activities has been either buried or stored retrievably at five principal ERDA shallow-land burial sites.* This waste is contaminated with about 1,000 kilograms of plutonium. NRC does not have records on the volume of commercial transuranic contaminated waste buried at commercial shallow-land burial sites; however, NRC estimates that about 120 kilograms of plutonium were buried at five of the six sites. According to an NRC official, no transuranic contaminated waste was buried at the sixth site.

A proposed amendment to NRC's regulation will ban the burial of commercial transuranic contaminated waste. The regulation would require those producing such waste to ship it to ERDA for storage as soon as practical but no later than 5 years after its generation. ERDA would then be responsible for storage and disposal of the waste at a Federal repository.

ERDA estimates that about 7 million cubic feet** of transuranic contaminated waste will be generated commercially through the year 2000. In addition, some of the 1.3 million

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1/ Numbered references are identified in app. I.

*This is also a subject of the GAO report footnoted on p. 2.

**According to an ERDA official this figure assumes no volume reduction.

cubic feet of waste which ERDA generates each year are contaminated with transuranic elements. ERDA's volume is expected to gradually decrease. Because of the long-lived toxicity of this waste, it will have to be isolated for several hundred thousand years. AEC therefore established a policy in April 1970 that its transuranic waste in concentrations exceeding a specified limit per gram must be stored retrievably.

PROGRAM ADMINISTRATION

Under the Atomic Energy Act of 1954, as amended, and title I of the Energy Reorganization Act of 1974 (42 U.S.C. 5811), ERDA is the lead Federal agency for research, development, and demonstration of energy technologies.

NRC, under the 1954 act and title II of the 1974 act (42 U.S.C. 5841), has authority and responsibility to protect public health and safety through regulation of the possession, use, and disposal of radioactive materials by the commercial sector. The 1974 act also mandates NRC licensing of certain ERDA facilities, including high level waste disposal facilities.

In addition to ERDA's and NRC's responsibilities in the area of radioactive waste disposal, the Environmental Protection Agency (EPA) is responsible for establishing generally applicable standards and criteria to assure environmental protection during the development and implementation of waste disposal methods.

PRIOR REPORTS

We have issued three reports addressing the problems of managing high level radioactive waste.* At the time of the last published report on high level waste, AEC's policy was to develop a retrievable surface storage facility (RSSF) large enough to hold all commercial high level waste generated through the year 2000 while continuing to evaluate geologic formations for high level waste disposal. RSSF was designed to store waste for about 100 years. The 100 years capability was picked to emphasize the need for the highest possible quality of care in the design, construction and operation of the facility, and was not intended to mean it would take 100 years to develop permanent waste disposal locations. ERDA stated

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*B-164052, dated May 29, 1968; Jan. 29, 1971; and Dec. 18, 1974, respectively.

that 20 to 30 years was considered much more likely for this purpose.

Since our report, ERDA has accelerated its geological disposal efforts aimed at finding and developing geological formations by the mid-1980s for high level waste disposal.

CHAPTER 2

PAST AND PRESENT WASTE DISPOSAL EFFORTS

Nuclear scientists have long recognized the need to isolate high level waste in a way that would require little reliance on human surveillance for thousands of years. In 1955 AEC asked an advisory committee of the National Academy of Sciences-National Research Council to identify geological formations in the United States that might be suitable for high level waste disposal. The committee reported that naturally occurring salt formations were possibly the best geological formations for this purpose. 2/

As a result, AEC's Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee, began studying the feasibility of disposing of high level waste in salt. In 1965 ORNL started storing spent fuel elements in an abandoned salt mine near Lyons, Kansas, to examine the effects of radiation and heat on salt. After favorable findings, the experiment was ended and the spent fuel retrieved.

In June 1970 AEC announced that it would build a Federal waste repository at the Lyons mine if futher geologic studies confirmed the site's suitability. The investigations over the next 2 years concluded that there was a possibility of water entry (and potential leakage of radionuclides) in the Lyons mine from numerous old oil and gas exploration holes and from salt mining operations near the site. According to ERDA officials, these two technical issues had not been definitively resolved when the project was canceled in 1972, because of adverse public and political reaction.

After the Lyons, Kansas, effort failed, AEC turned to development of an above ground RSSF as an interim solution. The agency continued to seek other bedded salt locations and alternative geological formations which would be acceptable for waste disposal. The above ground facility was designed to store all commercial high level waste generated through the year 2000. AEC believed this would provide time for an orderly search for disposal sites in salt and other geological formations.

In 1976 ERDA withdrew its request for funds to construct the facility. One of the main reasons for not proceeding with the facility was the inadequate rating EPA gave the facility in the draft environmental statement. EPA took strong exception to the avowed interim nature of the facility and to the lack of information on ERDA's program for permanent waste disposal. EPA also expressed concern that economic and institutional pressure might transform this interim facility into an

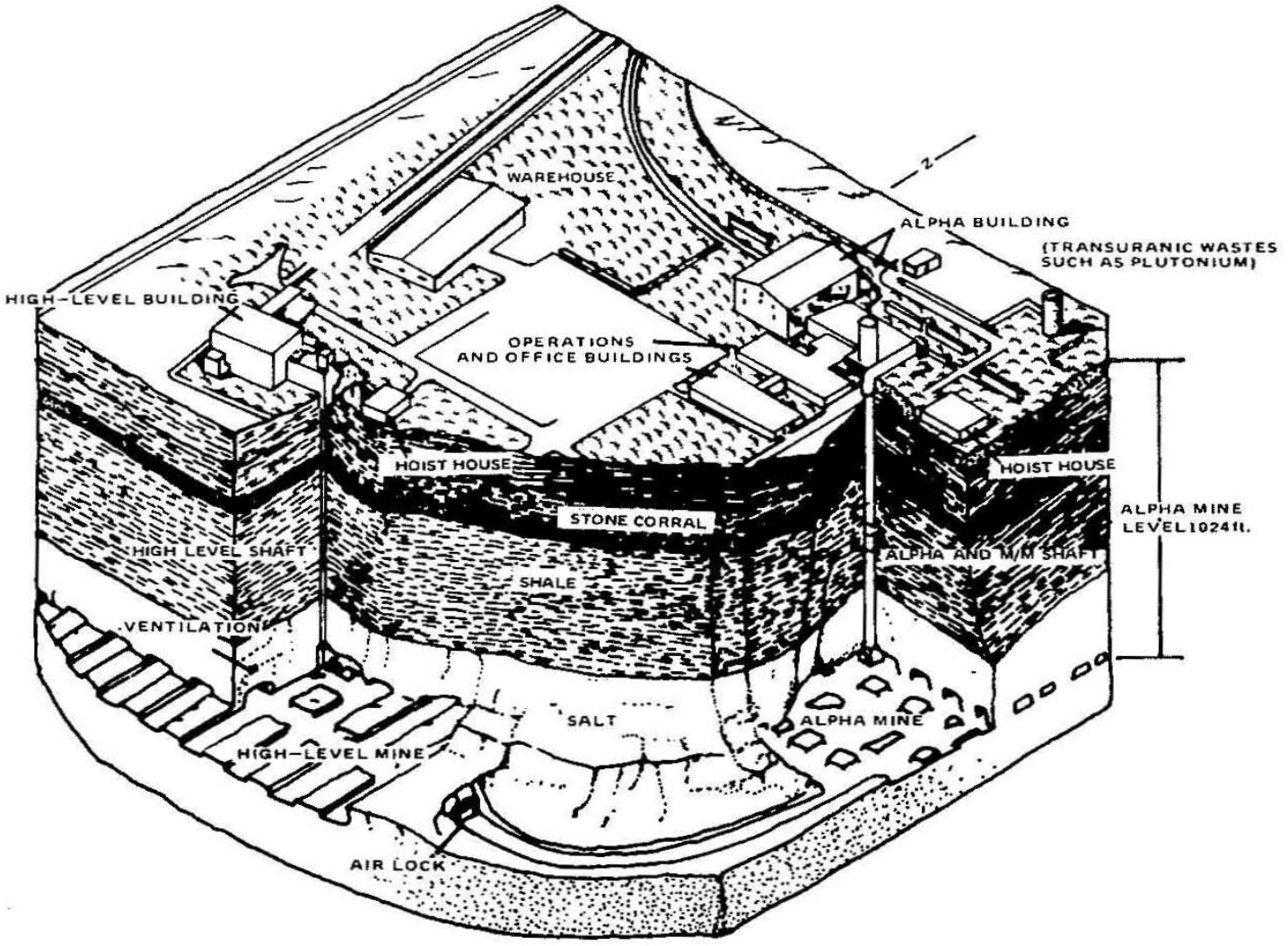
environmentally unacceptable permanent facility. The National Resources Defense Council (NRDC) and the Sierra Club also shared EPA's concerns. In addition, these groups argued that high level and transuranic wastes would eventually be buried in in a geological formation and that the expense and hazards of building the more vulnerable interim surface storage facility should be bypassed in favor of finding an acceptable geological site as soon as possible.

President Carter's indefinite deferral of reprocessing may create the need to have spent fuel stored retrievably, pending a later decision to either reprocess or to dispose of spent fuel directly into a geological repository. We learned that a surface storage facility similar to RSSF is being studied to meet this storage need. According to an ERDA official, President Carter's revised fiscal year 1978 budget includes research and development funds for this project.

The project is referred to as the Surface Unreprocessed Fuel Facility (SURFF) and is intended to provide safe and economical storage of spent fuel. According to ERDA officials, the design of SURFF will consider its possible additional use for waste storage but this is a low-priority facet of the project. In addition, ERDA officials stated that while SURFF will probably be very similar to the RSSF concept from a technological sense, its purpose is entirely different. These officials stated that while RSSF was intended to store commercial high level waste pending the availability of permanent geological disposal, SURFF is intended for storage of spent fuel to permit a deferred decision as to whether it will be discarded as a waste, or reprocessed.

In February 1976 ERDA announced an expanded program to identify suitable sites for six commercial waste disposal pilot facilities each costing about $200 million. This program is being directed by the Union Carbide Corporation's Office of Waste Isolation at Oak Ridge, Tennessee, which was specifically established for this program. This corporation also operates ERDA's Oak Ridge National Laboratory. A separate geological investigation program for ERDA transuranic contaminated waste, entitled, "Waste Isolation Pilot Plant," is being conducted by Sandia Laboratories, Albuquerque, New Mexico. This facility is estimated to cost between $130 million to $150 million.

ERDA plans--for the commercial repository program--to have two pilot disposal facilities in operation by 1985, two in 1987, one in 1989, and one in 1991, to receive commercial solidified high level and transuranic contaminated wastes. (See fig. 1, p. 10, for an artist's concept of a Federal repository.)



ARTIST'S CONCEPTUAL DRAWING OF A FEDERAL REPOSITORY

FIGURE1

At the time ERDA expanded its commercial repository program, it envisioned that spent fuel elements now accumulating at nuclear reactors might have to be disposed of rather than be reprocessed. Since President Carter deferred reprocessing indefinitely, ERDA must now prepare for the retrievable storage and/or disposal of spent fuel. If no repository is available by the mid-1980s, utilities could be forced to shut down their nuclear reactors unless alternative storage, such as SURFF, mentioned earlier, becomes available. ERDA estimates that the earliest possible date a geological waste disposal facility or SURFF could be ready to receive spent fuel is 1985. By this time the nuclear industry could be faced with a severe shortage of storage capacity even after making modifications to existing storage facilities. (Our analysis of the program target dates is discussed in ch. 3.)

ERDA's commercial repository program envisions facilities in various regions of the United States with waste retrievability at each site for a specified test period. It believes this approach has advantages:

--The risk of dependence on one site and facility is reduced, improving the chances of timely operation of at least one repository.

--Waste could be removed from a site if necessary. The concern is that after opening a repository, additional technical information might dictate changes and even relocation. In such an event, the retrievability feature would allow any change with relative ease.

--Each of the six repositories would be more readily accepted by the public, because no one site would serve as the country's sole waste repository.

--Transportation costs and risks of shipping waste will be reduced if more than one repository is operating. The average shipping distance from all reprocessing plants will be less than would be the shipping distance for a single repository.

ERDA officials informed us that as far back as the Lyons project, AEC projected that one repository of a practical working size in salt could handle all the U.S. solidified commercial high level waste through the year 2000. These officials stated that the six-repository program was not proposed due to waste volume considerations, but to gain experience in formations other than salt and to gain regional acceptance for the program.

During earlier geologic evaluation programs, Union Carbide identified 12 broad geologic formations. These formations underlie many parts of the continental United States. (See app. II for a map identifying the general areas of interest within these formations.) For the first two repositories scheduled for 1985, ERDA plans to survey two salt formations for potential sites. They are the Salina formation underlying parts of Michigan, Ohio, Pennsylvania, West Virginia, and New York, and the interior Gulf Coast salt domes underlying Louisiana, Texas, and Mississippi. ERDA is also evaluating two additional salt formations as contingencies--the Paradox formation in Colorado and Utah and the Permian basin in Oklahoma and Texas. ERDA's geological program for disposal of its transuranic contaminated waste is being conducted in the Permian Salado salt formation in New Mexico.

ERDA plans to locate the two repositories scheduled for 1987 in geological formations other than salt to determine their suitability for waste disposal. Union Carbide believes the shale and limestone formations in Illinois, Ohio, Kentucky, and West Virginia are the most promising. The formations for the remaining facilities have not yet been identified.

ERDA is currently not including New Mexico among the States earmarked as potential commercial high level waste disposal sites. New Mexico should be considered as a prime candidate for the first pilot repository because the geology has already been extensively evaluated. The U.S. Geological Survey (USGS), Department of the Interior, believes that salt formations underlying New Mexico may contain promising sites for geological high level waste disposal. 3/ In fact, ERDA is now trying to locate a site in New Mexico for its own transuranic contaminated waste.

ERDA is investigating several alternatives for managing its military and research wastes, including

--immobilization and entombment in place,

--solidification and geological disposal at Hanford and Savannah River, and

--solidification and shipment to a Federal geological repository.

As discussed in chapter 4, each of these alternatives presents technical, environmental, and economic problems.

CHAPTER 3

GEOLOGICAL WASTE DISPOSAL: OBSTACLES TO A PERMANENT SOLUTION

ERDA has set 1985 as the target for completing two pilot geological disposal facilities for commercial high level and transuranic contaminated wastes and spent fuel (if and when it is defined as a waste). In addition to these, ERDA plans to complete four more pilot geological disposal facilities for commercial waste between 1987 and 1991.

ERDA plans to build another disposal facility by 1983 for its own transuranic contaminated waste. At this facility, it will have the experimental capability to determine the suitability of the site for high level waste disposal. Although this facility might eventually be used for routine high level waste storage, ERDA has not established a date for storing such waste.

We believe that ERDA's goals may be difficult to achieve because of

--public and political opposition to high level waste repositories;

--geological uncertainties about the most promising salt formations;

--regulatory obstacles; and

--overly optimistic estimates of the time required to identify, study, design, construct, and confirm the feasibility of the repositories.

PUBLIC AND POLITICAL OPPOSITION

According to a recent Harris poll, the American public favors wider use of nuclear energy but at the same time considers waste disposal a major problem and the biggest obstacle to nuclear power. Political and business leaders, regulators, and environmentalists who responded to the Harris poll feel that no one is taking definite steps to solve the problem. While the Federal Energy Resources Council*, in May 1976,

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*The Federal Energy Resources Council had the responsibility for coordination of Administration policies and programs relating to energy. The Council participants include: Council on Environmental Quality, Department of Commerce, USGS, EPA,

supported ERDA's efforts to demonstrate waste disposal, the success of ERDA's efforts depends to a great extent on whether it can demonstrate to the public and elected officials that it has a sound waste management program and that the risks associated with the storage and/or disposal of radioactive waste in geological formations are low.

ERDA intends to construct two pilot repositories by 1985 to receive commercial high level waste. It appears that ERDA established the 1985 date to relieve public concern over the waste disposal problem. Furthermore, it is not clear at this time where ERDA is going to get commercially processed solid waste to store in these facilities by 1985 when there are neither reprocessing operations nor solidification facilities built to produce a solid waste. Since President Carter indefinitely deferred commercial reprocessing, ERDA may eventually dispose of spent fuel in the planned repositories. ERDA's SURFF project, however, is intended for the interim storage of spent fuel. When and what will eventually be placed in the repositories is currently unknown. ERDA officials told us that if the President's policy on spent fuel reprocessing is still in effect at the time a repository is ready for testing, radioactive materials other than high level waste, such as spent fuel borrowed from the SURFF project, might be used.

Nevertheless, by showing that a solution is well within reach, ERDA is hoping that critics of nuclear power will be quieted. This view is shared by Mason Willrich*, et al, in a recent report which states that:

> "It seems generally acknowledged that one of the major obstacles to public acceptance of nuclear power is concern that there is no safe solution to the radioactive waste problem. It is believed by many that this concern is derived, at least

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Federal Energy Administration, and ERDA. The Council's functions were recently transferred to the newly created Department of Energy under President Carter's reorganization plan for the Executive Office of the President.

*Mason Willrich is currently Director of International Relations, Rockefeller Foundation. He is also Professor of Law, University of Virginia (on leave), and previously Visiting Professor of Nuclear Energy, Massachusetts Institute of Technology. Mr. Willrich has published numerous articles and participated in several studies on nuclear energy. He prepared the quoted report for ERDA under contract, on waste management and regulation.

> in part, from the absence of a demonstrated permanent waste repository. It seems reasonable to conclude that one of the most important purposes intended by the waste repository demonstration 'on a timely basis' (i.e., in operation by 1985) is to increase public confidence." 4/

To promote better public and political acceptance, ERDA has developed a public affairs plan. Under this plan, it intends to work closely with other Federal agencies (such as USGS), State and local agencies (such as State geological surveys), and private groups and citizens to identify safe and acceptable locations for commercial nuclear high level waste repositories. ERDA made a major public announcement in December 1976, highlighting the main goals of its commercial repository program and identifying 36 States of interest to the program.

We believe, however, that ERDA may continue to have public and political acceptance problems because its program goals may be overly optimistic. This raises questions about the soundness of its waste management program. A sound waste management program in itself may not be enough because of the public perception of the risks associated with nuclear waste disposal. We believe public and political acceptance is the biggest obstacle that ERDA must overcome in resolving the waste disposal problem.

ERDA has twice been unsuccessful in developing potential waste disposal sites because of insufficient attention to the public acceptance factor. In Kansas, public and political opposition developed over the proposed Lyons site. Although AEC believed it could overcome the site problems, it decided instead to withdraw from the Lyons site and other potential locations in Kansas. We understand that this decision was based, in part, on statements by some Kansas elected officials to AEC opposing a repository in the State.

In Michigan ERDA did not adequately inform all the affected public and government officials about the pilot repository program. As a result, when ERDA announced it would conduct site screening studies in one Michigan county, government officials and the public believed a site had already been selected. Opposition to the repository program developed from this misunderstanding. In the November 1976 elections, voters in the affected and two nearby counties voted overwhelmingly against waste repositories in their counties.

Union Carbide and ERDA officials said that public opposition in Michigan has delayed the program about a year and that the 1985 target date can only be met if similar delays

are avoided. An ERDA official told us that the agency is beginning to face public opposition in Louisiana, the other prime waste repository candidate.

UNCERTAINTIES ABOUT THE MOST PROMISING SALT FORMATIONS

ERDA, NRC, and the National Academy of Sciences all agree that the primary barrier for isolating high level and transuranic contaminated wastes must be the surrounding geology. Because of the long-lived nature of these wastes--about 500,000 years--the waste form and its container would break down much sooner than it would take the radionuclides to decay to innocuous levels.

In cooperation with USGS, other renowned geologists, and the National Academy of Sciences, ERDA is exploring the use of geological salt formations underlying areas of the United States as ultimate disposal repositories for high level waste. Extensive knowledge has been gained from over 15 years of research on the use of salt formations as waste repositories. For this reason, ERDA is focusing on salt formations for the first two geological disposal pilot plants for commercial waste and one for its own waste.

Salt has many properties that make it more attractive than other types of rock. The principal advantages are its stability and relative freedom from circulating ground water--the key vehicle for carrying radionuclides into the environment. In other rock formations, earthquakes or other natural or human events could cause fractures or channels though which ground water could flow. Salt, however, can deform without fracturing and can heal fractures which might otherwise result in ground water movement.

Salt is also highly abundant, can dissipate large quantities of heat common to high level waste, and has radiation shielding properties approximately equal to concrete. To take full advantage of these characteristics, the salt formation, according to an NRC document, should be at least 200 feet thick and the repository between 500 and 2,000* feet below the surface. 5/

Although salt has many favorable qualities, it is not without disadvantages. The principal disadvantages are:

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*According to Union Carbide officials, with new mining techniques repositories can be located in salt beds at depths of 3,000 feet below the surface.

--Salt is very corrosive and subject to chemical reaction.

--Healing properties of salt are relatively slow and salt will dissolve rapidly if and when it is exposed to circulating water.

--Salt formations are located in areas where hydrocarbons, oil, gas, and potash--used for fertilizer--are frequently found. Hydrogen sulfide--a deadly gas--is often found near oil and gas and, as such, poses problems to waste repository operations.

Preliminary geological information on the three most promising salt formations--the Salina formation and the Gulf Coast salt domes for commercial waste, and the Permian Salado salt formation for ERDA transuranic contaminated waste--indicates that there are major uncertainties, such as instability of the geological salt dome formations and activities created by man's search for natural resources--salt, oil, gas, and potash. Furthermore, according to USGS officials, geologic formations may also become unstable after placing high level waste in them. First, heat from these wastes may cause migration of brines to the heat source with attendant reaction with the emplaced waste. Second, ground water may gain access to the geological formation, most likely through the shaft used to emplace the waste. The reaction of this water with the waste and its ultimate fate need to be assessed. These uncertainties must be resolved or avoided before a repository can be established. ERDA is aware of these uncertainties and is addressing them.

Methodology for selecting commercial and military repositories

ERDA's selection of possible repository sites begins with surveys of potential formations. Data on a formation's properties, including structure, depth, thickness, hydrology, natural resources, and general surface characteristics is gathered. From this data, ERDA will select candidate areas, perhaps of "county" size, within each formation.

After candidate areas are identified, ERDA plans to conduct experiments on the physical behavior of the rocks, the waste cannisters, and the stability of underground formations. According to a Union Carbide report, this work is essentially completed for one salt formation but still needs to be completed for other formations of interest. 6/ ERDA considers the verification of predicted radioactive decay heat dissipation to be probably the most important reason for the test phase of a high level waste repository.

Geological studies that follow area selection are designed to develop specific data on each candidate area. These studies include (1) core drilling of perhaps 6 to 10 holes per 1,000 square miles, (2) geologic field mapping, (3) hydrologic studies, and (4) geophysical studies of the subsurface. When these studies are completed, three or more specific locations will be identified. According to Union Carbide officials, technical review groups made up of Federal, State, and local government officials, and professional organizations will assist in selecting specific repository locations of about 2 to 5 square miles each.

Union Carbide has established a senior technical review group made up of individuals from professional organizations and universities to study and review the plans and activities leading to site selection and facility development. It is not clear, however, at what stage Union Carbide intends to involve these and other intended review groups. ERDA officials told us that they intend to involve review groups from the Association of State Geologists and the Geological Society of America at the earliest possible date and that steps to achieve this have already begun. It is unclear what ERDA means by the "earliest possible date," but in our opinion the groups should be involved at the very beginning--in the planning of a geological exploration--to minimize any subsequent errors in the site exploration process. For example, site selection and experimentation criteria should be established and agreed to by the review groups at the outset. Otherwise, any geologic data collected during further investigation might fall short of what the review group would consider necessary to make a determination that a site was suitable for further study.

Commercial waste repositories

Most of the Michigan bedded salt formation (part of the Salina formation) is too deep for waste repository operations, except at its outer edges. Here, however, the salt is not always thick enough to meet the 200-foot thick criteria (except in northeastern and southeastern Michigan).

Moreover, large portions of the salt formation in Michigan have been explored and surveyed for oil and gas. Current maps indicate that potential oil reserves lie along the outer edges of the salt and in the deeper portions of the basin. In southeastern Michigan, oil and gas drilling has taken place. The region also has had salt solution mining operations. These two factors contributed to ERDA canceling the Lyons, Kansas, project in 1972. Because of these activities and the high population densities in southeastern Michigan, Union Carbide wanted to emphasize exploration in northeast Michigan. According to the Union Carbide's consulting geologist, many

northeastern Michigan counties which are promising for waste disposal have parcels of land already leased for oil and gas exploration. 7/

This geologist extended his analysis of the Salina formation into Ohio, Pennsylvania, West Virginia, and New York. His analysis indicated that, except for northern Ohio and central New New York, the salt formation is too deep for waste repository operations. According to him, northern Ohio and central New York areas contain numerous petroleum and gas drill holes. 8/

The second most favorable formation for commercial high level waste is in the interior Gulf Coast salt domes, especially in Louisiana. However, these domes contain many unfavorable features. For example, according to an NRC document:

> "Domes result from tectonic instability and massive volumes of salt have penetrated the rock sequence above deeply buried source salt beds. Therefore, such domes are not usually protected from ground water by thick impermeable rock sequences, and it would be necessary to establish in detail the ground water flow as well as to demonstrate that the formation process (diaspirism) is not now active and that its reinitiation is highly unlikely." 9/

In a study for AEC, USGS also noted unfavorable characteristics of salt domes in general. USGS selected 36 of the 263 known or suspected interior salt domes. The rejected domes were too deep or had been used for petroleum or salt production or for gas storage. USGS issued the following caution on the selected domes:

> "Our ability to assess the suitability of salt domes in general is somewhat limited by the fact that information sought by mineral and petroleum companies does not completely overlap information needed to evaluate suitability for waste emplacement. This is especially so in regard to recent salt movement and detailed hydrology (including dissolution) of salt domes, two topics that are of vital concern for waste emplacement. There are almost no specific data on these topics for the domes under consideration and very little data available for salt domes in general." 10/

Union Carbide is aware of the problems noted by USGS and NRC and is studying the stability of specific domes.

ERDA plans call for the identification and confirmation of the first two commercial pilot repository sites by fiscal year 1978. Between fiscal year 1978 and 1984, continued geologic testing, land acquisition, design and construction, and safety and environmental studies will be undertaken. By fiscal year 1985, the two facilities would begin receiving actual waste. While technically feasible, NRC and ERDA officials recognize that the tasks required to meet the 1985 date are formidable.

During the pilot phase, ERDA expects to store up to 2,000 cannisters of high level waste, to demonstrate and evaluate (over a 5- to 10-year period) retrievability devices, emplacement concepts, and effects radiation and heat have on the stability of the underground excavation. Furthermore, ERDA will continue to study the chosen geological formation to determine if any irregularities exist that would rule out the site as a suitable disposal repository. After a successful demonstration period and amendment of the NRC license, the retrievability requirement will be relaxed so that the excavations can be sealed. According to ERDA, this sealing does not make retrieval impossible but only more difficult, time consuming, and expensive.

We believe that it may be risky for ERDA to drop the retrievability option after a demonstration period of only 5 to 10 years. The experimental data gathered may not be sufficient to establish the degree of confidence needed to make valid extrapolations of long term risks associated with radioactivity escaping to man's environment. In this regard, Mason Willrich, et al, stated in their report to ERDA that:

> "It will, of course, be impossible to 'demonstrate' with high assurance of validity, the capability of the repository to contain HL waste over the period for which it constitutes a potential radiological hazard. What can be demonstrated is (only) the ability to receive and emplace solid waste in the repository." 11/

In addition, USGS officials told us that the 5- to 10-year period of retrievability may not be adequate to assess all of the effects on the geologic medium from the emplacement of heat producing high level waste. However, ERDA believes this period provides ample time to verify laboratory tests and models that predict the dissipation of radioactive decay heat.

ERDA's transuranic contaminated waste repository

Because the Sandia pilot plant site near Carlsbad, New Mexico, is further along in development than any site in the commercial program, we believe it could also serve the needs of the commercial nuclear industry by becoming the first commercial waste repository. Furthermore, New Mexico officials are receptive to such a facility, as well as such other fuel cycle activities as reprocessing, enrichment, and fuel fabrication.

Since selecting the Sandia site, ERDA's position has been that the location is for its own transuranic contaminated waste and to provide experimental capability to determine the suitability of the site for high level waste disposal. ERDA has stated that the site is being developed for its transuranic contaminated waste because the commercial repository program is being developed for commercial high level waste, and because of the urgent need to remove the large backlog of ERDA transuranic waste at ERDA's Idaho National Engineering Laboratory. We believe that the site could be concurrently developed for commercial high level waste. A possible drawback to this would be that the repository would require an NRC license at the preconstruction stage. The Sandia project manager and an ERDA official both estimate that it would take up to 2 years to obtain an NRC license for the project. According to one ERDA official, any NRC involvement would hamper ERDA's ability to attain the milestones to which the project is committed.

During February 1976 hearings before the Joint Committee on Atomic Energy, ERDA was asked, "Will the pilot repository for ERDA transuranic waste in New Mexico be used for the storage of high level waste, and if so, when is this contemplated?" In addition, the Joint Committee asked, "Will this site be used only for ERDA high level waste, or commercial high level waste as well?" ERDA's Assistant Administrator for Nuclear Energy responded:

> "During the pilot plant phase, ERDA does not plan to store either ERDA or commercial high level waste * * *. We do plan to conduct high level waste experimentation * * * with readily retrievable limited numbers of simulated or actual high level waste cannisters. It is possible that this could lead to a decision to store ERDA or commercial high level waste there in the future." 12/

According to the Sandia project manager, small-scale experiments for storing high level waste (probably calcine wastes from Idaho) are scheduled to start in 1983. According to a Sandia report, a pilot plant for high level waste could

be in operation by 1985. 13/ This official told us that the pilot plant could be designed to handle larger quantities of high level waste. Furthermore, Sandia and ERDA field operations officials told us the facility may be able to handle all ERDA and commercial high level and transuranic contaminated wastes through the year 2000.

Although the Sandia project is further along than the commercial projects, it is not without possible obstacles. One is the infringement on potential fossil fuel (oil and gas) and mineral resources (potash) for use by this and future generations. Sandia and ERDA officials told us that this general area of southeastern New Mexico has potential fossil fuel and mineral resources. According to a Sandia report this area provides over 85 percent of the Nation's reserves of potash 14/--a valuable mineral used for fertilizer. An ERDA official stated, however, that less than 4 percent of the reserves are projected within the 35 square mile exploratory area and only a token under the 2,000 acre proposed site. Most of the planned repository area--2,000 acres of State land and 16,000 acres of Federal land--is under lease. The Federal land is leased from the Bureau of Land Management, Department of the Interior to private industry. These leases will have to be bought back before a repository could be established.

Sandia encountered another obstacle in its drilling program when hydrogen sulfide gas was struck during drilling at their first site. They have since moved to a nearby site, however, according to Sandia in a report filed with ERDA:

> "Potash mining experience, petroleum drilling and the ERDA drill holes at the Los Medanos site (old site) reveal the existence of occasional (hydrogen sulfide) gas pockets within the Salado Formation and brine/gas flows from the Castile. These features could pose operational problems for the facility and must be better understood with respect to long term integrity of the repository." 15/

ERDA has been criticized by NRDC for proceeding too rapidly in such a sensitive geological area. 16/ NRDC is concerned that ERDA wants the Bureau of Land Management to begin withdrawing leases before the Bureau makes a full quantified assessment on the potential loss of valuable potash ore. This concern was also shared by some Bureau of Land Management officials. According to an ERDA official in February 1977, the whole issue of potash resources in the study area is uncertain.

The ERDA official added that construction funds for the repository will be requested in fiscal year 1979 if Sandia can complete a draft environmental impact statement in time for the

budget submission. The draft statement will address the issue of potash resources and contain a complete cost-benefit analysis of using the area as a potash and oil/gas resource or as a site for radioactive waste disposal.

NRC LACKS AUTHORITY OVER ALL WASTE STORAGE AND DISPOSAL FACILITIES

NRC authority to regulate radioactive waste is derived from two acts: the Atomic Energy Act of 1954, and the Energy Reorganization Act of 1974. The act of 1954 gave AEC authority to license and regulate possession, use, and disposal by persons* of source, byproduct, and special nuclear material. The AEC staff and its prime contractors were exempt from licensing control.

Title II of the Energy Reorganization Act of 1974 transferred the regulatory authority given in the Atomic Energy Act to NRC. ERDA and its prime contractors remained exempt from NRC regulatory authority except as provided in section 202 of the act. Section 202 of the 1974 act gave NRC specific authority to license certain ERDA waste management activities:

--ERDA facilities used primarily for the receipt or storage of high level radioactive wastes** from commercial licensed activities (i.e., reactors, reprocessing plants, etc).

--Retrievable surface storage facilities and other facilities for the express purpose of long term storage of high level radioactive waste generated by ERDA which are not used for, or a part of, research and development activities. (NRC considers storage longer than 20 years to be long term.)

In testimony before the Subcommittee on Energy and the Environment, House Committee on Interior and Insular Affairs,

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*Persons are any individuals, firms, or agencies (with exception of NRC and ERDA).

**High level waste has a specific meaning within current NRC regulations. It is defined in title 10, Code of Federal Regulations, part 50, appendix F, as follows: "High level liquid radioactive wastes means those aquaeous wastes resulting from the operation of the first cycle solvent extraction system, or equivalent * * * in a facility for reprocessing radiated reactor fuels."

in May 1977, NRC stated that its regulatory authority over radioactive waste is limited by statutes which specify who and what is to be regulated, and that it is not based primarily on the degree of hazard posed by the waste, the lifetime of the waste, or the waste form.

NRC testified that its authority to license ERDA high level waste storage facilities does not extend to ERDA wastes which are used for or are part of research and development activities. It also does not include licensing of ERDA waste storage facilities in existence before enactment of the Energy Reorganization Act or ERDA facilities not intended for "long term storage" of ERDA high level waste.

NRC stated that the definition of high level waste in AEC's (now NRC's) regulations contemplated reprocessing of spent fuel so that the fission products, along with small amounts of transuranic nuclides, would be separated from reusable uranium and plutonium. NRC regulations require that high level waste be sent to a Federal repository because the intensely radioactive fission products (dangerous for several hundred years) and the highly radiotoxic transuranic nuclides (dangerous for thousands of years) require special care over long periods of time which can best be exercised by the Federl Government to assure adequate protection of the public health and safety. NRC stated that spent fuel and transuranic waste require consideration and care similar to that for high level waste for the protection of public health and safety but that neither spent fuel nor transuranic waste currently fall under the definition of "high level waste" and therefore are not within NRC's licensing jurisdiction if stored or disposed of in an ERDA repository.

NRC testified that it became apparent several years ago that high level waste was not the only waste which required care over long periods. Certain wastes of lower activity are contaminated with significant quantities of the long-lived transuranium elements. This so-called transuranic waste comprises a larger volume than the high level waste and remains potentially hazardous for similarly long periods of time. NRC believes that this waste should also be sent to a Federal repository.

NRC testified that spent fuel, if it is to be disposed of or stored for long periods, requires consideration and care over the same long periods of time as the high level waste from reprocessing, because it contains all of the fission products and transuranium elements in high level waste plus the additional plutonium and uranium that is not extracted by reprocessing.

NRC stated that spent fuel and transuranic waste require long term care similar to that required for high level waste from reprocessing, and while NRC probably has the authority to regulate an ERDA repository for the receipt of spent fuel, as waste, NRC's authority to regulate an ERDA repository for the receipt of transuranic waste is in question. NRC stated that there is also uncertainty as to what point spent fuel becomes waste.

NRC testified that it is clearly responsible for licensing:

--All facilities primarily used for storage and/or disposal of high level waste resulting from licensed activities (i.e., commercial).

--Facilities for long term storage and/or disposal of ERDA high level waste.

--Commercial facilities for storage and/or disposal of spent fuel and transuranic waste.

--Commercial facilities for processing or treatment of wastes (including ERDA wastes).

NRC testified that its licensing jurisdiction is either nonexistent or uncertain with respect to waste storage or disposal facilities in the following manner:

High level waste

--Facilities for short term handling, treatment, or storage of ERDA high level waste are not subject to licensing.

--"Long term" and "short term" storage are not defined in the 1974 act. NRC considers storage of less than 20 years to be short term.

--There is some uncertainty about licensing ERDA facilities built to store or dispose of waste types in addition to high level waste (i.e., spent fuel or transuranic wastes) since technically they may not be primarily for storage of high level waste.

--ERDA does not need an NRC license for a high level waste repository used for research and development.

--ERDA facilities for disposal of high level waste generated in foreign countries would not fall under NRC

jurisdiction unless they could be regarded as resulting from issuance of an NRC export license.

Transuranic waste

--ERDA storage or disposal of non-high level transuranic waste, no matter what the source, is not subject to licensing.

Spent fuel

--Spent fuel stored or disposed of by ERDA might not be subject to licensing because of the current definition of high level waste. It is possible that NRC could redefine high level waste to include spent fuel. Even with such redefinition, if spent fuel is considered a resource to be stored by ERDA for future use, it may not be subject to NRC licensing.

--Spent fuel brought back from other countries and stored by ERDA would not be subject to NRC licensing.

We believe that when dealing with hazardous nuclear materials, the public should have adequate assurance that their health and safety are being protected to the maximum degree possible. No matter how competent or conscientious the managers of a project or facility may be, there can be advantages from an efficient, timely review of their operations by an outside independent review.

In a recent report and testimony before the Subcommittee on Energy and Power, House Committee on Interstate and Foreign Commerce, we commented on the propriety of ERDA assessing the adequacy of its systems for protecting public health and safety. In brief, we concluded that the Congress should amend ERDA's enabling legislation to provide for independent assessments of its nuclear operations to insure, among other things, public health and safety. We recommended three alternatives to accomlish such assessments:

--Give NRC the authority and responsibility for establishing policies, standards, and requirements in cooperation with ERDA for carrying out these assessments.

--Retain this responsibility and authority within ERDA, subject to certain statutory provisions to insulate the oversight activities.

--Authorize NRC to periodically assess ERDA's nuclear programs and facilities and annually report the results to ERDA and the Congress.

In testimony we favored the first alternative. Regardless of which alternative is selected, we believe that all ERDA's facilities for the storage and/or disposal of radioactive materials should receive independent oversight. We also believe that uncertainties in regulatory authority over ERDA facilities for storage and/or disposal of these materials need to be clarified so that there exists no "gray areas" concerning who should be responsible. We believe the American public deserves this protection.

Licensing high level waste disposal facilities

When ERDA established its goal of two pilot commercial waste repositories by 1985, it did not plan on going through NRC's licensing process at the preconstruction phase. In October 1976, however, the President announced that ERDA will apply for NRC licenses for the two commercial pilot repositories. NRC held that, if long term storage is contemplated at the pilot repository stage, NRC's licensing jurisdiction would apply at that time. NRC also pointed out that since its licensing review must be performed prior to construction, an ERDA decision to proceed without obtaining a license might be grounds for denying the license at a later time.

NRC is now developing preconstruction licensing procedures. Since ERDA did not initially plan to get an NRC construction permit, it did not factor this regulatory process into its 1985 goal. We believe that this process may substantially delay ERDA's program of achieving its 1985 goal. NRC must make extensive safety and environmental reviews followed by public hearings. As indicated earlier Sandia and ERDA officials believed that NRC licensing could take as long as 2 years.

ERDA does not plan to obtain an NRC license before building the New Mexico salt repository because the agency has designated it to receive ERDA transuranic contaminated waste. This repository will also have experimental capability to determine the suitability of the site for high level waste disposal. Therefore, this repository could become a long term disposal facility for high level and transuranic wastes if the project is successful.

Licensing transuranic contaminated waste storage and disposal facilities

ERDA and NRC both agree that the 1974 act does not give NRC authority to license ERDA storage or disposal facilities for either ERDA or commercial transuranic contaminated waste. NRC authority to license ERDA waste facilities is restricted to high level waste. Although the act does not define high level waste, NRC regulations do: those wastes created during the initial and subsequent steps in chemically reprocessing spent nuclear fuel.

Currently, ERDA's principal facility for storing its transuranic contaminated waste is the Idaho National Engineering Laboratory. ERDA is storing this waste retrievably until the repository in New Mexico is completed. Under the act as now written, ERDA will not need a license to store or ultimately dispose of transuranic contaminated waste.

We believe that transuranic waste storage and disposal should be licensed by NRC or receive other independent review and oversight, because it can be as hazardous to the public health and safety as high level waste.

Licensing ERDA interim waste storage tanks and bins

NRC and ERDA agree that the 1974 act (section 202(4)) did not give NRC authority to license ERDA interim waste storage tanks and bins for high level waste from its military and research programs. ERDA is adding more of these tanks at its Hanford and Savannah River plants and bins at Idaho Falls so it can transfer existing waste and store future waste. NRC would have to license any ERDA storage tanks and bins intended for long term high level waste storage. NRDC petitioned NRC in July 1975, challenging ERDA's planned construction of several new waste tanks without obtaining an NRC license. This petition was based on section 202(4) of the 1974 act which NRDC believed was applicable to the waste storage facilities mentioned above.

ERDA's position is that these storage tanks and bins are not subject to NRC licensing under section 202(4) of the 1974 act because they are not intended for long term high level waste storage. ERDA plans to store wastes in these tanks and bins for a period of 15 to 20 years. NRC accepts ERDA's position. However, it informed ERDA that it wants to be kept advised of any major changes in plans for the future use of these storage tanks--such as long term waste storage.

Licensing storage and disposal facilities for spent fuel

High level waste is generated by the reprocessing of spent fuel. Therefore, spent fuel contains all the fission and transuranic radionuclides that are found in high level waste. If commercial fuel reprocessing is not allowed in the United States, the spent fuel from nuclear powerplants will have to be stored or disposed of like high level waste. But spent fuel, like transuranic contaminated waste, is not defined as high level waste in current NRC regulations or in the Energy Reorganization Act of 1974. Thus, any ERDA facilities for storage or disposal of spent fuel might not be subject to NRC's regulatory control through their licensing requirements. According to an NRC counsel, the Commission could probably redefine high level waste in its regulations to include spent fuel because spent fuel is like high level waste. Thus, NRC would have authority to license such facilities if they change their regulations. Since President Carter deferred reprocessing indefinitely, we believe NRC should license spent fuel storage and disposal facilities operated by ERDA, or that these facilities should receive some other type of independent review and oversight.

NEED FOR NRC DECISIONS

Before ERDA can design, obtain NRC licenses for, and construct its commercial waste repositories, NRC must

--develop regulatory procedures for licensing the facility, and

--develop numerous criteria, such as criteria for the waste form and cannister to be used for shipping to and emplacement in a repository.

Licensing the repository

Because the repositories will be the first of a kind and will receive wastes that must be isolated from the biosphere for thousands of years, NRC officials told us that these repositories would be licensed with procedures similar to those used for licensing nuclear powerplants, and such procedures are being developed. Under nuclear powerplant licensing procedures, the requirements for obtaining an NRC license to construct and operate the repository are stringent and time consuming. However, such procedures would afford greater assessment of health, safety, and environmental concerns because other agencies and the public are involved.

NRC's nuclear powerplant construction permit reviews include (1) an NRC staff safety and environmental review, (2) an Advisory Committee on Reactor Safeguards (ACRS)* review, and (3) public hearings on safety and environmental matters.

During a staff safety and environmental review, NRC would evaluate, among other things, geological and hydrogeological data on a proposed site to confirm the integrity of the site. For nuclear powerplants, NRC staff safety and environmental reviews take about 2 years. Public hearings, averaging about 6 months for contested hearings, follow these reviews.

We believe it is reasonable to expect that the waste repositories may be opposed by some Federal, State, and local agencies, environmentalists, and local citizens. Therefore, it is reasonable to anticipate that the public hearings may be hotly contested and could last for years.

If NRC decides to license the pilot repositories using the procedures similar to those for licensing powerplants, it could take at least 2 years to license the two repositories that ERDA projects to be on line by 1985. If the repositories are contested at public hearings, the licensing process may be much longer.

Developing criteria

ACRS reported to NRC in April 1976 that before waste repositories can be established, waste solidification criteria must be developed. 17/ According to ERDA officials, the following NRC performance criteria need to be developed by 1978 to design the two pilot repositories which are to be on line by 1985:

--The form and process of solidifying the waste.

--The design of containers for holding the waste as well as the type and design of casks needed to hold the containers during transportation to a repository.

NRC agrees that criteria are urgently needed. The NRC technical staff estimates that draft criteria for waste solidification and cannister performance will be completed by December 1977 and published for comment--in the form of a

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*ACRS is an independent committee of up to 15 members established by the Congress. It is required to review each nuclear powerplant application and make other reviews as requested.

regulatory guide--by April 1978. The draft criteria do not dictate a specific waste form or type of cannister but do give performance criteria that must be met under normal and transportation accident conditions. Spent fuel was not considered to be a waste when NRC developed its draft performance criteria.

As of March 1977, some of the performance criteria had not been developed. Considering past history of the development of crucial standards such as these, the April 1978 date may not be met. For example, a new rule governing releases of nuclear powerplant waste effluents was in process almost 3 years before a final regulation was promulgated. The criteria being developed by NRC must be in conformance with EPA's generally applicable standards. EPA is currently developing generally applicable environmental standards for high level waste, with a December 1977 schedule for a proposed standard and draft environmental impact statement.

Waste cannisters will have to be shipped to a repository in a cask that provides radiation shielding and accident protection during transport. A cask design specifically for transporting waste cannisters has not been approved by NRC. According to an NRC official, the design of the cask will be similar to those used for shipping spent fuel except that the internal structure will be changed to accommodate waste cannisters. The official indicated that the cask design would be approved under regulations for spent fuel shipping casks. Edison Electric Institute's "Nuclear Fuels Supply" report indicated that NRC licensing and detailed design typically takes 15 to 30 months to approve a shipping cask design. 18/

Solidification technology that commercial fuel reprocessors could use for the high level waste stream has been developed by ERDA at its Idaho National Engineering Laboratory. The process--calcination--reduces the liquid to a granular powder substance. Calcined waste has inherent disadvantages which may make the form less suitable for long term disposal than other waste forms such as glass. For example, in relation to other waste forms, calcined waste is readily soluble in water, susceptible to dispersion under accident conditions, and unstable. If water ever breached the geologic containment, the calcine waste could be dissolved and introduced into the environment. Whether the calcination process can be used by industry depends on the performance criteria developed by NRC.

Besides calcination, ERDA has also been developing methods for solidifying acid waste into a glasslike form. This process, according to ERDA, has advanced beyond the developmental stage to a point where it is ready for demonstration. The

glass form has many favorable properties such as low leachability, low volatility, high impact resistance, and good thermal and radiolytic stability.

Although neither solidification process has ever been demonstrated with commercial high level waste, ERDA has proposed $12 million in its fiscal year 1978 budget for a project that would process a small amount of actual commercial spent fuel and glassify the resultant high level waste. ERDA has also proposed $10 million in this budget to continue design on a full-scale waste solidification process on the basis of this demonstration project. According to an ERDA official, glassification is ERDA's prime effort aimed at reaching a commercial scale by 1983.

CONCLUSIONS

ERDA has launched an ambitious program to develop and test radioactive waste repositories. The success of this program will greatly affect the future of nuclear power as an energy alternative for this country. The program should also provide some answers on what to do with the millions of gallons of high level waste now temporarily stored at its reprocessing sites.

ERDA should take the necessary time in developing the earth science data required to demonstrate acceptably low risks--the key point in gaining public and political acceptance. Attempting to move too fast on the repository program could, we believe, cause repetition of problems similar to that involved at Lyons, Kansas.

When it publicly announced its waste repository program objectives and goals, ERDA may have promised more than it can deliver. There are, we believe, formidable social, geological, and regulatory problems which must be solved. Foremost among them is opposition of public and some political leaders. ERDA may not be successful in gaining their acceptance unless it can convince people that it has a sound waste management program and that geological disposal risks to man's environment are acceptably low.

Another aspect of ERDA's waste repository program which is not, in our opinion, based on realistic appraisals is the goal of building six waste repositories in the stated time period. This goal appears overly optimistic in estimating the time required to identify, study, design, construct, and confirm the feasibility of the repositories. The damage which can result from an unachieved time frame is that it will further decrease the public's confidence in ERDA's waste management program.

As a result of President Carter's indefinite deferral of commercial reprocessing of nuclear spent fuel, ERDA is considering SURFF for interim storage of nuclear spent fuel. In the event a decision is made against reprocessing and spent fuel is determined to be a waste, it might be disposed of in the repositories. This could have an impact on the repositories currently being planned for by ERDA. ERDA initially planned six six repositories. This number was mainly arrived at to (1) spread the nuclear wastes regionally throughout the Nation and (2) minimize program setbacks should a potential site or sites prove unacceptable. Storage and/or disposal of spent fuel at a geologic repository requires more acreage than is needed for storage and/or disposal of high level waste because of the longer term heat problems associated with spent fuel. Also, should the United States adopt a policy to store spent fuel from foreign countries to discourage them from reprocessing, this too would have an impact on the number of repositories needed. While the precise number of repositories now needed to store or dispose of spent fuel is not known, NRC and ERDA officials indicate that maybe three repositories, of the size currently being planned by ERDA, are all that would be needed. ERDA is now beginning to look at the question of exactly how much land area is needed for the disposal of spent fuel in geologicl formations and the problems associated with spent fuel storage and disposal.

We have not taken a position as to how many repositories should be built, but in view of the $200 million cost per repository, and questions of excess capacity, public acceptance, and security needs, we feel ERDA should thoroughly evaluate the number of repositories currently planned and justify on a cost-benefit basis the number it finally believes will be necessary.

In our opinion, ERDA

--may not achieve its goal of having two pilot commercial waste repositories on line by 1985;

--should thoroughly evaluate the number of repositories currently planned in view of the $200 million cost per repository, and questions of excess capacity, public acceptance, and security needs;

--should proceed on a priority basis to complete its planned study on disposal of spent fuel in geological formations;

--should consider using its New Mexico salt repository as a commercial waste repository because this area has been studied extensively with favorable results;

--may not be able to drop the retrievability option after a 5- to 10-year demonstration because the experimental data obtained may be insufficient to assess all the effects of heat producing high level waste on the repository; and

--should include early involvement of the technical and scientific community at the outset of any site selection program.

Because radioactive wastes are highly toxic the Congress should either give NRC authority over those ERDA facilities--including research and development facilities--intended for the storage and disposal of ERDA's high level waste, or provide for other independent oversight and assessment of these facilities. The Congress should also either give NRC authority over the storage and disposal of transuranic contaminated waste and spent fuel, or provide for an alternate means of independent oversight and review.

Furthermore, we believe that NRC will not be able to develop crucial waste performance criteria needed by ERDA by 1978--the date ERDA stated they needed such criteria to design its two waste repositories scheduled for operation in 1985. Also, NRC's waste performance criteria will need to be updated to include spent fuel, in light of President Carter's decision to defer commercial reprocessing. NRC is presently developing waste repository licensing procedures. In view of the long-lived and toxic nature of these wastes, we believe the procedures should closely parallel NRC's present nuclear powerplant licensing procedures, including staff safety and environmental reviews, ACRS safety reviews, and public hearings on safety and environmental matters.

RECOMMENDATIONS

We recommend that the Administrator, ERDA:

--Reconsider the need for six high level waste repositories in view of disposal requirements through the year 2000 and justify on a cost-benefit basis the number it finally believes will be necessary.

--Proceed on a priority basis to reevaluate the impact that spent fuel disposal will have on its commercial repository program.

--Reevaluate goals for completing the first two repositories by 1985, realistically considering all social, geological, and regulatory obstacles.

--Consider the appropriateness of using the New Mexico location also as a commercial waste disposal site, because by 1985 other facilities may not be ready to receive these wastes and the utilities may no longer be able to store them at the reactor sites unless new facilities are constructed. This should be done without sacrificing or impairing the mission of the site to receive ERDA transuranic waste.

We recommend that the Chairman, NRC:

--Proceed on a priority basis to complete its waste repository licensing procedures.

--Proceed on a priority basis to include in its waste performance criteria, criteria for the storage or disposal of spent fuel.

RECOMMENDATION TO THE CONGRESS

We recommend that the Congress amend the Energy Reorganization Act of 1974 to provide for independent assessments of ERDA's facilities--including research and development facilities--intended for (1) the temporary storage and/or long term storage or disposal of commercial and ERDA produced transuranic contaminated waste; (2) the temporary storage of ERDA high level waste; and (3) the temporary storage and/or long term storage or disposal of commercial spent fuel, to better insure public health and safety. We recommend three alternatives to accomplish such assessments.

--Give NRC the authority and responsibility for establishing policies, standards, and requirements in cooperation with ERDA for carrying out these assessments.

--Retain this responsibility and authority within ERDA, subject to certain statutory provisions to insulate the oversite activities.

--Authorize NRC to periodically assess ERDA's facilities and annually report the results to the agency and the Congress.

In testimony before congressional committees, we have stated a preference for the first alternative.

AGENCY COMMENTS

Although NRC did not agree with several conclusions in this chapter, it generally agreed with our recommendations.

NRC did not agree with our view that under current law it had no authority to regulate the disposal by ERDA of spent fuel should there be no reprocessing, and that spent fuel would have to be disposed of like high level waste. Furthermore, NRC stated that it does not regard the definition of high level waste in its regulation (app. F, 10 C.F.R. 50) to be the exclusive definition of high level waste for the purpose of the Energy Reorganization Act of 1974. As such, NRC's view is that should spent fuel become a waste--something of no useful value--NRC would have authority to define it as such and regulate its disposition by ERDA under section 202 of the Energy Reorganization Act of 1974.

We do not state that NRC's definition of high level waste, as defined in its regulations, is the exclusive definition of high level waste to be applied to the Energy Reorganization Act of 1974. NRC's regulatory definition of high level waste was used in the report to show that, at present, NRC does not include spent fuel or transuranic contaminated waste in its definition of high level waste; and therefore, such materials are not currently within NRC's licensing jurisdiction if stored or disposed of at an ERDA facility. Our report includes NRC's legal view of its authority over spent fuel should it become a waste. However, we point out in the report that although NRC has authority to license an ERDA facility for the disposition of spent fuel as a waste, NRC recognized that its authority might not extend to an ERDA facility that stores spent fuel considered a resource for future use.

NRC stated that we believe it does not have the authority to regulate ERDA waste repositories in the early "pilot plant" stage, and it disagrees with this position. We do not state in our report that NRC does not have authority to license commercial pilot plant waste repositories. We recognize in our report that ERDA has agreed to submit a license application at the pilot plant stage and that NRC is developing licensing procedures for these repositories. We do state that NRC does not have the authority to regulate ERDA's Waste Isolation Pilot Plant being developed in New Mexico. ERDA has designated this facility to receive transuranic contaminated waste and as such does not require an NRC license. This facility will also have the experimental capability to determine the suitability of the site for high level waste disposal. According to NRC, ERDA does not need an NRC license for a high level waste repository used for research and development. The experimental capability of this project to determine suitability for high level waste disposal has been determined by ERDA to fall under the terminology of research and development, and as such, it would not need an NRC license under section 202 of the Energy Reorganization Act.

NRC does not believe the licensing review to be applied to repositories will necessarily delay ERDA's program. We believe that the repository licensing process, which NRC states will be similar to reactor licensing procedures in depth and thoroughness, has the potential to delay the program because it will also face many of the uncertainties currently experienced in the reactor licensing process, such as the hearing phase which has contributed to delays in getting nuclear powerplants on line.

NRC stated that it is an unwarranted prejudgement for us to recommend that the period of retrievability be longer than 5 to 10 years. Although we do not recommend this, we point out that the 5- to 10-year period of retrievability may not be adequate to assess all of the effects heat producing high level waste will have on the geological medium, and USGS agrees with this position.

ERDA generally concurred with our recommendations to it and stated that it has already been doing work in the areas covered by the recommendations. Regarding the recommendation to the Congress, ERDA agrees that an independent assessment within its organization has merit from the standpoint of assuring the Administrator and the public as to the adequacy of its nuclear operations. However, it does not consider that the first and third alternatives of placing this responsibility with NRC is viable since it would, in its view, impose extraordinary burdens on both organizations without commensurate benefit. It believes such a recommendation would be tantamount to requiring its facilities to be licensed by NRC. Further, ERDA contends that added NRC activities at its facilities could result in NRC having to acquire expertise it does not now have and which would, to a large extent, be duplicative of ERDA. ERDA stated, however, that it has undertaken a comprehensive study to determine how its current assessment activity could be restructured within its organization to provide greater assurance to the general public. We doubt, however, that ERDA can in fact, structure an organization within itself to independently assess its waste operations without Congress enacting amending legislation to insulate ERDA's oversight activities from developmental functions.

POSSIBLE LEGISLATIVE ACTIONS THAT WOULD INSULATE ERDA OVERSIGHT ACTIVITIES FROM DEVELOPMENTAL FUNCTIONS

If the Congress chooses the second alternative of retaining the independent assessment authority and responsibiliity within ERDA, we strongly suggest that it enact the following types of statutory provisions which we believe could effectively insulate these oversight activities.

--Give the head of the oversight activities (who would be appointed by the President and confirmed by the Senate) a specified term of office. The term of office should exceed that of the Administrator of ERDA.

--Require that the head of the oversight activities report directly to the Administrator of ERDA.

--Stipulate by specific legislative provisions the responsibilities of the oversight organization emphasizing its independence from energy policy formulation and development. In this regard, provide through legislative history the intent of the Congress that the head of the oversight activities be able to speak independently on matters relative to the oversight activities, including testimony before the Congress.

--Provide for close congressional monitoring of the oversight organization's activities.

--Vest the oversight responsibilities directly in the head of the oversight organization.

--Require that requests for ERDA appropriations identify the portion of the request intended for the support of the oversight activities, a statement of the differences, if any, between the amounts requested, and the head of the oversight activities' assessment of his organization's budgetary needs.

--Provide that neither the head nor the deputy head of the oversight activities could be removed from office for purposes other than being permanently incapacitated, guilty of neglect of duty, malfeasance in office, or guilty of a felony or conduct of moral turpitude.

--Establish the oversight activity as a professional organization by requiring its head to be a person who, by reason of professional background and expertise, is specially qualified to handle a nuclear oversight activity and chosen on a merit basis.

CHAPTER 4

MANAGEMENT OF MILITARY HIGH LEVEL WASTE

During the early years of the Nation's nuclear defense program, little attention was devoted to developing technologies for long term storage or disposal of high level waste. Priority was placed on producing nuclear weapons materials. Waste management decisions were based on short term expediency rather than long term implications. As a result of these and recent decisions, about 71 million gallons of high level defense waste are "temporarily" stored in steel tanks at Hanford and Savannah River. Additionally, about 3 million gallons are stored at Idaho Falls.

ERDA has stated that the New Mexico salt project could possibly be used as a repository for these wastes. However, before these military wastes could be moved to a repository, major questions involving their retrievability from the temporary storage tanks at Hanford and Savannah River must be resolved:

--Can ERDA safely remove the wastes and convert them into a suitable disposal form? If so, at what cost?

--If not, are there other safe long term storage or disposal alternatives?

The waste stored at Hanford and Savannah River make up about 94 percent of the total volume of ERDA waste. ERDA does not now have the technological capability to extract all of this waste from its storage tanks. Furthermore, this waste has been converted into a chemical form that may be unsuitable for long term storage or conversion to an acceptable long term storage form with current technologies.

ERDA is testing methods which it believes will enable it to extract up to 99 percent of the high level waste from most storage tanks. However, these methods may not work with some older tanks because of their poor condition. The remaining 1 percent of the waste would contain long-lived toxic radionuclides, such as plutonium and strontium-90. The costs of extracting all of the waste and preparing it for geological disposal are uncertain. Estimates range from $2 billion to $20 billion. 19/

ERDA is exploring alternatives for long term storage or disposal of this waste at Hanford and Savannah River. Alternatives include entombment in the existing tanks if the waste cannot be removed, and removal and solidification of the wastes in the tanks for burial at the site--either in near-surface

facilities or in deep geological formations. These alternatives present still other obstacles which must be resolved. Questions have been raised about the suitability of the two sites for geological disposal. In addition, any facilities for long term storage or disposal of the waste at all ERDA sites will require licensing by NRC.

CAN ERDA REMOVE DEFENSE WASTE FROM STORAGE TANKS AND CONVERT THEM TO SUITABLE DISPOSAL FORMS?

The key issues facing ERDA in the long term management of its existing and future high level waste are whether or not it can demonstrate technologies to safely remove it from storage tanks, process it into suitable long term storage or disposal forms, and transport it to storage or disposal sites. ERDA has completed or is now preparing separate documents on alternative methods for long term management of the high level waste generated at Hanford (planned issue date October 1977), Savannah River (issued May 1977) and Idaho Falls (planned issue date September 1977). The documents describe the current technological status and relative costs and risks of identified waste forms and storage methods.

Defense high level waste management to date

Most high level waste from reprocessing operations is produced in an acidic chemical form. Stainless steel--more resistant to acid corrosion than cheaper carbon steel--must be used for temporary storage tanks for acid waste. In the early years of the Nation's nuclear defense program, however, stainless steel was scarce and expensive. So AEC decided to neutralize the waste produced at Hanford to allow storage in tanks constructed from cheaper and more readily available carbon steel. The design of the Savannah River facilities, constructed in the early 1950s, was modeled after the Hanford facilities, incorporating improvements from Hanford operating experience. As a result, acidic waste at Savannah River is also neutralized before storage in carbon steel tanks.

There are some disadvantages to neutralizing acidic waste. For example:

--Injecting the neutralizing agent at least doubles the volume of high level waste which must be stored and eventually disposed.

--Plutonium and strontium-90 are insoluble in the neutralized waste and eventually settle in a sludge at the bottom of storage tanks. Removing the sludge from the storage tanks is currently the most difficult

technological problem in the existing defense waste management program.

--A technology to convert neutralized waste to a suitable form for long term storage or disposal has been demonstrated only on a laboratory scale.

There are 71 million gallons of defense high level waste stored as neutralized waste at Hanford and Savannah River. The 3 million gallons at Idaho Falls have not been neutralized. About 2.5 million gallons are temporarily stored as liquid acid waste in stainless steel tanks. The remaining 500,000 gallons have been dried to a granule (calcine) form and stored in stainless steel bins. Following is a discussion of the high level waste storage programs at these facilities.

Hanford

In 1943 the Corps of Engineers selected the Hanford site for the production and reprocessing of plutonium for nuclear weapons use. Nine production reactors and four reprocessing plants were built and operated there. Only one production reactor remains in operation and one reprocessing plant is on standby. Thus far 156 interconnected carbon steel tanks have been built to store about 50 million gallons of neutralized high level waste generated from reprocessing operations. One hundred forty-nine are of single steel wall design, contained in a reinforced concrete vault. Their capacities range from 50,000 to 1 million gallons. These tanks were constructed until 1964. The seven tanks built since 1964 have double wall primary and secondary steel liners inside reinforced concrete vaults. Each has a 1 million gallon capacity.

From 1958 through 1975, 20 of the older single-wall tanks have developed leaks suspected to be caused by stress corrosion cracks resulting in about 430,000 gallons of high level waste leakage into the soil beneath the tanks. The cracks in these tanks occurred from 3 months to 29 years after they were placed in service. No leaks in the newer double walled tanks have yet been detected. According to ERDA, the design life of these newer tanks is at least 50 years. But metallurgists are reluctant to provide estimates of a specific tank life because stress corrosion cracks are somewhat unpredictable.

To prevent further leakage from these and other storage tanks, ERDA is solidifying the liquid high level waste by evaporation into a damp salt cake. This process reduces the waste volume in the tanks, and puts the waste in a more suitable form for temporary storage. However, because the salt cake is soluble, this must be taken into account in evaluating its suitability for long term storage or disposal.

ERDA is now phasing out defense nuclear materials production at Hanford; therefore few high level wastes will be produced there in the foreseeable future. The high level waste inventory at Hanford has been reduced to about 50 million gallons by means of the evaporation process.

Savannah River

Savannah River has replaced Hanford as the major production facility for the Nation's nuclear defense program, with three production reactors now operating. Presently, about 21 million gallons of high level waste are stored there in carbon steel tanks. ERDA is processing high level waste at Savannah River into salt cake as at Hanford. It expects the net volume of high level waste (considering increases from reprocessing operations and decreases from salt cake processing) to grow by about 1 million gallons each year.

ERDA is presently using 31 tanks for high level waste storage, ranging in capacity from 720,000 to 1.3 million gallons. All tanks are constructed of carbon steel and sit in a reinforced concrete vault. Eight have single steel walls and the others have double steel walls (primary and partial or full-height secondary liners). Another 24 of the largest size tanks are under construction or planned.

Stress corrosion cracks have appeared so far in the primary liners of eight double-walled tanks with partial secondary liners. On one tank, 175 cracks have been detected. Leakage from these numerous small cracks resulted in a 100-gallon spill of liquid high level waste into the surrounding soil. If this leak had occurred in a new tank with a full-height secondary liner, it would not have reached the soil. However, the partial secondary steel liners have contained the leaks from the seven other tanks.

Idaho Falls

At Idaho Falls AEC built reprocessing facilities in the early 1950s to reprocess spent fuel from its research reactors. Idaho Falls is also the site for reprocessing spent fuel from the Navy's nuclear program. The amount of fuel reprocessed there, however, is quite small in comparison to Hanford and Savannah River--only 3 million gallons of high level waste are now stored there after more than 20 years of reprocessing. The waste has been retained in its acidic chemical form, unlike Hanford and Savannah River.

Acid wastes from Idaho Falls reprocessing operations are transferred to stainless steel holding tanks. There are currently 15 of these tanks, 9 with 300,000-gallon capacities, 2

with 318,000-gallon capacities, and 4 with 30,000-gallon capacities. Each of the 11 larger tanks is contained in an underground concrete vault. The four smaller tanks are buried on a concrete pad but are not surrounded with a vault. These tanks were used to store wastes from early reprocessing operations and are now empty. None of the Idaho Falls tanks have leaked.

At Idaho Falls ERDA constructed a calcining facility and began operations in 1963. In this process the liquid acid waste in the holding tanks is converted to a dry granule solid--a safer storage form. Calcination also results in a 9-to-1 reduction in waste volume, minimizing long term storage costs. The granules are stored in stainless steel bins which are enclosed in buried concrete vaults. Fourteen of the 18 bins were designed for complete retrievability of the calcined waste. ERDA believes it can modify the other four bins for retrievability.

ERDA has not demonstrated an acceptable technology for retrieving wastes at Hanford and Savannah River

Hanford and Savannah River waste is in three physical forms--liquid, sludge, and salt cake. After acid waste from reprocessing operations is neutralized, it is transferred to storage tanks as a slurry. Much of the radioactive material in the waste is initially suspended in the liquid and over about a 2-year period settles to the tank bottom as a sludge. Time, pressure, and heat generated by radioactive decay may cause the sludge tc harden. Long-lived plutonium and strontium-90 and essentially all other present radionuclides except long-lived cesium-137 settle as part of the sludge.

In the past ERDA has pumped liquid waste from one tank to another and has removed salt cake from tanks. ERDA believes it can slurry the sludge and pump it from the tanks. However, acceptable methods for removing all of the sludge from tank bottoms have not been demonstrated. ERDA proposed to do this by a combination of (1) sluicing--breaking up the sludge with low pressure jets of liquid waste, and (2) removing residual sludge by chemical flushing.

During the late 1960s the sluicing technique was tried in two tanks at Hanford with radically different results. In one tank, complete sludge removal was precluded by a hardened 1- to 2-inch top layer of sludge. In another tank, the sludge was easily removed. Savannah River officials believe that a combination of sluicing and chemical flushing would result in a 1 percent sludge residue in the tanks. They found that most of the radioactivity associated with sludge samples taken during

preliminary chemical flushing tests remained in the residue left after chemical flushing. Furthermore, 16 of the storage tanks at Savannah River have a network of cooling coils close to the tank bottoms which may accumulate sludge deposits. This factor must be considered in any sludge removal process. Thus, the characteristics and dispersion of the sludge in a tank are important in determining a tank's suitability for the proposed sluicing and chemical cleaning.

More importantly, the 20 cracked tanks at Hanford may not be susceptible to sluicing due to the danger of dissolving salt crystals that plug the leaks and cause new leakage. ERDA officials told us that at Savannah River there is no problem sluicing cracked tanks because the tanks have double walls, and Savannah River has the capability to recover the waste from the space between the two walls. An alternative method for which the technology has not been demonstrated is mechanical mining. This is, however, a more risky process because of the danger of airborne radioactivity releases.

ERDA has not demonstrated technologies for converting existing high level waste to suitable long term storage or disposal forms

Important characteristics of high level waste forms suitable for long term storage or disposal include (1) resistance to leaching (dissolution or dispersion in water), (2) particle size, (3) resistance to sudden and rapid temperature increases, (4) impact resistance, (5) long term resistance to chemical and physical change, (6) steady state temperatures from radioactive decay heat, and (7) container stability (for long term storage). If ERDA high level waste is eventually shipped to designated long term storage or disposal sites, as previously discussed, fire, impact, and particle size characteristics are especially important because of the danger of airborne dispersal from transportation accidents.

The present physical forms of ERDA's neutralized and calcined waste may be unsuitable for long term storage or disposal. Both waste forms are quite leachable and of small particle size. The neutralized wastes have poor steady-state temperature and heat resistant qualities. Only the calcined waste form may be suitable for shipping.

Glass may be the best alternative identified for transportation, long term storage, or disposal. In laboratory tests on several categories of Hanford waste, ERDA has converted neutralized waste to glass forms. Calcined waste has been converted to glass on a larger scale. In tests at Hanford ERDA has converted neutralized sludge to glass. The key to demonstrating the glass conversion technology for ERDA's existing

waste is determining the technical and economic feasibility of making a satisfactory glass, incorporating high-sodium contents (the neutralizing agent) in the waste. Depending on the success of this research, ERDA estimates that the technology for converting neutralized waste to glass could be available as early as 1983 or as late as 1988--with a full-scale operational facility on line anytime from the late 1980s to the late 1990s.

Another long term waste form ERDA is studying is aqueous silicate. The characteristics of this form are not as acceptable as glass. The conversion process involves mixing aluminum silicate clays with neutralized waste, producing a solid, relatively insoluble mineral with the high level waste radionuclides trapped in the aluminum silicate chemical structure. At Hanford ERDA has demonstrated the aqueous silicate process on a laboratory scale with actual waste. Engineering studies are underway to develop this process and the equipment, permitting pilot-scale demonstration and ultimate production scale operation in a time frame similar to the glass conversion process.

At Savannah River ERDA is studying the feasibility of converting its waste into cement or glass for retrievable storage in sealed containers. These processes are in the developmental stage, although laboratory studies with actual waste are underway to evaluate solid waste forms and container materials. Advantages of these forms include low leaching and dispersion qualitites, low care and surveillance requirements, and transportation capability. Disadvantages include subsequent reprocessing difficulties of cement (if later found unsuitable for disposal), the large volume of residual contaminated salt to be stored, and potential pressurization of cement product containers. ERDA expects that the technology might be developed and an operational processing facility placed on line by 1987. A rough ERDA estimate of the cost is $2.4 billion to construct a solidification and storage facility and $7 billion to process existing and future Savannah River high level waste through the late 1990s.

ARE THERE SAFE DISPOSAL ALTERNATIVES?

At Hanford and Savannah River, ERDA is investigating entombment in the storage tanks as an alternative to removing salt cake from high level waste tanks, and possible onsite deep geological disposal as an alternative to transporting the waste to a repository.

Entombment in storage tanks

At Hanford one primary long term high level waste management alternative being evaluated involves continued salt cake

storage in the present tanks. At Savannah River ERDA is considering as waste management options removal and glassification or conversion to cement and entombment of the waste. Under the entombment option, ERDA would convert the salt cake to an insoluble and nondispersable form in the tanks to avoid the hazards and expense of removing the waste and transporting it offsite.

ERDA may be faced with perpetual storage of some or all of its high level waste in the tanks at Hanford and Savannah River. Thus, it must be able to demonstrate that the geological and hydrological characteristics at these sites are well defined; also, that the highly toxic and long-lived radionuclides will remain within or near the surrounding soil area of the tanks so that it is isolated from the environment for the long time period required.

ERDA recently analyzed the environmental impact of existing waste management operations at the Hanford, Idaho Falls, and Savannah River reservations and issued a final environmental impact statement on the Hanford site (dated December 1975) and draft impact statements on Idaho (June 1976) and Savannah River (October 1976). As part of these statements, ERDA includes a discussion of the earth science characteristics of the sites.

ERDA indicates that radioactive waste in the ground at Hanford (high level liquid from tank leaks and other wastes) poses neither present nor potential environmental hazards. ERDA's conclusion is based primarily on information from hydrogeological studies conducted over a period of years, the monitoring network, and mathematical models which predict the paths and rates of subsurface radionuclide migration.

In written comments on the draft environmental statement, USGS and EPA raised technical questions about the data used to support ERDA's conclusion. USGS and EPA determined that uncertainties and deficiencies in the current knowledge about the geological and hydrological conditions at the Hanford reservation prevent a firm conclusion about the future fate of radionuclides in the ground. Both USGS and EPA state that additional hydrological assessments should be made at Hanford. EPA said that the following questions still need to be answered: 20/

--Have the monitoring networks and data accurately documented the extent of underground contamination?

--Do the available hydrogeological studies accurately describe the geological framework of the Hanford site and the movement of water through it?

--Are the waste-soil rock interactions and the movement of waste through the ground sufficiently understood to allow valid conclusions?

--Is contamination presently reaching the offsite environment and, if so, in what quantities?

--Can accurate predictions of the location of waste be made at the present time and in the future?

USGS concluded:

"From the data presented in the draft statement, it can be concluded that very little is known about the groundwater movement in the highly heterogenous aquifer at the Hanford Reservation. A recent comprehensive review* of the groundwater movement, environmental monitoring program, and mathematical models reaches the same conclusion * * *. 21/

ERDA officials told us that they have addressed EPA's and USGS's comments in the Hanford final environmental impact statement yet recognized in the statement that critical earth science information is still needed. ERDA stated it is continuing to study and research the geology, seismology, hydrology, meteorology, and ecology of the area, and plans to publish and make available to the public and Federal agencies these studies when completed.

Since the mid-1950s, AEC and now ERDA have often asked the National Academy of Sciences (NAS)-National Research Council Committee on Radioactive Waste Management for advice on the problems and alternatives of managing radioactive waste. In 1957 and again in 1966 and 1972, the NAS committee told AEC that waste storage in surface tanks was a safe temporary measure. But the committee added that relatively permanent disposal methods must be found. To date ERDA has not decided on how to permanently dispose of its high level waste.

Onsite geological disposal

At Hanford and Savannah River ERDA is considering onsite disposal deep in geological formations as a high level waste disposal alternative. This option appears relatively economical

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*Reference to a recent comprehensive review of the hydrogeological program by two consultants of ERDA: R. A. Deju and W. K. Summers. Their review resulted in several reports to ERDA.

from information developed at Savannah River for its waste but involves many risks.

In 1969 AEC initiated a study at Hanford of deep cavern storage of radioactive wastes. This would be an alternative to its proposed long term storage method of solidifying wastes in tanks. The study was to determine the feasibility of isolating radionuclides in caverns mined in the basalt deep beneath the site. Under this storage method, the salt cake resulting from the intank solidification of liquid wastes would be removed in a dry state. Water would be added in the transfer system and the slurried waste would be pumped to underground caverns 2,000 to 4,000 feet below the surface. AEC deferred this investigation in 1972 when it decided to concentrate on the feasibility of other long term storage alternatives.

The NAS committee also recommended in 1966 that geological testing be done to explore the potential of desert hills near Hanford as waste repositories. 22/ Neither AEC nor ERDA actively pursued this alternative.

From 1961 through 1972, AEC explored the possibility of pumping Savannah River high level waste into bedrock 1,500 to 2,000 feet beneath the site. Test drilling and other geological investigations were conducted.

In the 1966 NAS committee report, the majority of the committee members recommended that AEC discontinue the investigation. 23/ The committee majority believed that injecting wastes into the dry bedrock could contaminate the large overlying aquifer which supplies water to Georgia. The committee minority favored continuing the investigations and AEC proceeded on the project.

By 1972, after much additional research had been done, the NAS committee concluded that the safety of the concept could not be adequately demonstrated without actually sinking an exploratory shaft and tunnels for extensive inplace investigation and recommended such action. At the same time, the committee recommended that AEC investigate alternative high level waste disposal methods in case the bedrock investigation proved unacceptable. 24/ AEC deferred bedrock investigation in 1972 when it decided to develop in more detail other long term storage alternatives. However, ERDA is again considering bedrock disposal as an alternative to solidifying waste in conrete or glass and shipping it offsite.

The State of Georgia opposes any bedrock storage of Savannah River radioactive waste because the fresh water

aquifer beneath the Savannah River site supplies water to all of the southern part of the State. 25/

CONCLUSIONS

The key issues facing ERDA in the long term management of its high level waste are whether or not it can demonstrate technologies to safely remove them from storage tanks, and process them into suitable disposal forms. The problems ERDA must solve vary from site to site.

At Savannah River the generally acceptable condition of the storage tanks may facilitate waste removal operations. This is fortunate since the Savannah River site does not appear, because of its high water table and nearby surface water streams that discharge into the Savannah River, to be suitable for long term storage or disposal. To remove the wastes from the site, however, ERDA must demonstrate a suitable neutralized waste solidification technology and the ability to remove sludge from the bottom of Savannah River tanks.

At Hanford ERDA may not be able to remove all of the high level waste from many of the tanks. Thus, entombment in the tanks is one of ERDA's preferred long term storage (if not its disposal) option. Again, ERDA is fortunate because the Hanford site, with its dry desert climate and deep water table (average about 250 feet below the subsurface), appears to be more suitable for long term storage or disposal. ERDA still must do additional site hydrogeological investigations before selecting this option.

ERDA is in a better position to deal with the Idaho high level waste since this waste was not neutralized and evaporated into a salt cake form but was kept acidic and converted to calcine. This form can be easily removed from the storage bins, converted to glass or other more suitable forms, and shipped offsite for disposal. Here too the hydrogeologial characteristics are not well defined. In 1974 USGS noted that

> "* * * the Snake River Plain of Idaho * * * (which underlies the Idaho laboratory) constitutes one of the most poorly known geologic areas in the United States." 26/

ERDA is currently supporting and has under consideration studies on waste management alternatives and environmental factors, such as surface water transport through sediments, area seismic stability, and area hydrology and geology.

RECOMMENDATION TO THE CONGRESS

After several decades of work, AEC did not, and ERDA has not yet (1) demonstrated acceptable solutions for long term storage and/or disposal of its high level waste and (2) satisfied the scientific community that present storage sites are geologically suited for long term storage or disposal. Therefore, we recommend that the Congress closely monitor, through the annual authorization and appropriation processes, ERDA's program for long term waste management. Specifically, such monitoring should focus on whether the program (1) is progressing in an orderly fashion, (2) is adequately funded, and (3) can be expected to produce answers to the many complex waste disposal problems.

CHAPTER 5

MANAGEMENT OF COMMERCIAL SPENT FUEL

A tremendous backlog of spent fuel (potential high level waste) is accumulating yearly at nuclear powerplants because no commercial reprocessors are operating in the United States. The nuclear industry wants to reprocess spent fuel to reclaim useable uranium and plutonium to refuel reactors.

SPENT FUEL STORAGE

Utilities have designed spent fuel storage pools (water filled basins) at nuclear powerplants which can store one normal refueling (about 1/4 to 1/3 of a reactor core* per year) plus an additional reactor core. Initial plans were that discharged fuel would be stored and cooled for about 6 months and then shipped to a reprocessor.

However, failure to solve reprocessing problems has already resulted in the accumulation of a large backlog of spent fuel at reactor sites. If the situation continues, nuclear powerplants will eventually be unable to discharge a full core into their storage pools. According to NRC, there is no regulatory safety requirement to maintain space in the storage pool for a full core discharge. This is, rather, an operational consideration. NRC officials believe the safety systems within the reactor can adequately protect the core if storage space is not available. The only time a complete core unloading (about 130 metric tons) becomes a regulatory requirement is when the utility has to perform reactor coolant system inservice inspections. Without such a capability, a utility would not be able to carry out such inspections and would be forced to shut down operation. To date, no nuclear powerplant has been unable to carry out such inspections for lack of a full core discharge capability.

By the end of 1983, assuming no reprocessing and no new storage facilities are constructed at reactors and reprocessors, NRC estimates that 23 of the 111 operating reactors will be without a full core discharge capacity.

In addition to having a full core reserve discharge capability, it is also important that the utility have at least enough space to accommodate an annual fuel discharge (1/4 to 1/3 of a full core). Without this space the reactor would

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*The central portion of a nuclear reactor containing all the nuclear fuel.

eventually have to shut down because of fission product build-up in the reactor fuel. NRC projects that by 1983, 2 of the 23 reactors will be in this situation. According to an NRC official, this figure assumes that all 111 operating reactors optimally modify their existing pools' storage capacities through compaction.

According to NRC, at the end of 1976, about 3,000 metric tons of spent fuel had been discharged into nuclear power-plant storage pools and the amount is increasing yearly. Over the next 10 years, if there is no fuel reprocessing, discharged fuel will accumulate at an average rate of 1,700 metric tons per year.

By 1983--a date that ERDA has established to demonstrate waste solidification processes necessary for reprocessing--NRC estimates that about 13,000 metric tons of spent fuel will have been discharged. This fuel will have to be stored to await reprocessing. Barnwell is the only reprocessing plant that could begin operations by 1983. The plant has a 1,500 metric ton/year capacity (the amount of fuel discharged in 1 year from 50 reactors). This capacity will not meet the needs of the utilities since, according to NRC, 111 reactors may be operating at that time.

Options

Because of the backlog of spent fuel and the potential loss of full core and annual discharge capabilities, utilities are adopting several options to increase their storage capacity. Storage capacities are being modified at existing reactors and larger pools are being planned at new reactors. Spent fuel shipment to storage pools within a utility's nuclear power-plant system is another alternative.

As of January 1977, utilities operating 36 of the 63 present nuclear reactors have notified NRC of their intent to increase storage capacities at their reactor pools by reducing the amount of space between stored fuel elements. This is referred to as compaction. (See fig. 2 p. 54 for a sketch of spent fuel storage pools with compacted and standard designs.)

According to NRDC, in a letter to the NRC Executive Director for Operations, placing more spent fuel than originally intended in the storage pools at operating reactors may: 27/

"1. increase the risk of unintended criticality;

2. require the use of boron panels in the pools thereby inhibiting the flow of coolant through the pool; and

3. inrease the amount of decay heat to be removed by the spent fuel cooling system."

We discussed these safety concerns raised by NRDC and other safety issues, such as structural integrity of pools with NRC officials.

They told us that the utilities, as part of their applications to compact fuel, are required to make a safety analysis on criticality, mechanical considerations, material considerations, thermal considerations, storage rack installation considerations, release of radioactive materials, and direct radiation. NRC officials also said that the application is subjected to a safety evaluation and environmental assessment. As of January 1977, NRC had granted 14 utilities permission to compact fuel. NRC officials told us that these actions would result in no significant environmental or safety impacts.

We visited 2 of the 14 utilities that have received license amendments to compact their spent fuel pools. These utilities told us that compaction is a very short term solution. They are planning to ship spent fuel between storage pools within their nuclear powerplant system (sharing) to provide storage space into the mid- to late-1980s. Both utilities indicated that sharing was the next most economical option left open to them after compaction. According to NRC officials, "sharing" is a bad approach in the long run because it leads to a situation where all existing reactors tend to run out of spent fuel storage space at once. These officials believe that a better approach would be to ship spent fuel away from reactors to storage facilities such as the one at General Electric's inoperative reprocessing plant at Morris, Illinois. One of the utilities told us that the sharing option is dependent on the availability of shipping casks which, according to Edison Electric Institute's "Nuclear Fuels Supply" report, will be in short supply in the 1980s. Sharing will increase the cost of operation because the transportation charge the utilities will have to pay for sharing operations will be over and above the fuel shipping cost to a reprocessor--presently estimated to range from $8,000 to $18,000 for truck transport and $14,000 to $22,000 for rail transport per metric ton of spent fuel shipped from the reactor. 28/

Prospective reprocessors have available storage facilities away from nuclear powerplants. The General Electric Company has a storage facility at its inoperative Morris, Illinois, plant. (See fig. 3 p. 55.) In December 1975 the company received an amendment to its fuel storage license to increase its storage capacity from 100 to 750 metric tons of spent fuel. The company submitted another license application in May 1977

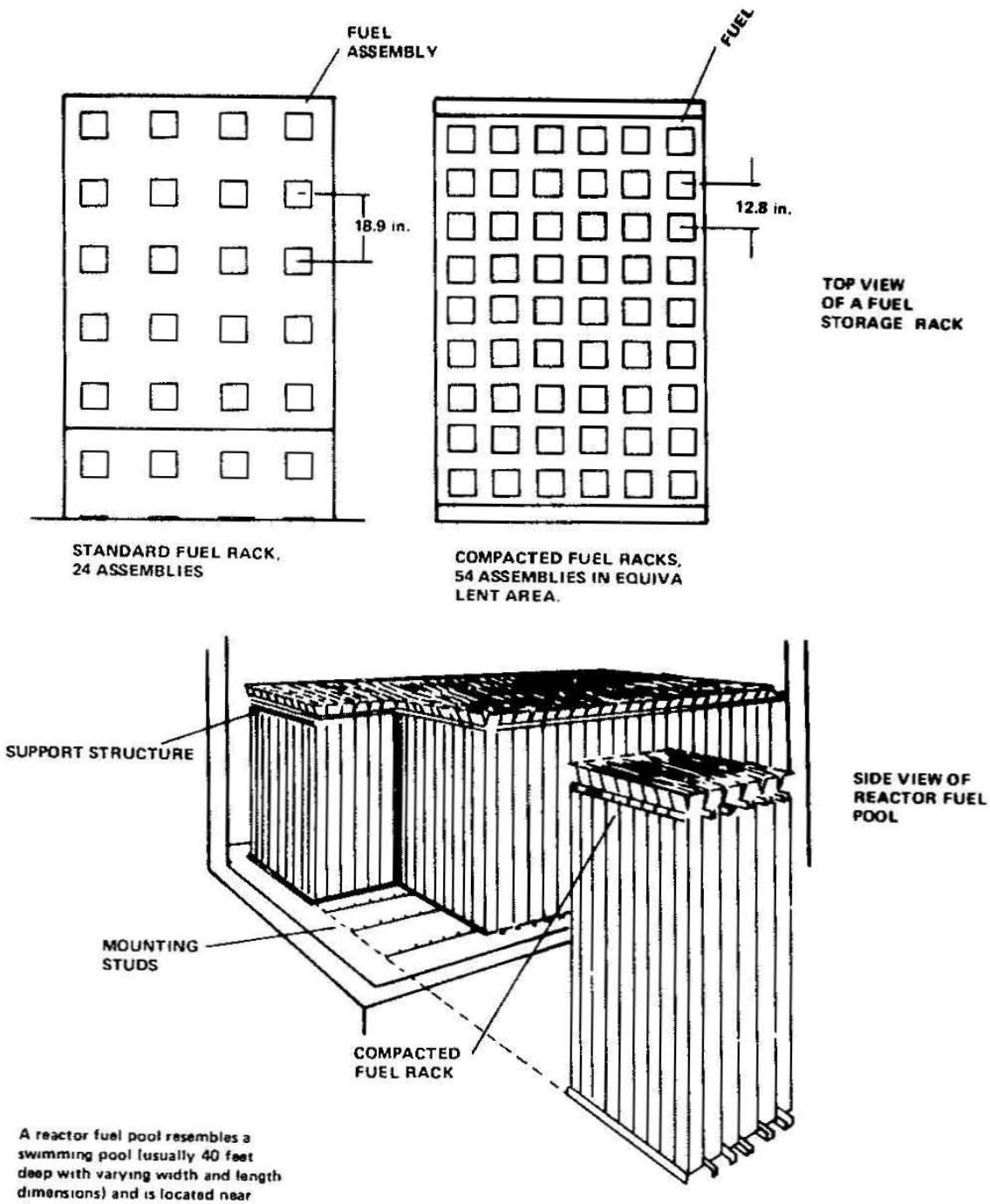

FIGURE 2– SPENT FUEL STORAGE COMPARING STANDARD FUEL RACK STORAGE WITH COMPACTED STORAGE.

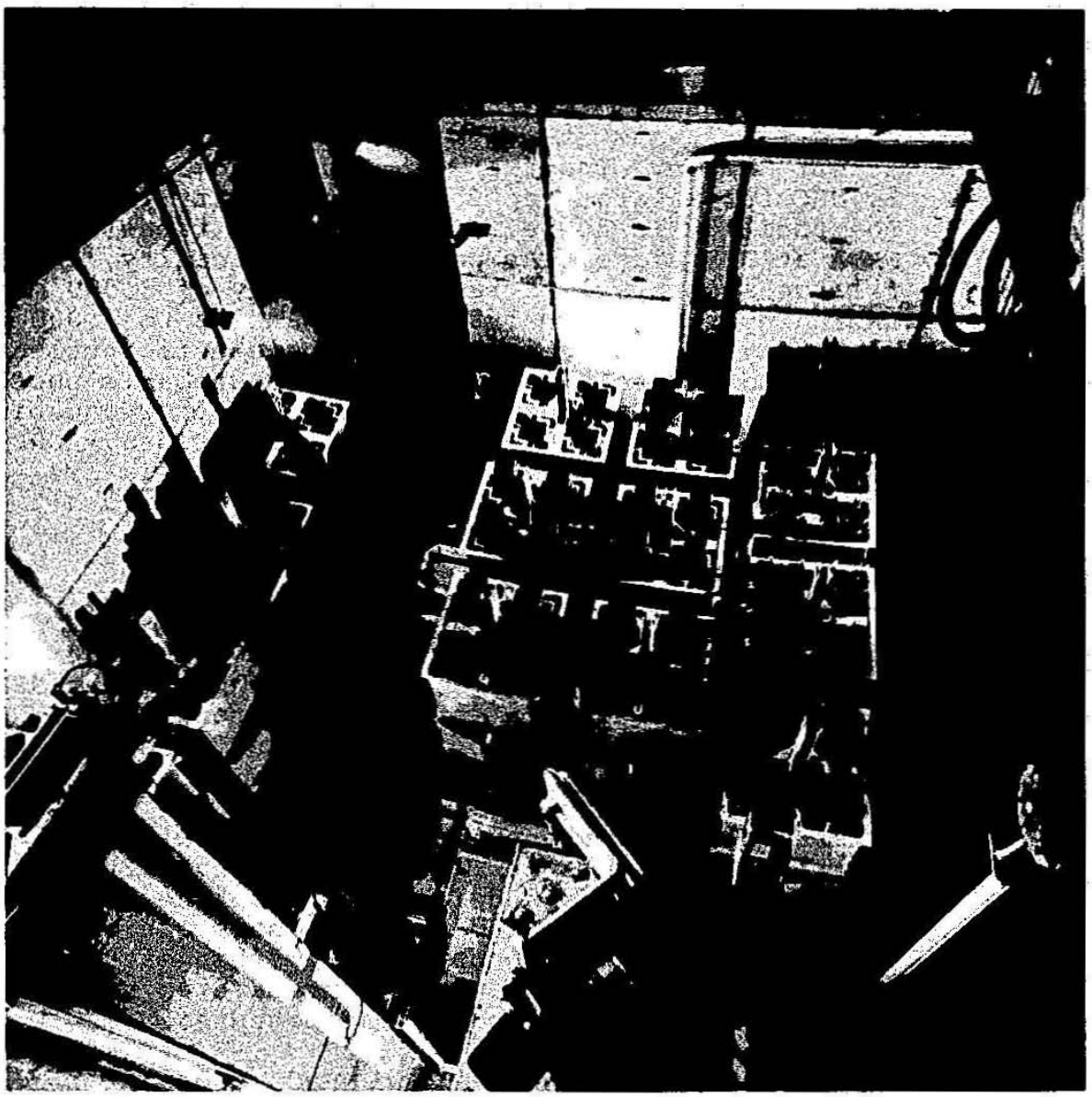

FIGURE 3– PICTURE OF SPENT FUEL STORAGE POOL AT GENERAL ELECTRIC'S MORRIS, ILLINOIS, STORAGE FACILITY.

to increase its capacity by building a new 1,100 metric ton storage pool at the site. This facility is expected to be operational by 1980-81. Both the company and NRC officials told us these expansions will cost millions of dollars.

EXXON Nuclear Company, Incorporated submitted a license application to NRC for a large reprocessing facility in January 1976. The facility is to be located on land transferred to EXXON by ERDA at Oak Ridge. As part of the facility, EXXON is planning a large spent fuel storage capability of 3,000 metric tons beginning operations in 1982 and expanding to 7,000 metric tons by 1984. According to ERDA, with domestic nuclear fuel reprocessing indefinitely deferred and the probable nuclear power growth past 1986, all of this planned storage capability, both at EXXON and General Electric, will be needed. ERDA stated that if these or equivalent plans do not materialize, there will be a significant number of reactors that will not have storage capabilities for scheduled discharges.

OBSERVATIONS ON NRC'S LICENSING PROCEDURES

The National Environmental Policy Act of 1969 and the Council on Environmental Quality's guidelines require that NRC and all Federal agencies prepare a detailed environmental statement on any major Federal action which significantly affects the quality of the human environment.

NRC officials told us that environmental and safety problems associated with expanded spent fuel storage facilities are insignificant and are not major Federal actions. These officials believe that environmental and safety issues can be adequately addressed on a case-by-case basis within each individual licensing review--without having to prepare an environmental impact statement before amending the licenses.

In a May 20, 1975, letter to NRC, an NRDC attorney representing the Businessmen for the Public Interest and the Sierra Club, wrote that:

> "The decision to adopt or not to adopt make-shift solutions to the current shortage of spent fuel storage capacity clearly constitutes major federal action significantly affecting the quality of the human environment. It is certainly well established that federal licensing decisions concerning nuclear waste generation and management, including the generation and storage of spent fuel [which would be managed as waste if recycling is not allowed,] constitute major federal actions significantly affecting the environment for which an environmental impact statement must be prepared

under the National Environmental Policy Act. By the same token, licensing decisions which approve widespread changes in the method of storage, or location or quantity of spent fuel being stored and which in the process permit the additional generation of spent fuel, constitute major federal actions significantly affecting the environment." 29/

This group believes that NRC can legally take no expansion option until a generic environmental impact statement is prepared assessing all reasonable alternatives, their environmental impacts, and the effect these actions will have on the central effort to develop a safe, ultimate disposal method for radioactive wastes. The group requested that NRC defer licensing any expansions pending the generic statement's completion.

Because of this intervention, NRC published a policy statement in the Federal Register on November 14, 1975, stating that it would prepare a generic environmental impact statement on the handling and storage of spent light water power reactor fuel. In the policy statement, NRC stated that it has:

"* * * concluded that there should be no such general deferral, of expansion of spent fuel capacity and that these related licensing actions may continue during the period required for preparation of the generic statement * * *." 30/

According to an NRC official, the draft generic statement is scheduled for completion by the fall of 1977 with a final statement to be completed in early 1978. As of January 1977, NRC had amended licenses at 14 operating reactors and one reprocessor to store additional spent fuel. For each such amendment, NRC staff prepares an environmental appraisal to support a negative declaration that an environmental impact statement is not necessary because the individual action will not significantly affect the quality of the human environment.

In reaching its interim licensing determination on each case, NRC applies, weighs, and balances five criteria. These are:

--Will the increased storage capacity change a facility's mode of operation? This action must be solely for the independent use of a particular nuclear facility or station.

--Would the taking of the licensing action be significant in cost and use of natural resources so as to preclude

its use by other utilities or prevent the utility from adopting another alternative if proven undesirable?

--Can the licensing action as proposed be adequately addressed within each individual application without overlooking any cumulative environmental impact?

--Can any technical safety issue that may arise be resolved in the course of an individual licensing application review?

--Would a deferral or severe restriction on the license result in great harm to the public interest--such as forcing a reactor shutdown thereby reducing the utility's service margins to a point where reliable service would be in jeopardy?

We reviewed 5 of the 14 license amendments at existing reactor pools. With regard to the third criteria, NRC believed that the environmental impact of individual licensing actions were insignificant. In regard to technical safety issues, the fourth criteria, NRC officials told us that storage pools are so conservatively designed that the reduction in safety margins attributed to greater amounts of stress, radioactivity, and heat from stored fuel would be minor. With regard to the fifth criteria, two of the five reactor amendments we reviewed showed that the reactors did not have any fuel stored in their pools and thus were not in jeopardy of being shut down. In these cases NRC justified acting on the utilities' request since additional fuel storage capacity could be needed in the future to permit continued plant operation if some safety problem subsequently developed with the fuel that required its removal from the reactor. Under these conditions, unless there was sufficient storage capacity at the reactor site at the time to permit unloading of the full reactor core, reactor operations would have to be suspended.

CONCLUSION

NRC has proceeded to issue amendments for increased storage before the generic environmental statement's completion because it is NRC's judgment that the impacts are insignificant. We believe that until NRC completes its environmental impact statement, it should limit through license restrictions the amount of spent fuel that can be put in storage pools to no more than the amounts authorized under the initial operating license, unless the utility can prove to NRC's satisfaction that it would be forced to shut down operations if increased storage at that site was not allowed. In addition, NRC should proceed with top priority in completing the impact statement, so that unanswered questions can be resolved concerning

increased fuel storage at reactor pools. We believe that NRC's interim licensing for increased storage capacity may raise public suspicions and concern, because the overall environmental effects--including safety--of such actions have not yet been fully determined. As a result, it is of the utmost importance that NRC complete and issue the generic environmental impact statement as soon as possible.

RECOMMENDATION TO THE CHAIRMAN, NRC

We recommend that NRC complete and issue its generic environmental impact statement on spent fuel as soon as possible, and in the interim, limit through license restrictions the amount of fuel which can be stored in reactor pools to no more than was originally licensed for, unless the reactor would be forced to shut down operations, if increased storage at that site was not allowed.

AGENCY COMMENTS

NRC disagreed with this recommendation, citing several operational and procedural reasons. While we do not take exception to NRC's reasons, we still believe that our recommendation should be implemented because NRC has not fully determined the overall environmental effects from these individual licensing actions, nor has it compared these actions to other alternatives for spent fuel storage, such as storage at centralized storage facilities away from nuclear powerplants. Such an assessment is the objective of the generic statement NRC is now preparing. Until this assessment is completed, we believe NRC should restrict the amount of spent fuel to be stored in a reactor pool. To do otherwise may raise public suspicion and concern that NRC has made prejudgmental findings on the overall environmental effects of such individual licensing actions, and as such, could possibly cast doubt on the integrity of the generic statement when issued. Furthermore, these individual actions could potentially foreclose the adoption of other storage alternatives that may be as good or better than allowing each utility to increase their storage capacities at the reactor site.

CHAPTER 6

SCOPE OF REVIEW

We obtained the information in this report by examining planning documents, environmental reports, geologist reports, correspondence, and other documentation, and by interviewing officials at

--commercial nuclear powerplants;

--ERDA headquarters, Germantown, Maryland;

--NRC headquarters, Bethesda, Maryland;

--ERDA operations and contractor offices at Oak Ridge, Tennessee; Albuquerque, New Mexico; Richland, Washington; Savannah River, South Carolina; and Idaho Falls, Idaho; and

--USGS headquarters, Reston, Virginia.

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28/ Steyn, J. J., R. B. A. Licciardo and J. T. Stone. "Spent Fuel Transportation." Appendix to the report of the Edison Electric Institute on Nuclear Fuels Supply, New York, New York. March 1976. App. V, pp. 9 and 10.

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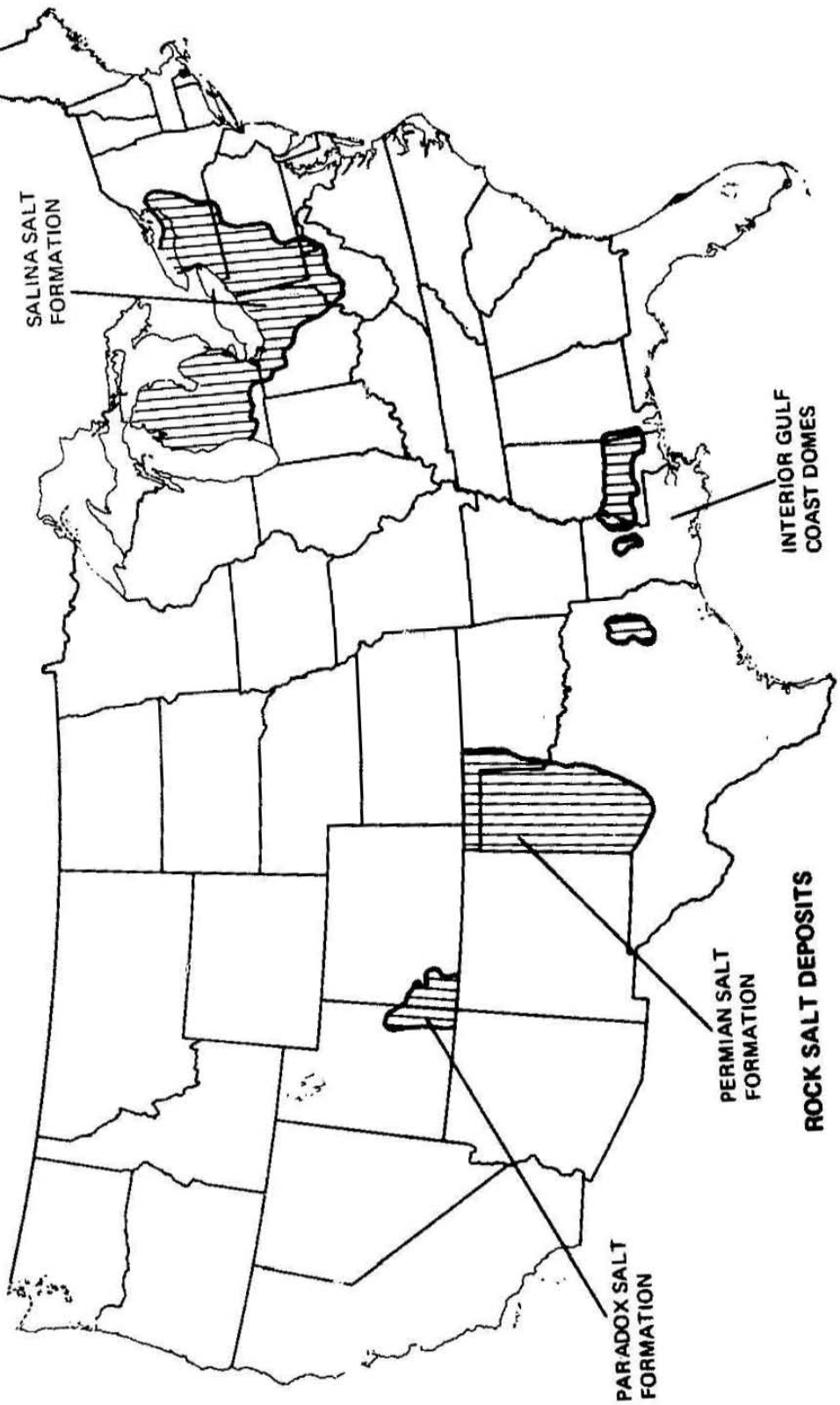
APPENDIX II

GENERAL AREAS OF INTEREST FOR RADIOACTIVE WASTE DISPOSAL
WITHIN THE CONTINENTAL UNITED STATES



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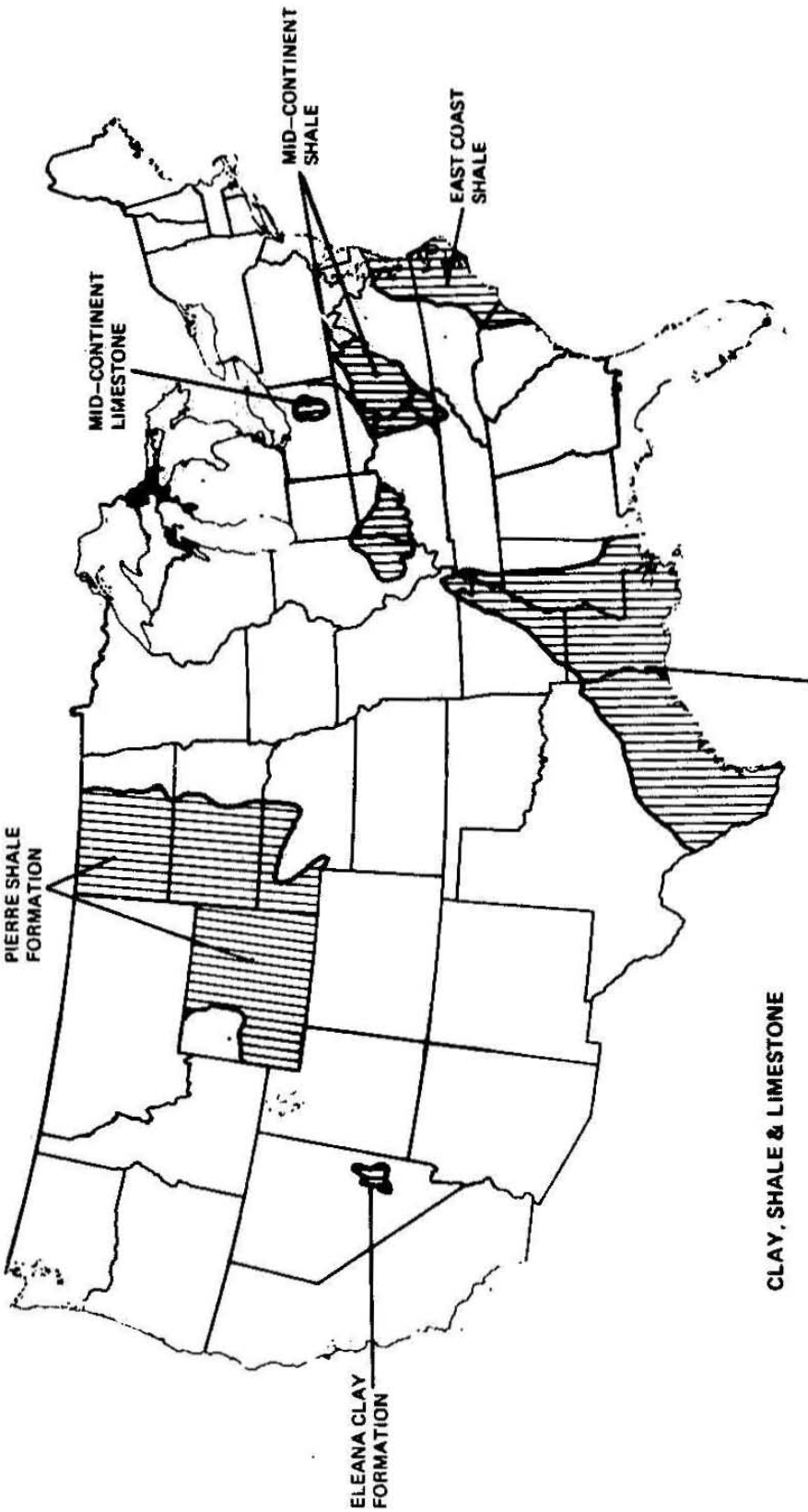

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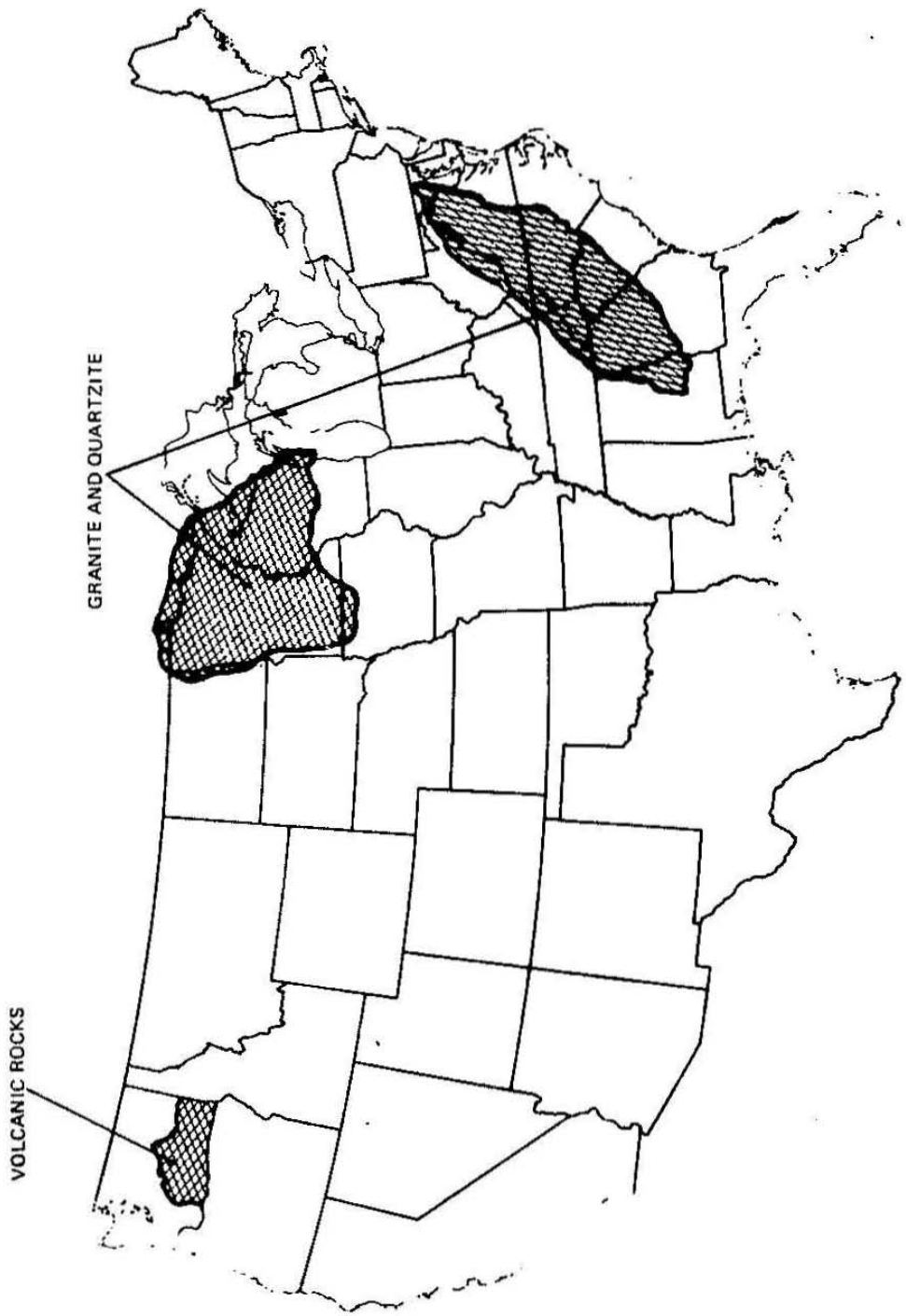

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
WASHINGTON, D.C. 20545

July 13, 1977

Honorable Elmer B. Staats
Comptroller General of the
United States
General Accounting Office

Dear Mr. Staats:

We appreciate the opportunity to review and comment on the draft of the proposed GAO report entitled "Nuclear Energy's Dilemma: Safely Disposing of High Level Radioactive Wastes." We have reviewed the draft with members of your staff and we understand that a number of changes and clarifications which we suggested will be made. However, there remain some significant aspects of the draft report which we could not satisfactorily resolve in our meetings with your staff and we, therefore, request that our views be included in appropriate sections of your final report.

For example, the draft report is somewhat unbalanced in that it is based on observations made by GAO in December 1976, three months after a massive acceleration of the program when organizational activities were still underway. Consequently, as indicated to members of your staff, the recommendations on page xxiii have indeed been addressed within this agency and we have been doing work in these areas since early this year; but these actions are not acknowledged in the report.

ERDA and the Congress recognize the urgency and need to provide a demonstrated solution to the radioactive waste management problem. The budget proposed by ERDA in January 1976 requested a significant increase of funding for the program and Congress provided even more funds than requested in recognition of the serious need.

However, successful resolution of some of the issues involved depends heavily on public confidence; it is our feeling that a critical report with heavy emphasis on events of the past and no acknowledgment of current efforts, will raise an unnecessary sense of concern over problems already solved or currently in process of being solved and may hinder our efforts to implement final solutions.

In addition, and as indicated to your staff, we strongly disagree with the proposed GAO recommendation that the Congress extend the authority of the Nuclear Regulatory Commission (NRC) to provide for independent assessment of Energy Research and Development Administration (ERDA) facilities, including research and development facilities, intended

for (1) the temporary storage and/or long-term storage or disposal of commercial and ERDA produced transuranic contaminated waste, (2) facilities for the temporary storage of ERDA high level wastes, and (3) the temporary storage and/or long-term storage or disposal of commercial spent fuel. We view the two recommended alternatives pertaining to NRC assessment of ERDA activities as being tantamount to subjecting ERDA facilities and programs to licensing by NRC. Some of the reasons for our disagreement are as follows:

A. The provisions of the Energy Reorganization Act (P.L. 93-438) and the Act's legislative history clearly indicate Congress' intent, after its careful deliberation, to give ERDA responsibility over its own facilities. Section 202 of the Energy Reorganization Act clearly reflects Congressional recognition of the differences in ERDA and NRC facilities by granting NRC licensing and related regulatory authority over a few specified ERDA facilities having strong commercial implications. These ERDA facilities are: certain demonstration nuclear reactors built for the express purpose of demonstrating the commercial feasibility of such a power reactor concept for the generation of electricity in an electric utility system; facilities used primarily for the receipt and storage of high level radioactive wastes resulting from activities which are licensed; and retrievable surface storage facilities and other facilities authorized for the express purpose of subsequent long-term storage of high level radioactive waste generated by the Administration, which are not used for, or are part of, research and development activities.

B. The GAO recommendation apparently disregards the differences in the basic missions of NRC and ERDA for which the two organizations have responsibilities, and for which each organization has developed and employs a different expertise.

C. We believe that implementation of GAO's recommendation would be detrimental to both the NRC and ERDA. It could result in the slowdown or halting of experimental projects pending the promulgation of regulations and standards by NRC, and would require some duplication by NRC of the necessary expertise to regulate the waste management activities of ERDA. ERDA has unique expertise in the storage, treatment, and transportation of radioactive wastes of ERDA, while NRC's experience in these areas is somewhat limited.

It appears that GAO has used this report, which is basically directed toward the problems associated with disposal of high level radioactive waste, to address the much more comprehensive matter of independent assessment and to extend NRC's authority to include ERDA's waste

research and development activities. However, in so doing GAO has not provided a discussion of the many issues and considerations involved, nor established a basis for the recommendation. We are, therefore, of the opinion that GAO's recommendation is unsupported and represents an opinion based on preference and not supporting facts.

We believe that the concept of independent assessment in ERDA has merit from the standpoint of strengthening assurances to the Administrator and the general public as to the adequacy of health and safety aspects of nuclear operations. ERDA has a comprehensive study underway to determine how the present assessment activity could be restructured within ERDA to provide greater independent assurance to the general public.

Sincerely,

Robert W. Fri
Acting Administrator

APPENDIX IV

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

June 20, 1977

Mr. Monte Canfield, Jr.
Director
Energy and Materials Division
United States General
Accounting Office
Washington, D.C. 20548

Dear Mr. Canfield:

We have received and reviewed a draft of the GAO report entitled "Nuclear Energy's Dilemma: Safely Disposing of High-Level Radioactive Wastes," and GAO has received our detailed comments separately.

There are several conclusions and recommendations in the report with which NRC does not agree. These can be summarized briefly as follows:

1. A dilemma is a problem for which there can be no satisfactory solution. NRC is not currently able to concur with this judgement which is expressed in the report title.

2. The report indicates that GAO does not think NRC has the authority under current law to regulate the disposal by the U.S. Energy Research and Development Administration (ERDA) of spent fuel should there be no reprocessing and spent fuel would have to be disposed of like reprocessing wastes. Should spent fuel become a waste, the better legal view would be that NRC would have authority to define it as such and regulate its disposition by ERDA under Section 202 of the Energy Reorganization Act of 1974.

   We do not regard the definition of high level waste in 10 CFR Part 50, Appendix F as the exclusive definition of high level waste for purposes of Section 202 of the Energy Reorganization Act of 1974.

3. The report indicates that GAO does not believe NRC has the authority to regulate ERDA waste repositories in the early ("pilot plant") stages. NRC disagrees. We are planning to start licensing procedures (and ERDA has agreed to submit an application) in the early stages of the repository program. The start up and testing of repository sites which ERDA hopes to use for permanent repositories is not considered by NRC to be research and development.

4. Throughout the report, references to a two year licensing review period imply that a corresponding program delay will result. This is not necessary. License applications will be submitted in advance of the required decision date and work may progress in the interim. NRC is developing licensing procedures specifically adapted to unique requirements of a repository and the steps in its development. We do not intend that a repository be licensed simply as an ordinary materials license under 10 CFR Parts 30 and 70.

5. GAO recommends licensing procedures similar to reactor licensing procedures. NRC agrees that the review should be similar in depth and thoroughness. However, as indicated in number four above, we are developing procedures adapted to the actual steps which will be followed in developing a repository.

6. GAO recommends that the period of retrievability be longer than 5 to 10 years. The concern expressed is that the data gathered will not be sufficient to make long-term extrapolations of risk. This recommendation is an unwarranted prejudgement of the quality of data to be gathered. No short term observations, 10, 50 or even 100 years will provide the basis for confidence in prediction of tectonic changes or events in a geological time frame. This is a two edged argument which can logically lead to no period of retrievability. Obtaining data for such a prediction is not the purpose of testing during a period of retrievability. The purpose is to obtain information about the interaction of the waste emplacement with the geologic formation. (Such as heat transfer properties). Such information can be determined in a short time frame. Whether the desired information will be obtained will depend on the quality of the data. This data quality should not be prejudged. If warranted, NRC will impose a period of retrievability of a length determined by the additional information to be derived.

7. GAO recommends that, pending issuance of generic environmental impact statement on spent fuel, the amount of fuel that can be stored in a reactor pool should be restricted to the originally licensed storage capability unless the reactor would be forced to shutdown if increased storage at that site were not allowed. NRC disagrees. Our reasons include: (1) modifications to increase spent fuel storage capability can be done with less personnel exposure to radiation when the pool has less than a full complement of spent fuel; (2) regardless of the amount of storage available, the added storage capability will not be used until the need for storage exists--storage capability does not cause a utility to generate a larger quantity of spent fuel just to

fill the pool; (3) our review and conclusions prior to authorizing construction of pool modifications already include consideration of increased storage needs (Under the GAO recommendation, the NRC and the licensee would be required to perform two licensing reviews of this issue instead of one. Such duplication of effort is not appropriate. Moreover, all concerns over this issue should be resolved prior to granting approval to modify the storage capability in the first place.); and (4) the Commission stated in the Federal Register on September 10, 1975, that approvals for pool modifications can be granted, pending issuance of the generic environmental impact statement, provided that this would be consistent with consideration of five specific factors. One of the factors specifically covers the need for the increased storage capability. All of the factors are considered in the Environmental Impact Appraisal issued by the NRC in support of every licensing action on a storage pool modification, and are fully adequate to insure compliance with NEPA.

Sincerely,

Lee V. Gossick
Executive Director for Operations

PRINCIPAL OFFICIALS RESPONSIBLE FOR ADMINISTERING ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office From	To
ATOMIC ENERGY COMMISSION		
CHAIRMAN:		
Dixy Lee Ray	Feb. 1973	Jan. 1975
James R. Schlesinger	Aug. 1971	Feb. 1973
Glenn T. Seaborg	Mar. 1961	Aug. 1971
GENERAL MANAGER:		
Robert O. Thorne (Acting)	Jan. 1975	Jan. 1975
John A. Erlewine	Jan. 1974.	Dec. 1974
Robert E. Hollingsworth	Aug. 1964	Jan. 1974
DIRECTOR OF REGULATION:		
L. Manning Muntzing	Oct. 1971	Jan. 1975
Harold L. Price	Sep. 1961	Oct. 1971
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION		
ADMINISTRATOR:		
Robert W. Fri (Acting)	Jan. 1977	Present
Robert C. Seamans, Jr.	Jan. 1975	Jan. 1977
NUCLEAR REGULATORY COMMISSION		
CHAIRMAN:		
Joseph M. Hendrie	Aug. 1977	Present
Marcus A. Rowden	Apr. 1976	June 1977
William A. Anders	Jan. 1975	Apr. 1976
EXECUTIVE DIRECTOR FOR OPERATIONS:		
Lee V. Gossick	Jan. 1975	Present

(30254)