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Report to Rep. Leo J. Ryan, Chairman, House Committee on Government Operations: Conservation, Energy and Natural Resources Subcommittee; by Robert F. Keller, Acting Comptroller General.

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Congressional Relevance: House Committee on Government Operations: Conservation, Energy and Natural Resources Subcommittee.
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The Nuclear Fuel Services, Inc. (NFS) plant at West Valley, NY, the only commercial nuclear reprocessing facility operated in the United States, was closed in 1972 for modifications aimed at limiting effluent releases, reducing personnel exposures to radiation, and increasing plant capacity. Recommendations: To help in formulating an appropriate waste disposal technology for this waste, the Nuclear Regulatory Commission (NRC) should: develop waste performance criteria; develop criteria for decommissioning waste storage facilities; identify alternative processes for waste management and determine their technical and economic feasibility; characterize the physical and chemical properties of this waste sludge; proceed on a priority basis in the current analyses to assess the seismic integrity of the waste tanks; include a review of the stress relieving data in determining tank life to assure that the proper techniques were used; and assess the condition of the vault system and the surrounding soil character. In addition, NRC should: require New York State to report its plans on the future use of the West Valley site; prepare NFS and State guidelines for decommissioning the plant and site and require a plan from them for decommission and correcting problems at the low-level waste burial site; and require the State to set up long term care requirements for the site. (Author/QM)

REPORT TO THE CONSERVATION, ENERGY, & NATURAL RESOURCES SUBCOMMITTEE, HOUSE COMMITTEE ON GOVERNMENT OPERATIONS

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

Issues Related To The Closing Of The Nuclear Fuel Services, Incorporated, Reprocessing Plant At West Valley, New York

EMD-77-27

MARCH 8, 1977

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

B-151475

The Honorable Leo J. Ryan
Chairman, Subcommittee on
Conservation, Energy,
and Natural Resources
Committee on Government Operations
House of Representatives

Dear Mr. Chairman:

In response to your request of October 19, 1976, here are the results of our study of the issues related to the closing of the Nuclear Fuel Services, Incorporated fuel reprocessing facility, West Valley, New York. A summary of the study was provided in testimony given by the Director of our Energy and Minerals Division before your subcommittee. This report consists of the Director's statement and an enclosure which presents in greater detail our findings.

As requested by your office we did not obtain formal agency comments on a draft of the study. We did furnish, however, copies of the draft to responsible officials of the entities involved. Their comments and views were informally obtained by discussion and given consideration in finalizing the study.

The report contains a number of recommendations to the Administrator of the Energy Research and Development Administration and to the Chairman of the Nuclear Regulatory Commission aimed at speeding up the decision-making process for finding acceptable solutions for disposing of radioactive waste stored at the West Valley plant. Officials of the Energy Research and Development Administration and the Nuclear Regulatory Commission generally agreed with these recommendations.

Sincerely yours,

Acting Comptroller General
of the United States

Enclosure

UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

FOR RELEASE ON DELIVERY
Expected at 9:30 a.m.
Tuesday, March 8, 1977

STATEMENT OF
MONTE CANFIELD, JR., DIRECTOR
ENERGY AND MINERALS DIVISION
BEFORE THE
SUBCOMMITTEE ON CONSERVATION, ENERGY & NATURAL RESOURCES
HOUSE COMMITTEE ON GOVERNMENT OPERATIONS
ON
ISSUES RELATED TO THE CLOSING OF THE
NUCLEAR FUEL SERVICES, INCORPORATED
REPROCESSING PLANT AT WEST VALLEY, NEW YORK

Mr. Chairman and Members of the Subcommittee:

We welcome the opportunity to be here today to discuss with you our report on the issues related to the closing of the West Valley nuclear reprocessing plant operated by the Nuclear Fuel Services, Incorporated (NFS). The West Valley site was the only commercial reprocessing facility that operated in the United States. The site consists of a reprocessing plant, four high-level liquid storage tanks containing about 612,000 gallons of waste, a high-level burial ground containing about 100,000 cubic feet, and a low level burial ground containing about 2 million cubic feet of solid radioactive wastes. NFS ceased operations in 1972.

The issues surrounding nuclear reprocessing and waste management are both important and complex. Their satisfactory resolution involves analysis of complex social, political,

and institutional questions. We cannot, based on our work at West Valley, offer a comprehensive perspective on these issues nor can we offer definitive means of resolving many of the issues relating to the closing of this plant. We feel, however, that the results of our work deal with many of the aspects of these issues in sufficient depth to be useful to this Subcommittee and others in the Congress in deliberations on this important matter.

Let me briefly highlight some of the major observations contained in our report.

--While the Nuclear Regulatory Commission (NRC) believes that the waste tanks at West Valley are in good condition, estimating tank life is unpredictable. We believe more work needs to be done on a priority basis before a reasonable judgment can be made that the waste tanks are safe. Specifically, such work should consist of (1) reviewing quality assurance data to determine that proper techniques were used in constructing the tanks, (2) assessing the present condition of the tank vault system, and (3) assessing the characteristics of the soil surrounding the vault system.

--The waste tanks may not meet current NRC seismic criteria. It is not known whether the tanks would rupture in case of an earthquake of the magnitude

likely for the area. The structural integrity of the NFS tanks was questioned by AEC in 1970 because the design of the tanks--while supposedly meeting building code requirements at the time of construction--was not acceptable for its existing seismic requirements. These requirements have since been upgraded even more.

--The physical and chemical characteristics of the high-level waste sludge contained in the tanks at West Valley are not completely known. Without such knowledge it will be virtually impossible to select an appropriate removal and solidification process for this waste sludge. Removing the sludge from the tanks presents an immense problem, because of design obstructions in the bottom of the tanks.

--The Energy Research and Development Administration (ERDA) is developing technology for solidifying and disposing of nuclear waste. Information from ERDA's effort is not likely to be available for 2 to 5 years, nor is criteria under which NRC will approve long term management processes. Both of these efforts must be completed before decisions on NFS waste management alternatives are made.

--It is unlikely that the West Valley reprocessing plant will ever operate again because (1) of the substantial costs ($615 million) to make the necessary modifications to expand the plant's capacity and to meet current NRC standards and (2) the plant design may not readily be susceptible to modifications which would lower the radiation exposures to workers to a level acceptable to NRC because certain routine maintenance operations require plant personnel to work in radioactive areas.

--To date, NFS and the New York Energy Research and Development Authority have not developed plans to decommission the West Valley site. Before such decommissioning plans can be prepared, NRC needs to develop decommissioning guidelines for reprocessing plants NRC has been working on such guidelines for over 6 years, and does not know when they will be completed. It is important that guidelines be developed so that reliable cost estimates of decommissioning and long term perpetual maintenance of radioactive material at reprocessing plants such as West Valley can be developed.

Our observations directly relate to the three key questions now confronting the State of New York, NRC, and ERDA.

What can be done with the reprocessing plant and wastes? How much will it cost? Who will be responsible?

Before decisions can be made on what to do with the high-level liquid wastes, ERDA has to do years of additional research. Furthermore, before reprocessing plant and burial ground decommissioning plans can be developed, the State of New York will have to decide on the future use of the West Valley site, and NRC will have to develop decommissioning guidelines.

Because decisions have yet to be made on plant and site decommissioning, NFS cost estimates for waste disposal and decommissioning are not available. An ERDA contractor has estimated that the cost of waste disposal at NFS would range from $58 million to $567 million. The contractor study did not cover the cost of decommissioning the plant. However, the contractor has estimated that it would cost from $19.7 million to $65.7 million to decommission the Barnwell reprocessing plant. The estimates for waste disposal at NFS could be misleading because of the use of questionable cost data, errors in computations, and inconsistent pricing and computation methods. For example, estimated costs for two carbon steel tanks were about $2 million; however, actual construction costs for similar tanks built by an ERDA contractor were $6.5 million.

The key to estimating decommissioning costs is the decision on the future use of the West Valley site.

Returning portions of the reprocessing plant site to its natural condition would require completely dismantling the plant and decontaminating the site. The areas used for the high-level burial ground and the low-level waste burial grounds will require perpetual care, and thus preclude returning the other portions of West Valley to its original state.

By contractual agreement, the State of New York is ultimately responsible for managing the radioactive waste at the site, and for care and disposal of the wastes. However, the State maintains it is incapable of resolving the many technical issues without substantial assistance from the Federal Government.

The rest of my testimony will address what must be done before the NFS issues can be resolved. It will also discuss the question of who is responsible.

NFS NEEDS TO CONFIRM THE SAFETY OF THE WASTE TANKS

From what is known about the high level waste tanks, NRC has concluded that they are in good condition and can store the waste for the foreseeable future. Although NRC is currently assessing the tanks' capability to withstand an earthquake of the intensity postulated for the area, we believe that more work is needed to confirm the safety of the tanks. For example, in April 1965 an accumulation of water in the

vault excavation area floated the concrete vaults, with the steel tanks inside them, out of the ground as much as 3 or 4 feet before they settled back to new positions. This placed high stresses on the concrete and reinforcing steel. Inspections of the vault now used for the spare tank revealed several cracks to the bottom of the vault and the roof. The bottoms of both vaults were resupported with concrete. At the time of the incident, the construction contractor concluded that all of the stress was placed on the vaults and not on the steel tanks inside. Although the contractor did not submit any inspection data or engineering analyses to support this conclusion, AEC agreed, and did not require any re-examination of the welds on the steel tanks.

We believe NRC should assess the condition of the vaults, in view of the vault floatation incident. In addition, NRC should assess the soil characteristics to determine whether it would contain the wastes in the event of a breach in the tank system.

NRC SHOULD ANALYZE THE HIGH-LEVEL LIQUID WASTE PROPERTIES

The high-level waste stored in one tank was "neutralized." Neutralizing the chemically acid waste permitted NFS to store the waste in tanks constructed from carbon steel, rather than more expensive stainless steel. Neutralization caused some of the radioactive materials--including most of the long-lived

plutonium and strontium 90--to precipitate out of the waste solution, settle on the tank bottom, and harden into a sludge. ERDA has estimated that about 30,000 gallons of sludge is on the bottom of the large waste tank. The properties of this sludge are not completely known; neither NFS nor NRC is planning to analyze the sludge at this time. Knowledge of the properties of this sludge is important to develop techniques for removing it and converting it to a form suitable for disposal.

We believe that NRC should attach priority to analyzing the NFS waste sludge properties.

NRC SHOULD DEVELOP NFS HIGH-LEVEL LIQUID WASTE DISPOSAL CRITERIA

ERDA is now developing several alternative processes for disposing of high-level liquid waste. Before any of these processes could be selected for application to the NFS waste, however, NRC must establish waste performance criteria. NRC's only present criteria is that the liquid waste be converted into a dry solid form and be shipped to a Federal repository not later than 10 years after it is generated. However, NRC regulations exempted the NFS waste from this requirement because the technology for solidifying neutralized waste was not developed. NRC intends to establish NFS waste disposal criteria at some future time by means of its rulemaking procedure.

We believe NRC should establish this performance criteria on a priority basis to foster the development of technically and economically feasible waste disposal processes.

NFS WASTE RETRIEVAL AND SOLIDIFICATION PROCESSES HAVE NOT BEEN DEMONSTRATED

ERDA is conducting research on methods for extracting neutralized waste sludge from the bottoms of its own waste tanks. The research may have application to the sludge in the NFS waste tank. A prerequisite to determining if the waste sludge can be removed from the tank, however, is identifying its properties and assessing the condition of the steel tank. Removing all of the sludge from the NFS tank will be difficult if not impossible with processes now being considered, because of physical obstructions in the tank. Because of the long-lived radionuclides present, any residual sludge will present a separate problem in decommissioning the reprocessing plant site.

Perpetual tank storage of the NFS high-level liquid waste would not satisfy NRC and ERDA commitments to solidify wastes and dispose of them in a Federal waste repository. Several potential solidification technologies are under investigation, but none have yet been demonstrated. Each of these technologies requires additional research and development and will not be available for application to NFS waste for many years.

NRC should develop criteria for decommissioning the waste tanks.

DECOMMISSIONING THE NFS PLANT AND BURIAL GROUNDS

The future use of the West Valley land is the key factor in selecting a decommissioning method. These methods vary from dismantling the facilities and completely cleaning up the area to continuous surveillance and a minimum removal of radioactivity. Costs of decommissioning the NFS reprocessing plant under any of the alternatives are not known at this time, nor can they be developed until NRC establishes decommissioning guidelines and the State of New York decides on the future use of the site.

Perpetual care of the high- and low-level solid waste burial grounds will be required for centuries because of the long-lived, highly toxic radionuclides buried there. Therefore, before proceeding with site decommissioning, it is important that long term care requirements be identified, remedial action be taken to correct known deficiencies at the low-level burial ground, and a sufficient perpetual care fund be established.

At the low-level burial site, there is a problem with water seepage from the surface of three burial trenches. NFS, with the State of New York's approval, has started a program to temporarily control this problem, and the State has contracted

for a study of long term control methods. Ten alternative methods identified to date would all require periodic equipment maintenance or replacement. The State's consultant has recommended further investigations before a decision is made on long term corrective actions.

The State of New York has required NFS to contribute to a fund to cover long term care of both the burial grounds and the high-level liquid waste. The balance of this fund is presently about $2.9 million. It is obvious to us that the fund is wholly insufficient to cover the cost of remedial action at the burial sites, decommission the reprocessing plant, and either dispose of the high-level liquid waste, or perpetually store the waste at West Valley.

WHO WILL BE RESPONSIBLE?

Ultimate legal responsibility for care and disposal of the radioactive wastes at West Valley belongs to the State of New York. Although NFS is presently responsible for care of the facilities and wastes at West Valley, it can voluntarily surrender this responsibility to the State's Energy Research and Development Authority before its agreements with the Authority expire. This transfer would be conditional on the Authority finding that the facilities are in good condition. When NFS' agreements with the Authority expire on December 31, 1980, the transfer would take place, assuming NRC's approval.

We should point out that any readjustment of NFS' technical and financial responsibilities must have NRC approval, because it requires an amendment to the facility license. For this reason, it is possible that NRC could place further restrictions on the surrender; for example, additional storage facility requirements.

The New York Energy Research and Development Authority has asked ERDA to completely take over the West Valley site. ERDA has not accepted this request, but has agreed to discuss West Valley issues with the Authority.

It appears to us that, at a minimum, the Federal Government will have to provide technical assistance to New York to resolve the outstanding waste management issues at West Valley.

We are making a number of recommendations aimed at speeding up the decision-making process for finding acceptable solutions to the issues at West Valley. To assist in developing an appropriate waste disposal technology for the NFS waste we recommend that NRC

--Develop waste performance criteria.

--Develop criteria for decommissioning waste storage facilities so that the impact of residual sludge in the NFS tank can be evaluated.

--Identify alternative processes for NFS waste management and determine their technical and economic feasibility so that a recommended process can be developed and implemented.

--Characterize the physical and chemical properties of the high-level waste sludge.

Although the Commission is studying certain aspects of the condition of the high-level waste tanks, other studies are needed. We recommend that NRC

--Proceed on a priority basis in the current analyses to assess seismic integrity of the waste tanks.

--In its plans to determine tank life, include a review of the stress relieving data for assurance that the proper techniques were used.

--Assess on a priority basis the present condition of the vault system and the soil characteristics surrounding the vaults.

With regard to decommissioning the reprocessing plant and burial grounds, we recommend that NRC

--Require New York State to report its plans on the future use of the West Valley site.

--Prepare for Nuclear Fuel Services, Incorporated and New York State guidelines for decommissioning the reprocessing plant and site.

--Require Nuclear Fuel Services, Incorporated and New York State to submit a decommissioning plan.

--Require New York State to submit a plan for correcting problems at the low-level burial site.

--Require New York State to establish long term care requirements for the West Valley site.

Finally, we recommend that NRC and ERDA develop a policy on Federal assistance to New York State for the West Valley site.

A recent development may be important. On February 24, 1977, NRC proposed that the Federal Government increase its control over the disposal of low-level wastes by, among other things, requiring Federal ownership and federally administered perpetual care programs at low-level burial grounds. Adoption of the proposed policy may weigh heavily in future deliberations on who should bear how much of the technical and financial burden for disposing of the wastes and decommissioning the West Valley facilities and site.

This policy proposal raises a bigger issue concerning whether or not, and to what extent, the Federal Government should provide financial assistance to the nuclear industry

by taking over the cost of managing activities in the back end of the fuel cycle. I will be happy to discuss some of the implications of these issues during the question and answer period. However, I have not included them in this formal statement because this report was not intended to cover them.

Mr. Chairman, this concludes my prepared statement. We will be glad to respond to your questions.

REPORT TO THE SUBCOMMITTEE ON CONSERVATION, ENERGY, AND NATURAL RESOURCES HOUSE COMMITTEE ON GOVERNMENT OPERATIONS

ON

ISSUES RELATED TO THE CLOSING OF THE NUCLEAR FUEL SERVICES, INCORPORATED REPROCESSING PLANT AT WEST VALLEY, NEW YORK

UNITED STATES GENERAL ACCOUNTING OFFICE

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INTRODUCTION

The Nuclear Fuel Services, Incorporated (NFS) plant at West Valley, New York, is the only commercial reprocessing facility that has operated in the United States. Reprocessing is the removal, by means of a chemical separation process, of the unused uranium and the plutonium from spent (used) nuclear fuel.

The plant is located in the Western New York Nuclear Service Center, about 30 miles south of Buffalo. The plant operated from 1966 to 1972, when it closed for modifications aimed at limiting effluent releases, reducing personnel exposures to radiation, and increasing plant capacity. In 1976, NFS indicated it planned to transfer control of the high-level waste storage and low-level waste burial site to the New York State Energy Research and Development Authority (New York Authority)--the owner of the Center--in accordance with contracts with the New York Authority.

The issues which must be resolved with respect to the NFS West Valley reprocessing facilities and burial grounds are: What is the status of plans to dispose of the approximately 600,000 gallons of high-level waste, decommission the facilities, and provide perpetual care for the waste burial grounds; who will be responsible for accomplishing decommissioning, disposal, and perpetual care of the site; what are the conditions of the waste tanks and the status of waste disposal technologies; and finally, what will the disposal and decommissioning costs be and who will pay?

NFS reprocessing plant history

In 1969, the forerunner of NFS, the Davison Chemical Division of the W. R. Grace and Company, formed the Industrial Reprocessing Group--Davison Chemical, the Bechtel Corporation, and five electric utilities--to determine the feasibility of building a commercial reprocessing plant. Later, W. R. Grace and Company established NFS as a subsidiary company to develop the plant with the five utilities as its customers. NFS then negotiated contracts with the predecessor of the New York Authority under which NFS would construct and operate a reprocessing facility and a commercial low-level solid waste disposal site at the State-owned Service Center.

In 1962 the Atomic Energy Commission (AEC) twice studied the feasibility of the plant design as proposed by NFS. Both

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studies concluded that there was not sufficient assurance that the plant could operate efficiently and reliably. 1/ As designed, the plant would have been far more complex than any AEC plant then in operation. In spite of this, AEC accepted NFS' assurance that the plant design was satisfactory. AEC's Director of Regulation found that NFS had satisfied all regulatory requirements and issued NFS a license.

AEC also agreed to supply NFS a baseload of fuels to get the business started. Without the baseload contract, NFS would not have undertaken the reprocessing venture because there was not enough commercial spent fuel available at the time to support a private chemical reprocessing plant.

By April 19, 1966, the construction of the plant was completed and AEC issued NFS and the New York Authority's predecessor, the Atomic Research Development Authority--a co-licensee --a license to operate the reprocessing and related waste storage facilities. By early 1972, NFS had reprocessed all of the spent fuel that had been made available for reprocessing (about 640 metric tons, which included 480 metric tons that AEC had supplied). At this time NFS shut down the reprocessing plant for the purpose of plant modifications.

In May 1972 AEC told NFS that its modification program constituted a "material alteration" of the facility and that it would require AEC review and approval. In October 1973, NFS submitted a safety analysis report for AEC review describing the modification program. The proposed program was under review by AEC and its successor regulatory agency; the Nuclear Regulatory Commission (NRC) until September 1976, when NFS announced its decision to terminate the reprocessing operation.

A major reason for the extended review period was the need to review the proposal in light of changes to AEC and NRC safety and environmental requirements made after NFS submitted its modification plan in 1973. The major changes included requirements that a reprocessing plant include (1) a facility for solidifying high-level liquid waste, (2) a facility for solidifying plutonium, and (3) protection against natural phenomena, such as earthquakes and tornadoes. In announcing its termination decision, NFS said that it would cost $340 million in 1976 dollars or $615 million by 1987 to meet changed regulatory requirements.

1/In a 1963 report to the Joint Committee on Atomic Energy (B-151475, May 14, 1963) we discussed these studies in more detail.

Description of NFS reprocessing operations

NFS received spent fuel encapsulated in tubular metal rods from AEC and electric utilities and stored them underwater in pools for about 150 days before reprocessing. The first step in reprocessing was mechanically chopping the spent fuel rods into 2-inch pieces to expose the fuel "pellets." The pellets were then dissolved in nitric acid, leaving the chopped tubing (hulls) as undissolved waste.

The dissolved solution was chemically processed to separate the uranium and plutonium from the other fission products. The separated uranium and plutonium were then purified, concentrated through evaporation, and sent to storage tanks. After analysis and sampling, the uranium was transferred to stainless steel tank trucks for shipping, and the plutonium was loaded into 10-liter polyethylene bottles and placed in shipping containers.

The acid waste from the separation and extraction processes was transferred to high-level waste evaporators to be concentrated. It was then transferred to a high-level waste storage tank. The solid waste materials, such as hulls and fuel hardware, were buried onsite. (See fig. 1 for a diagram of the plant process and fig. 2 for the location of the site with its surface streams, reprocessing plant, storage lagoons, high-level waste tanks, and high-level and low-level waste burial sites.)

The NFS reprocessing plant consisted of a spent fuel storage pool, the chemical separation facility, and four high-level liquid waste tanks. About 612,000 gallons of high-level liquid waste was generated from the reprocessing operations. About 600,000 gallons of this waste is being stored in one 750,000 gallon carbon steel tank, with a second tank available as a spare. This waste was "neutralized" with sodium hydroxide, in order to store the normally acidic high-level waste in a tank constructed with carbon steel. Neutralizing these wastes causes major drawbacks. For example:

--Plutonium and strontium-90 are insoluble in the neutralized waste and eventually settle in a sludge at the bottom of the storage tanks. Removing the sludge from the storage tanks is currently the most difficult technological problem in the Energy Research and Development Administration's (ERDA's) waste management program.

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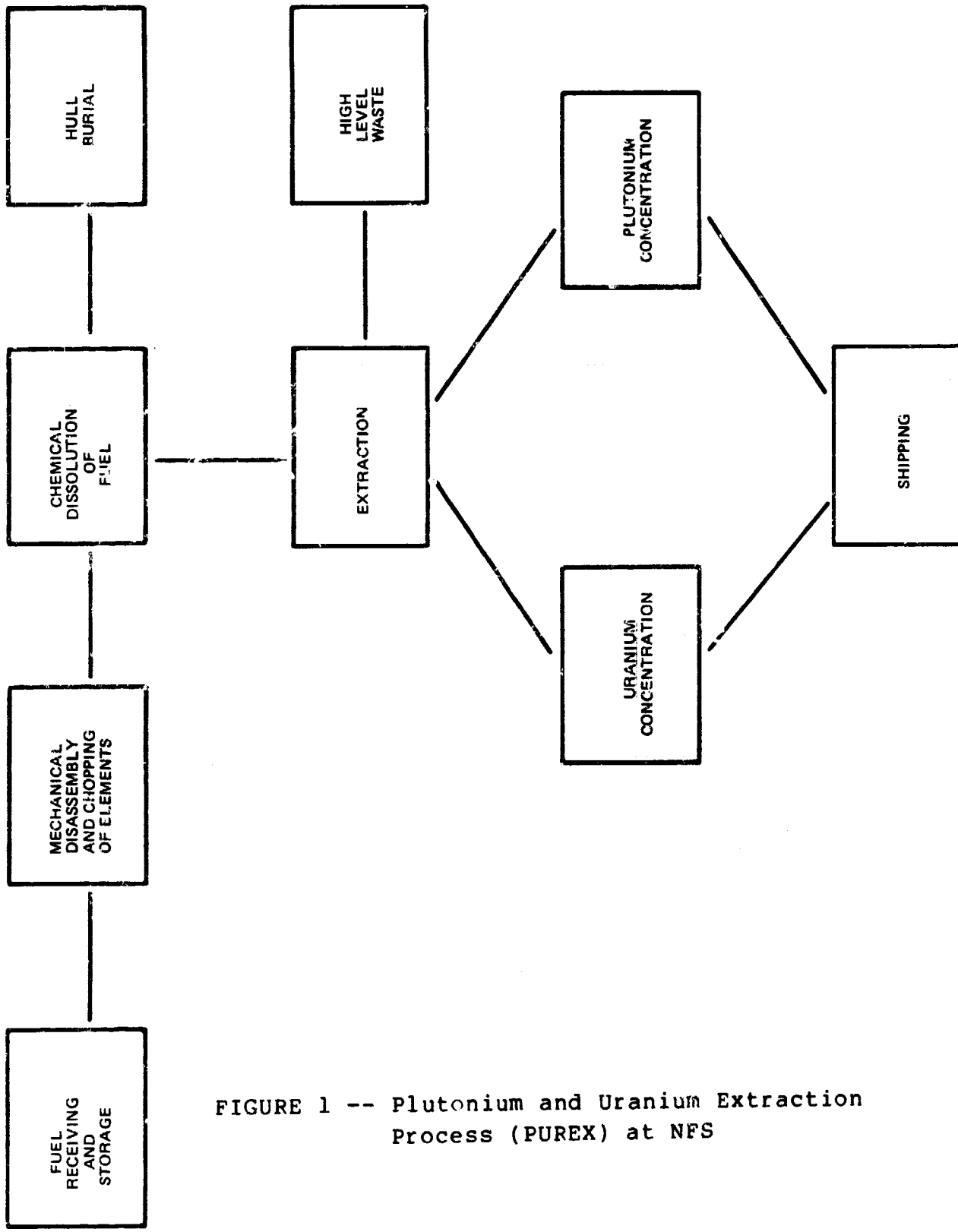

FIGURE 1 -- Plutonium and Uranium Extraction Process (PUREX) at NFS

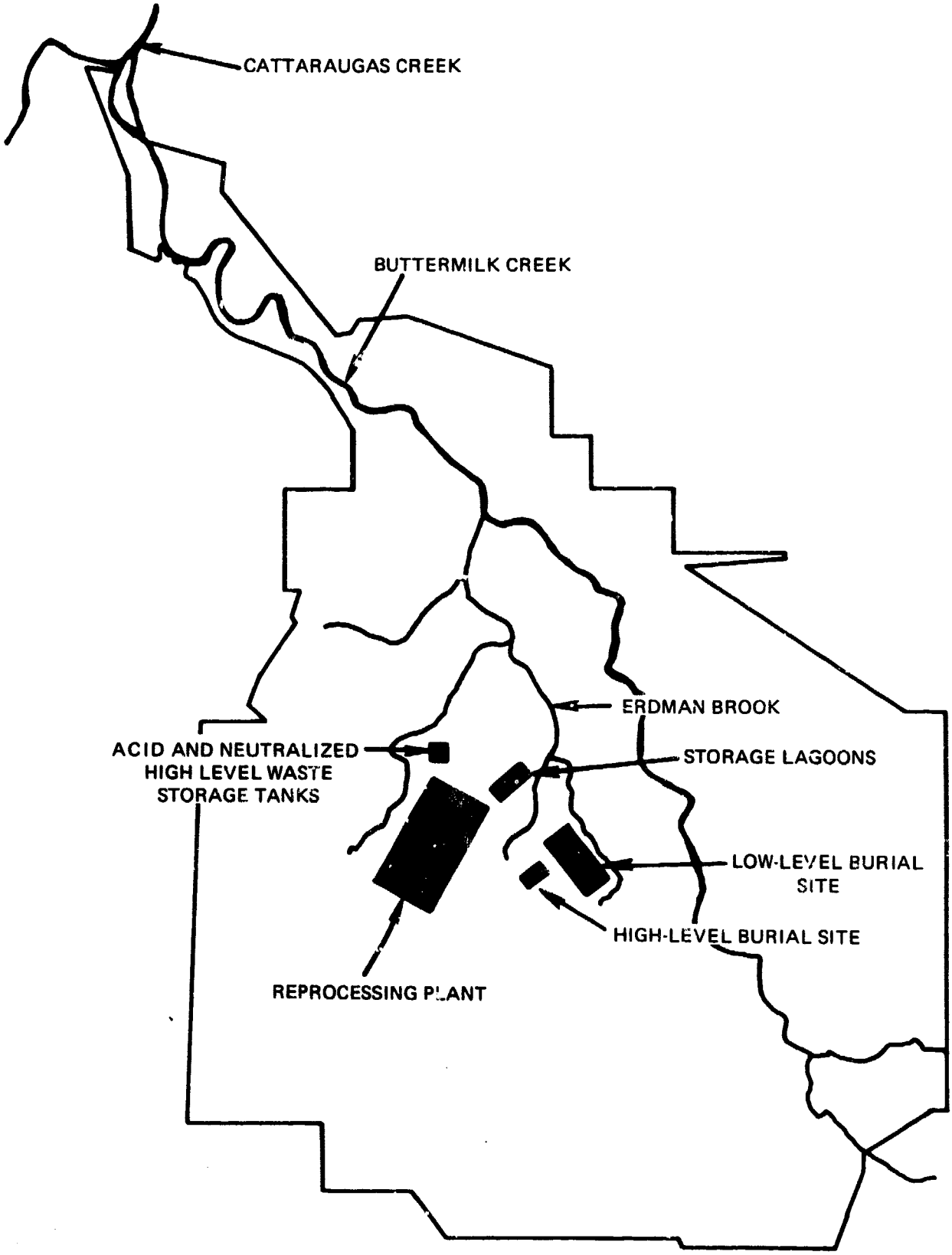

FIGURE 2 -- Geography of the West Valley Site

--The neutralized wastes require further treatment to produce a more acceptable solid form for disposal. However, a technology to convert this waste to a suitable form for long-term storage or disposal has been demonstrated only on a laboratory scale.

The remaining 12,000 gallons of waste generated from experimental thorium fuels used by a commercial nuclear powerplant is stored in a 15,000-gallon capacity stainless steel tank, with a second tank available for a spare. The tanks were constructed of stainless steel so the waste could be stored in its original acidic condition to minimize precipitation of the thorium in the waste products to the bottom of the tanks. According to an NRC report, this waste can be easily removed.

The major issues pertaining to the NFS tanks' condition, removing the wastes from the tanks, and disposing of them relate to the 600,000 gallons of neutralized waste in the large tank. For this reason, the discussion of these issues in this report is limited to the neutralized waste and waste tanks.

WHAT IS THE CONDITION OF THE WASTE TANKS?

NRC officials believe that the waste tanks are in good condition and can continually store the high-level liquid waste for the foreseeable future. But the history of leaks from Federal waste carbon steel tanks indicates that assessments of tank life is unpredictable. Although NRC is undertaking additional work to support its belief, we believe still more work must be done on a priority basis to establish the safety of the waste tanks.

Tank description

An underground carbon steel waste storage tank was constructed to store the high-level liquid neutralized waste generated during fuel reprocessing. A full capacity spare tank was also constructed. Each tank is enclosed within a steel pan and a concrete vault (about 8 feet underground) and surrounded with a clay-like soil (see fig. 3).

The tanks are 70 feet in diameter and 27 feet in height with a nominal capacity of 750,000 gallons. The tanks are at least 1/2-inch thick on the sides and bottom, and 7/16 inch thick on the roof. NRC must know the condition of the tanks

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and their expected life before it can (1) establish a time-frame in which decisions must be made regarding ultimate disposition of the waste and (2) determine the waste removal alternatives which could be used.

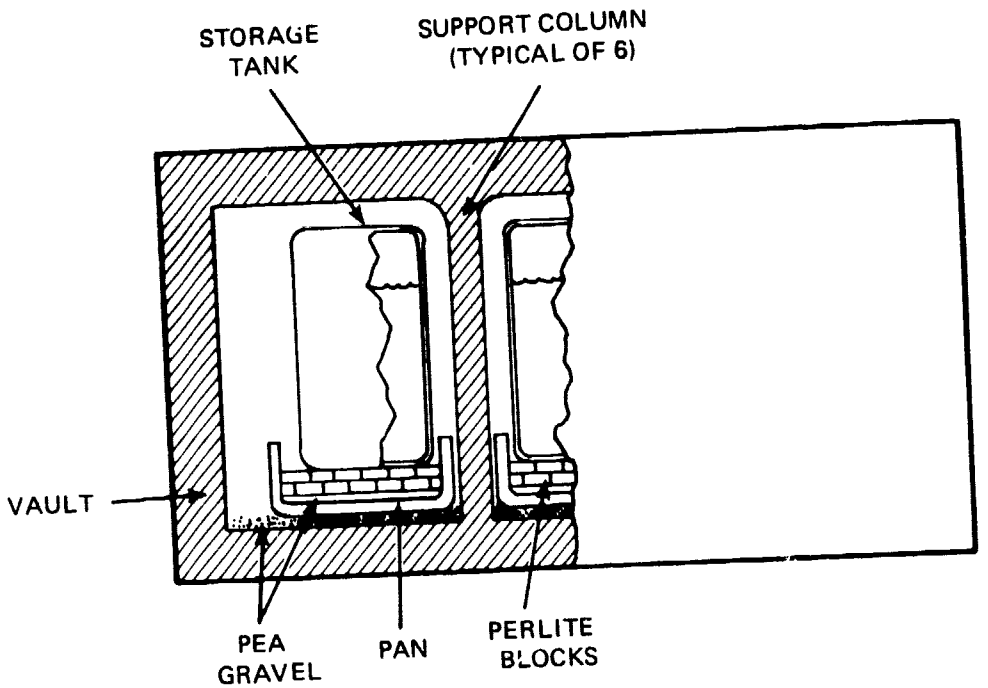

FIGURE 3 Existing NFS Neutralized Waste Storage Tank (8D-1 and 8D-2)

NRC assessment of tank safety

NRC officials say the storage of the high-level liquid waste in the working tank can be continued safely. NRC takes this position because

--no leaks have been detected since the tank was placed in operation in 1966,

--a recent inspection of corrosion samples has indicated that general corrosion rates were much less than the tanks were designed for; and

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--all welds have been treated to prevent stress corrosion cracking.

Additionally, in the event of a leak, NRC has determined that other mechanisms are available to prevent any waste release to the environs. It has commented that the tanks stand within a steel liner and are encased in underground concrete vaults; any leaks which develop tend to be self-sealing because of the salt-like nature of the waste; the liquid waste can be pumped to the spare tank if a leak occurs; and the clay-like soil surrounding the tank and vault is notably impenetrable to water flow.

Notwithstanding the above, NRC is seeking more information on tank safety. In December 1976 it requested Lawrence Livermore Laboratory to review the structural adequacy of the tanks during earthquakes. This effort is expected to be completed in January 1978. Additionally, NRC is considering contracting for an expert analysis of waste tank integrity.

Tank safety is uncertain

We believe that it cannot be assured that the waste tanks are in good condition or that the waste would not be released to the environment if a tank failed or ruptured. Specifically, we found that:

--Tank life is unpredictable and therefore a tank could fail at any time.

--The NFS tanks, according to NRC, may not meet its current seismic criteria, therefore, NRC is evaluating the tanks to see if they would rupture in the event of an earthquake near the site.

--On a past occasion, an accumulation of water in the vault excavation area forced the waste tanks and vault system out of the ground.

Experiences of tank failures

In general, tanks leak at such different points in their life that the certainties of waste tank safety is unpredictable, at best. Also, while NRC has maintained that corrosion tests indicate the NFS tanks have a useful life of hundreds of years, most leaks occur from stress cracking at the welds rather than from corrosion of the tanks.

From 1958 through 1974 at ERDA's laboratory at Hanford, Washington, 18 of the 149 older, single wall tanks developed

stress corrosion cracks, leaking 430,000 gallons of waste. The cracks in these tanks occurred from 3 months to 29 years after they were placed in service. Because of the relative inaccessibility of the tanks at Hanford, it is not known what caused the stress corrosion cracking.

At ERDA's laboratory in Savannah River, South Carolina, stress corrosion cracks, apparently at the welds, appeared in 8 of 24 older tanks. On one tank, 175 cracks have been detected. Leaks from these numerous small cracks spilled 100 gallons of waste into the surrounding soil. However, steel liners contained the leaks from the other seven tanks.

NFS officials told us that the NFS tank welds were treated to prevent the type of corrosion cracking that probably occurred at the Hanford and Savannah River facilities. ERDA's experience at its Savannah River facility with six newer tanks which were also treated like the NFS tanks revealed that no cracks occurred. An NRC official confirmed that NFS treated the welds, but he believed that a metallurgist should examine the data on these treatments to assure that proper techniques were used.

According to NRC, metallurgists are still studying the phenomenon of stress corrosion cracking--which is unpredictable--and ways to prevent it.

NRC seismic criteria

The possibility of earthquakes and their consequences to a nuclear facility must be considered in the safety evaluation of such facilities. The structural integrity of the NFS tanks in the event of an earthquake was initially questioned by AEC in 1970. In a memorandum dated June 1970, several AEC officials pointed out that the design of the waste tanks--while supposedly meeting building code requirements at the time of construction--was not acceptable for its existing seismic requirements. These requirements have since been upgraded even more. In fact, NFS announced that the main reason it left the reprocessing business was because of the tremendous costs that would be incurred to meet upgraded requirements to protect the plant from earthquakes. (See our discussion of seismic issues on page 19.)

Tank and vault floatation

In April 1965, during construction of the tanks, water accumulated in the vault excavation area and forced the vaults, with storage tanks inside, out of the ground. The actual distance the vaults floated was not determined, but according

to an AEC inspection report it was as much as 3 or 4 feet before settling back to a new position.

According to a consultant hired by the New York Authority to review the incident, the two waste storage vaults and tanks floated out of the ground like ships. The consultant considered the incident very serious because of the high stresses placed on the concrete and reinforcing steel of the roof, bottom slab, and wall of each vault.

The consultant inspected the primary vault (the one now used as a spare) and found several radial and circular cracks of various lengths and widths in the bottom and a pattern of radial cracks uniformly spaced around the vault roof. Both vaults were later resupported by pouring concrete under them, as the consultant had recommended.

An NRC official told us that the tanks, which were empty at the time, were not reexamined after the incident because it was his belief--based on the opinion of the consultant and the contractor--that all the stresses experienced during the incident were placed on the vault and not the tanks. According to NRC officials, because the original primary vault was damaged more than the spare, NFS redesignated which of the two tanks would be the working one and which would be the spare. Also, according to NFS officials, it maintains 5 feet of liquid in the spare tank to prevent the tank from floating if water gets inside the vault.

Conclusions

Before the NFS wastes can be extracted and solidified for long-term storage or disposal, the condition and integrity of the carbon steel waste tanks must be verified. Because of the the history of tank leaks at ERDA facilities and the question of the NFS tanks' ability to withstand earthquakes, we believe the potential for leaks is present. NRC is proceeding to analyze the tanks in regard to the earthquake question, and there are plans to review the tanks' integrity. We believe it should proceed on these issues on a priority basis.

Additionally, because of the problems encountered by the floatation of the tanks and vault system, we believe that NRC should determine the present condition of the vaults and assess the soil characteristics of the soil surrounding the vault system to determine whether it would contain the waste in the event of a breach in the tank system. This also should be done on a priority basis.

Recommendations

We recommend that the Chairman, NRC:

--Proceed on a priority basis in the current analyses to assess seismic integrity of the waste tanks.

--In its plans to determine tank life, include a review of the stress relieving data for assurance that the proper techniques were used.

--Assess on a priority basis the present condition of the vault system and the soil characteristics such as ion exchange capability and impermeability of the soil surrounding the system.

WHAT IS THE CONDITION OF THE WASTE?

The specific physical and chemical characteristics of the high-level liquid waste at NFS has been analyzed. However, the sludge at the bottom of the tank has not been. The characteristics of the waste must be known to select the appropriate removal and solidification process.

Waste description

During reprocessing at NFS, the normally acidic high-level waste was neutralized before being transferred to the waste storage tank. Neutralization of the acidic waste was adopted by NFS which was and still is the system used at ERDA's Hanford and Savannah River facilities. About 600,000 gallons of this neutralized waste is now stored at the West Valley plant.

According to ERDA contractor officials, the physical and chemical characteristics of the liquid portion of the neutralized waste is generally known. However, the characteristics of the estimated 30,000 gallons of sludge that have settled to the bottom of the tank are not completely known and need further analysis. ERDA contractors estimate that almost all of the long-lived fission products, such as strontium-90, and almost all of the transuranic 1/ elements, such as plutonium, have settled to the bottom of the tank. Nonetheless, netiher NFS nor NRC has indicated that it plans to sample the sludge in the tanks and determine its physical and chemical characteristics.

1/Transuranic elements--such as plutonium--are man-made and radioactive for hundreds of thousands of years.

ENCLOSURE

The most serious question surrounding retrieval and disposal of the NFS waste will be how to retrieve and dispose of the sludge. Removal of the waste sludge from ERDA waste tanks is the most difficult technological issue facing ERDA in its defense waste management program. (See page 14 for a discussion of ERDA's waste retrieval research program.)

In the NFS situation, this problem might be even more perplexing because the waste tanks contain many obstructions --structural supports on the tank bottom--that could hamper removal. According to ERDA contractor officials, the longer the sludge sits on the bottom of the tank, the greater the probability that hardening could take place and further complicate any removal attempts.

Conclusions

The physical and chemical characteristics of the high-level waste sludge need further analysis. With sludge in the tanks, the problems in totally extracting the waste will be immense. To date, no one has completely characterized the physical and chemical properties of the waste sludge. This should be a priority task because without this knowledge it will be impossible to select a waste solidification and and removal alternative for the NFS waste.

Recommendation

We recommend that the Chairman, NRC, on a priority basis, characterize the physical and chemical properties of the NFS waste sludge.

WHAT IS THE STATUS OF TECHNOLOGY FOR MANAGING NFS WASTE?

The technology for managing the NFS waste is being developed, but the information needed to reach decisions on waste management alternatives will likely not be available for many years. The status of the technology depends on such factors as the criteria governing the final waste form, the ability to remove the wastes from the tanks, the techniques or processes available for converting the wastes to the required form, the means available for ultimate disposal of the converted waste, and the costs or economic feasibility of alternative approaches to solving the NFS waste management problem.

ENCLOSURE

Has NRC established criteria concerning waste solidification?

NRC has said that for high-level waste to be acceptable for disposal in a Federal repository, it must be converted to a "dry solid form." NRC is in the early stages of developing performance criteria to implement this general criterion.

NRC assumes that high-level solid waste will be shipped to a Federal repository, and the repository site will have the characteristics--geology, hydrology, etc.--necessary to prevent dissolution and underground movement of the waste by means of groundwater. The Energy Reorganization Act of 1974 (42 U.S.C. 5841) requires NRC to license and regulate Federal high-level waste repositories, which would be designed, built, and operated by ERDA.

NRC is developing three performance criteria which will apply to the solid waste form. These criteria will prescribe leaching, volatility, and particle dispersibility testing procedures and performance requirements which a solid form must meet, independent of any containers it may be in. The specifics of the criteria for the solid waste will depend on how much protection NRC decides should be provided by containers.

Are techniques available to solidify NFS waste for ultimate disposal?

None of the solidification methods now being considered (conversion to glass, calcination, aqueous silicate, shale cement, conversion to cement and residual salt cake, shale fracturing, or in-tank cement solidification) have been demonstrated for neutralized wastes. Moreover, each solidification alternative requires additional research and development work and will not be available for application to NFS waste for as many as 14 years. In laboratory tests ERDA has converted neutralized wastes to a dry solid form but this technology needs to be demonstrated on a larger scale.

In August 1974 AEC consulted with its contractors to do a study for use in developing a policy for disposition of the NFS waste. The results of this study, dated April 1976, provided preliminary information on the eight alternative processes cited above.

The study estimates research and development costs to adapt solidification processes for NFS waste management range from $2 million to $4 million for shale fracturing ($2.1 million to $4.2 million in 1976 dollars) to $12 million for

calcination and glass ($12.6 million in 1976 dollars). The research and development time estimated to be needed to develop the processes for NFS waste ranged from 2 years to 5 years.

The estimated time before any of the processes could be used at NFS range from 5.5 years (for the shale fracturing process) to 14 years (for conversion to glass). The time frames include not only research and development time but also the time required to scope and design the facility, and to license and construct it.

Can all high-level waste be removed from NFS tanks?

Acceptable technology for removing all of the estimated 30,000 gallons of settled sludge in the NFS neutralized waste tank has not been demonstrated. Sluicing, removing, and cleaning of the sludge will be difficult because of physical obstructions in the tanks. Removing all of the sludge is not currently feasible. The 12,000 gallons of acid waste and the estimated 570,000 gallons of liquid in the neutralized waste can be pumped from the NFS waste tanks with few problems.

A technique proposed in an NFS study for sludge removal consists of (1) breaking up the sludge with low pressure jets of liquid waste, (2) pumping out the resulting liquid and pieces of sludge, and (3) removing residual sludge by chemical cleaning.

This technique has been used at Hanford, but with varying success. In one case complete sludge removal was not possible because the sludge had hardened to a point where the low pressure jets could not break up the sludge. In another case the sludge had not hardened and most was retrieved with relative ease. This technique has not been used on the tanks at Savannah River although laboratory experiments with it have been conducted there. ERDA contractor officials at Savannah River estimate that 99 percent or more of the sludge can be removed from a waste tank using this technique. However, the actual demonstration using this technique to remove the sludge from a tank at Savannah River is not scheduled to start until fiscal year 1978, and will not be completed until fiscal year 1979.

These officials at Savannah River stated that there are no techniques available to remove all of the radioactive sludge from a waste tank. Complete removal of the sludge would require digging the tank out of the ground, cutting it up, and transporting the remains to a permanent storage

facility. The officials told us, however, that it is beneficial to get most of the waste out of a tank to reduce (1) waste mobility and leak potential, (2) the level of radionuclides, and (3) the level of surveillance required.

Before it can be determined whether the sludge can be removed from the waste tanks at NFS, the sludge must be analyzed, the low pressure sluicing and chemical flushing technique developed, tank integrity verified, and tank decommissioning plans defined. The study on NFS wastes shows this research and development effort will take about 3 years and will cost $2 million to $4 million ($2.1 million to $4.2 million in 1976 dollars).

What are the expected costs of waste removal and disposal?

Reliable cost estimates are not available. Developing such estimates depends on developing processes for waste removal, processing, and disposition to a point where specific equipment and facility requirements are identified.

The April 1976 study on NFS wastes developed preliminary cost estimates for implementing the various alternatives. As emphasized in the study, the costs were based on very limited concept definitions and the broad range of estimated costs for each alternative indicated "large uncertainty in the estimates due to their preliminary nature."

According to the study, the estimates do indicate the general size of waste management costs for each alternative for purposes of comparison. We believe, however, that the study estimates should not be used for comparing the relative costs of various alternatives because of the speculative nature of the estimates and various errors in the preparation of them. Further, these estimates did not include costs for decommissioning the existing waste tanks and processing plant.

Speculative nature of cost estimates

The study cost estimates were based on very limited data. Because of the many uncertainties involved, the costs were expressed in broad ranges. As a result, they are speculative at best.

A contractor official whose office prepared the original estimates told us that the information on which they were based was, at best, preconceptual design information. He also told us the initial estimates were prepared in a relatively

short time. An ERDA official advised us that adequate cost estimates could not be prepared without detailed process flow sheets (identifying needed equipment and facilities) based on proven application of the process to NFS wastes.

Because of the uncertain nature of the cost estimates, factors of from 75 to 200 percent were applied to capital, operating, and disposal costs to develop a range of estimated total costs for each waste disposal alternative. For example, the estimated total costs for the conversion to glass alternative (assuming offsite disposal) was presented as $160 million to $380 million--a difference of $220 million ($168 million to $399 million in 1976 dollars). Similarly, calcination was estimated to cost $170 million to $380 million ($174 million to $399 million in 1976 dollars) and conversion to cement was $200 million to $480 million ($210 million to $505 million in 1976 dollars).

Errors in cost estimates

Our review showed that questionable cost data was used, pricing and computation methods were not followed consistently, and significant computation errors were made in developing the cost estimates to which the 75 to 200 percent factors were applied to establish cost ranges. For example, the cost of the continued in-tank storage alternative for two additional carbon steel tanks was estimated at $2.1 million ($2.2 million in 1976 dollars). However, based on actual tank construction costs at Hanford, a contractor official estimated the two tanks would cost at least $6.5 million in 1976 dollars.

Conclusions

It is clear that the information on either technical or economic feasibility needed to select and pursue development of a process for managing the NFS wastes has not been developed. Moreover, none of the solidification processes has been demonstrated, nor has NRC developed specific performance criteria for the solidified waste product or its containment system. Without such criteria, the potential applicability of any process to the NFS waste cannot be determined.

Although each of the solidification alternatives requires removal of waste from the tanks, complete sludge removal from the neutralized waste tank is not presently possible. Because of the long-lived radionuclides in the sludge, any sludge left in the tank presents a separate problem for either long term management or decommissioning of the site.

ENCLOSURE

Until necessary criteria are developed, further research and development completed, and additional technical and economic feasibility studies made, the existing waste must remain in liquid storage. We believe it is imperative, however, that a means for solidification and ultimate disposition of NFS waste be developed and implemented on a priority basis.

Recommendations

We recommend that the Chairman, NRC, on a priority basis,

--develop waste form and waste system performance criteria for NFS waste;

--develop criteria for decommissioning of waste storage facilities so that the impact of residual sludge in the NFS tank can be evaluated; and

--identify alternative processes, considering the preceding developed criteria, for NFS waste management and determine their technical and economic feasibility so that a recommended process can be developed and implemented.

WHAT SAFEGUARDS SHOULD BE USED TO PROTECT THE SPENT FUEL AND HIGH-LEVEL WASTES?

NFS is required to protect the spent fuel storage facility and high-level waste tanks from possible acts of sabotage. To provide this protection it has implemented a security plan approved by NRC. To date, NRC has found that the security which NFS provides at the site has been adequate to satisfy its requirements. In a separate report, which we plan to issue later this year, we will address NRC's safeguards requirements.

The NFS security plan is exempt from public disclosure so as not to compromise its effectiveness. However, NRC requires all facility security plans to include (1) a security organization including guards, (2) physical barriers, (3) facility access control, (4) detection aides, (5) communications equipment, (6) a testing and maintenance program, and (7) liaison with local law enforcement authorities.

In four inspections since the physical protection regulations were established, AEC and NRC have found 11 instances of NFS noncompliance. None of the noncompliance items was determined to significantly affect the overall physical protection controls. Twice, however, NRC inspectors found that a central

station was not continuously manned, thereby reducing NFS' physical protection capability below the required level. In these cases, other systems such as physical barriers, precluded substantial loss of physical protection plan effectiveness.

CAN THE NFS PLANT RESUME OPERATIONS?

It is unlikely that the NFS reprocessing plant will ever operate again. NFS estimates it would cost $615 million by 1987 to make the necessary modifications--an estimate that appears reasonable. However, the high cost of modifications, the plant's limited capacity even with expansion, and its limited remaining useful life makes it appear to be uneconomical to operate regardless of the potential demand for reprocessing services. Furthermore, it is unlikely that the NFS facility can be modified to reduce radiation exposures to workers to a level that would be acceptable to NRC.

Regulatory requirements adopted since the NFS plant was constructed

The largest part of the estimated $615 million necessary for plant modifications relates to AEC and NRC regulatory requirements adopted after the NFS facility was constructed. Major requirements include (1) a high-level liquid waste solidification facility for future wastes, (2) a plutonium solidification facility, and (3) protection against natural phenomena, such as earthquakes and tornadoes.

High level waste solidification facility

Until 1970, storage of high-level liquid waste in buried tanks was acceptable to AEC. At that time, AEC began requiring reprocessors to solidify high-level liquid waste within 5 years of separation of the waste products from the spent fuel and to transfer the solidified waste to a Federal repository within 10 years of separation. In March 1971 AEC amended its regulation to exempt existing high-level liquid waste, which, of course, included the NFS waste. The exemption was made because the technology was not developed to solidify neutralized wastes.

The AEC regulation did apply to any future NFS reprocessing operations. NFS initially proposed a 5-year tank storage preparatory to solidification, but in 1976 said it intended to solidify future high level wastes immediately following the reprocessing operations. NFS estimated that the solidification facility could be completed in 1987 and would cost about $210 million ($117 million in 1976 dollars).

Plutonium solidification facility

In June 1974 AEC adopted a regulation which requires that the liquified plutonium extracted in reprocessing operations be converted to a solid form for shipment offsite starting after June 17, 1978. Plutonium extracted in prior NFS reprocessing operations had been shipped in its liquid form. NFS estimated that a plutonium solidification facility would cost $17 million ($10 million in 1976 dollars).

Protection against natural phenomena

When the NFS reprocessing facility was constructed, AEC did not have specific standards for protection against natural phenomena, such as earthquakes and tornadoes. In 1971, however, AEC began investigating the area surrounding the NFS plant and calculated the magnitude of the largest earthquake likely in the area. NFS prepared its 1973 application to modify the plant on this basis.

Further, in May 1974, AEC notified NFS that the planned modification would have to be designed so that the facility would comply with AEC's new tornado design standards. The AEC standard was much more comprehensive than the building codes in effect when the plant was built.

In 1976, however, following additional evaluations of fault structures near the NFS plant, field studies, and reviews of historical seismic activity, NRC concluded that a still more conservative earthquake design was required. Thereupon, NFS' consultant geologists and seismologists agreed that NRC's methodology and conclusions were reasonable. To provide the required level of earthquake protection, NFS proposed to construct a reinforced concrete containment structure around the chemical separation facility.

NFS estimates that $186 million ($105 million in 1976 dollars) would be required to meet the regulatory requirements for protection against these natural phenomena.

Reducing radioactive exposure and effluent release levels

Radiation exposure levels for plant personnel steadily increased from 1966 to 1972. While NFS usually remained within the maximum allowable limits set by AEC, the levels increased at a rate that caused AEC to become concerned over the possibility of each plant employee receiving an excessive

radiation exposure. In addition, while NFS remained within the maximum allowable limits for radioactive materials which can be released as airborne or liquid effluents, these releases continually increased over the 6 years of plant operation. These problems were serious enough that by 1972 one AEC official stated that the spread of radioactive materials had imposed a potential threat to the health and safety of the public.

The problem with increases in personnel exposures is particularly significant because NFS did periodically attempt to modify the plant--at AEC's insistence--to reduce exposures. These efforts, however, were not successful. Regarding effluent releases, AEC inspectors found that NFS had allowed unmonitored liquid and gaseous discharges and excessive radiation levels outside the plant boundaries, and that NFS' controls were inadequate to accurately account for the total amounts of radioactive material released into the environment.

NRC inspection officials told us that the personnel exposures were primarily caused by the plant's contact maintenance design as opposed to a remote maintenance design. 1/ Contact maintenance permits lower initial plant capital cost but requires that plant personnel manually perform most operation and maintenance functions. In contrast, ERDA's Hanford Reservation reprocessing facility was constructed using a remote maintenance design with a large initial capital investment. This latter approach imposes minimum manual responsibility on plant personnel for its operation and maintenance. In an NRC inspector's opinion, it would be more economical to build a new plant than to convert the NFS plant to the remote maintenance mode of operation.

Economic considerations

To satisfy NRC and AEC conclusions that major modifications were needed to reduce personnel exposures and radioactive effluent releases, NFS in 1968 began planning to modernize the plant and expand its reprocessing capacity from 300 to 660 metric tons of spent fuel per year. Initial estimated cost at that time was $12 million.

1/"Contact maintenance design" requires that plant personnel perform various repair and maintenance functions in radioactive areas, whereas "remote maintenance design" relies on remote control machinery.

In June 1976 NFS estimated that the cost of required modifications to satisfy new regulatory requirements and the expansion program had risen to $340 million in 1976 dollars, or $615 million by 1987 when all modifications could be completed.

The cost estimates appear reasonable when compared to other reprocessing facilities currently under construction or planned. A study performed for a group of utilities concluded that it will cost $1 billion ($590 million in 1976 dollars) to build one new reprocessing facility by 1986. Allied General Nuclear Services, Inc., has spent $250 million to construct most of its Barnwell, South Carolina, facility, and estimates that another $350 million (in 1976 dollars) will be needed to complete plutonium solidification and waste management facilities. EXXON estimates the cost of its reprocessing facility to be located at Oak Ridge, Tennessee, and planned for start-up in 1986 at $700 million (in 1976 dollars).

While the estimated cost of the NFS plant modifications are comparable to the cost of other reprocessing plants, NFS believed it would be unable to compete with these reprocessors because of the limited plant capacity--660 metric tons a year even with expansion, as compared to 1,500 metric tons for other plants under construction or planned. NFS would have to recover its $615 million capital investment over much fewer metric tons of spent fuel per year, and fewer years than other plants. By 1988 when NFS estimated it could have completed the plant modifications and resumed plant operations, the reprocessing plant would be over 20 years old, and there would be greater risks associated with using the old equipment which has been idle for several years.

Before NFS decided to quit the reprocessing business, it had announced a reprocessing charge of about $1 million per ton of spent fuel to its existing customers. NFS decided, however, that utilities would be unwilling to pay that amount. Comparative charges were not available since no other commercial reprocessor is operating or ready to operate. However, an April 1976 study by Allied General estimates the cost of its plant reprocessing services--not the company's proposed charges--at $193,000 per metric ton. This study assumed an operating level of 1,500 metric tons per year.

Conclusions

Based on a review of cost estimates available, it appears that NFS' cost estimates in combination with the limited plant capacity and remaining useful life would make it economically unfeasible for NFS or anyone else to modify the plant and provide

reprocessing services. More importantly, the modifications may not reduce the personnel exposure levels because of the maintenance design concept used for the facility.

WHAT ARE THE PLANS FOR DECOMMISSIONING THE NFS SITE?

To date, NFS and the New York Authority have not developed plans for decommissioning the West Valley site and probably will not do so until NRC provides decommissioning guidelines. Six years after announcing that overall decommissioning guidelines for reprocessing plants would be prepared, NRC is still developing them.

Since there are no decommissioning plans, we reviewed (1) the current NRC regulations, guides, and alternatives for decommissioning the reprocessing plant and (2) the decommissioning and long term care requirements for the waste disposal site at West Valley. We found that before decommissioning takes place there is a need for

--decisions on the future use of the West Valley site,

--guidelines for decommissioning the reprocessing facility and site,

--a plan to correct problems at the waste burial sites, and

--long term care requirements for the West Valley site.

Decommissioning the reprocessing plant

At the time NFS constructed its reprocessing plant, AEC had no policy or guidelines on decommissioning fuel reprocessing facilities. In November 1970, AEC published a regulation setting forth for the first time a policy relating to the siting of fuel reprocessing plants and related waste management facilities. In this regulation, AEC stated that criteria would be developed for the extent of decontamination to be required upon decommissioning and license termination. In this regard, NRC is presently developing criteria in conjunction with a decommissioning study being done under contract with Battelle's Pacific Northwest Laboratory. This study was just completed and a draft report issued to NRC in February 1977. It discusses the various alternatives and costs involved in decommissioning a reprocessing facility of the size and type being constructed at Barnwell, South Carolina. This facility is

much larger than the NFS facility and is believed to be more representative of future commercial reprocessing facilities; therefore, costs for decommissioning the NFS facility will require a separate study.

Because of the late release date of the study, we were unable to evaluate its applicability to the NFS facility. However, according to an NRC licensing official, many of the general results of the Battelle study has application to the NFS facility.

An NRC guide now exists that describes conditions and procedures acceptable to decommissioning reactors--not reprocessing plants--under several alternatives. They are mothballing, entombment, and dismantling. The Battelle study describes an additional alternative called "layaway" and does not include an evaluation or cost estimate for entombment because this alternative would limit future options for using the facility and adjacent lands. The table on the following page describes the four decommissioning alternatives.

Future use of the facility and lands is a key factor in selecting a decommissioning alternative. In the case of West Valley, because of the low-level waste buried at the site, complete cleanup to restore the site back to its original condition is virtually impossible because of possible safety hazards in retrieving the highly toxic radionuclides. And, more importantly, it may not be possible to retrieve all the buried radioactive waste.

ENCLOSURE

Decommissioning Alternative Characteristics

Code	Facility status	Contamination control	Potential use of site
Layaway	Leave facility in place	Minimum removal of loose contamination; operation of active protective systems	Restricted essentially to the operation and surveillance of active and passive protective systems
Protective storage (mothball)	Leave facility in place	Remove loose contamination; provide temporary physical barriers; operation of passive protective systems	Restricted use; surveillance required; maintenance of passive protective systems and physical barriers required
Entombment	Leave facility in place	Remove loose contamination; provide hardened permanent physical barriers by filling structures with concrete or other suitable material	Conditional use; must not jeopardize entombment barriers or structures
Dismantling	Fully decontaminate or remove facility	Reduce contamination to unrestricted level by removing all radioactive material and structures	Unrestricted use

ENCLOSURE

According to an NRC official, the technology to decontaminate reprocessing plants is available today and has been demonstrated on a number of ERDA pilot plant reprocessing facilities. Nevertheless, the NFS and other planned commercial fuel reprocessing plants are more complex than ERDA's pilot reprocessing facilities, and thus could be more difficult to decontaminate and decommission.

According to the Battelle study, as shown in the table below, immediate dismantling of the Barnwell reprocessing facility represented the highest initial decommissioning cost, with protective storage being the second most expensive alternative, and layaway represented the least expensive for initial decommissioning. According to the study, in terms of total decommissioning costs, including the first 100 years of surveillance, the layaway alternative is the highest, with immediate dismantlement second, and protective storage third. The immediate dismantlement alternative involves no surveillance cost because all radioactivity is removed.

Estimated Costs of Decommissioning a Reprocessing Plant (in 1976 dollars)

Decommissioning mode	Decommissioning with no surveillance	Decommissioning plus 100 years of surveillance
Dismantling	$33,000,000	$33,000,000
Protective storage (mothballing)	7,400,000	19,700,000
Layaway	4,800,000	65,700,000

Nuclear reactors have been decommissioned by one or a combination of the options discussed above. Since 1960, five licensed nuclear powerplants, four demonstration nuclear powerplants, six licensed test reactors, and 28 licensed research reactors have been or are in the process of being decommissioned. Although the experience gained from reactor decommissioning would have some application to fuel reprocessing plants, it would not be fully applicable because of differences in the type and quantity of radioactive wastes involved. The cost information on decommissioning these facilities generally supports the Battelle study's observations that dismantlement represents the highest initial decommissioning cost and that other modes will have continual surveillance costs incorporated into their total cost. For example, the cost of dismantling the small Elk River nuclear powerplant was approximately

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$6 million, as compared to a $500,000 cost of mothballing the Saxton test reactor. However, an annual surveillance cost of $10,000 for the Saxton reactor is required as compared to no surveillance cost at the Elk River site.

Costs to decommission the NFS reprocessing facility under the four decommissioning alternatives is not known at this time and will have to await the decommissioning plan. Before the plan can be prepared and an alternative selected, a decision will be needed on the future use of the West Valley site. If the State of New York wants unrestricted use of the site, dismantling of the facility will be necessary. This would probably involve (1) total decontamination, dismantling, and removal of equipment and (2) total decontamination and/or dismantling of the containment building. On the other hand, if the State has plans for having other nuclear facilities occupying the site, then either mothballing, entombment, or layaway may be sufficient since the other facilities could assume the long term safety duties for NFS plant, such as radiation monitoring and environmental surveillance. Since a low-level waste burial ground already exists that also requires long term care, and if problems noted on pages 27 to 29 concerning the low-level waste burial grounds are corrected, the eventual caretaker of this facility could assume the care and surveillance requirements for the NFS plant, making the alternatives to mothball, entombment, or layaway somewhat more attractive from an economic viewpoint.

Decommissioning and long term care of disposal sites

Monitoring and maintaining the low-level waste and spent fuel hull disposal sites will be required for many centuries because of the long-lived, highly toxic radionuclides buried. Therefore, before decommissioning the site, it is important that long term care requirements be identified, remedial action taken to correct known site deficiencies, and a sufficient fund established for perpetual care.

Low-level waste burial site

The commercial burial ground at West Valley is licensed by the New York State Department of Environmental Conservation

to handle byproduct 1/, source 2/, and special 3/, nuclear material. The site was opened in 1963, and through 1974 it had received the following amounts of waste.

Volume (cub. ft.)	Byproduct material (curies a/)	Source material (pounds)	Special nuclear material (grams)
2,282,400	517,483	991,910	54,933

a/A curie is a measure of radiation intensity. It is equivalent to 37 billion disintegrations per second, which is approximately the rate of decay of 1 gram of radium.

We testified before the Congress on February 23, 1976, on our report dated January 12, 1976, entitled "Improvements Needed in the Land Disposal of Radioactive Wastes--A Problem of Centuries." We reported that land burial site suitability for radioactive waste disposal depends on the site's ability to prevent radioactivity from migrating into the environment and becoming a public hazard. Furthermore, we said that, before disposal sites are selected to receive radioactive waste, qualified earth scientists should properly assess the site's characteristics and ability to retain the radioactivity. We found, however, that (1) systematic site selection criteria have not been established, (2) important earth science characteristics have not been well defined at some disposal sites, and (3) some commercial as well as ERDA-owned burial sites have been releasing radioactivity to the environment, although not at levels which pose an immediate public health hazard.

The West Valley site was one of the commercial sites identified as releasing radioactivity to the environment and in need of additional geological and hydrological information for determining site suitability. With regard to West Valley, we found that information was lacking on

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1/Byproduct material refers to radioisotopes produced in nuclear reactors.

2/Source material refers to natural uranium and thorium.

3/Special nuclear material means plutonium, uranium-233, and uranium enriched in the isotope 233 or 235.

--direction and rate of ground water movement,

--source of water in and connection between sand deposits,

--ion exchange capabilities of the soil, and

--extent of fracturing.

At the time we testified, the results of studies initiated in 1973 indicated that no extensive underground migration had occurred, but that there was a problem with water seepage from the surface of three trenches which had accumulated water. In March 1973 NFS stopped operating the low-level burial site pending a decision by State regulatory authorities on the operation of the waste burial area. To date, the site is not operating. NFS, with the State's approval, initiated a plan to control the water seepage problem in the three trenches by pumping the water to a treatment facility which is part of the fuel reprocessing treatment facility. The radioactive water pumped to the treatment facility was treated to reduce the radioactivity to a level acceptable to NRC and released to a nearby surface stream.

Although NFS has acted on trench water problems, the State recognized, as did NRC, that a more permanent solution to prevent water infiltration was needed and that extensive geological and hydrological studies of the site were needed. The current action taken to correct the problem of trench overflow (pumping) provides only a temporary solution. Therefore, further action must be taken to prevent excessive accumulation of water in the trenches. In this regard, the New York Authority contracted with a private commercial firm in October 1975 to study long range control methods. The consultant submitted an interim status report to the New York Authority on October 1976, discussing 12 potential methods in addition to pumping to eliminate the accumulation and overflow of water in the trenches. They included the use of various synthetic liners, asphalt covers, and reforming the soil cover over the trenches.

All the various alternatives for controlling trench water problems would still require periodic maintenance or replacement. For example, one alternative which involves the use of the synthetic liners may have a life expectancy of only about 20 to 25 years, and as indicated below, are expensive to replace. When compared to the longevity of the wastes--centuries--this time period is minimal.

ENCLOSURE

As to the cost of implementing the various methods, the consultant's report 1/ provided some rough estimates in 1976 dollars on the various methods. According to the consultant's report, the cost of using asphalt (2 inches thick) for all 11 trenches will be about $115,000. If reforming the soil cover option is adopted, the costs would be about $178,000. For synthetic liners, the most expensive liner would cost about $431,000. Before a decision can be made on what corrective action to take, the consultant recommended the following tasks be performed:

--Development of a trench water monitoring program.

--Formulation of a program of remedial actions to be used until trench soil cover stability is achieved.

--Preparation of erosion control procedures.

--Development of a technique to predict trench mound slumping time.

--Formulation of a program of long term remedial action.

High-level burial site

The high-level solid waste burial site is located south of the reprocessing plant and adjacent to the low-level waste site. Like the low-level waste burial ground, surveillance and perpetual care will be required. From 1966 to 1972 NFS buried 100,000 cubic feet of spent fuel hulls and other solid waste at this site.

Most of the waste consists of 30-gallon drums of spent fuel hulls, and is buried in holes that are about 30 feet deep. Spent fuel hulls are contaminated with long-lived mixed fission products, such as strontium-90 and cesium-137, and transuranic elements, such as plutonium-239. Because of the radiation levels associated with this waste, a remote operated crane was used in handling the waste for burial.

1/Dames and Moore, Interim Status Report on "First Stage Development of Methods to Eliminate the Accumulation and Overflow of Wastes in the Trenches at the Radioactive Waste Disposal Site at West Valley, New York," prepared for the New York State Energy Research and Development Authority, October 1976.

Early in 1969, when NFS was ready to process some of the spent fuel from a reactor at Hanford, it discovered 42 ruptured fuel elements that could not be processed. On April 23, 1969, NFS buried these fuel elements in the high-level solid waste burial ground although this action was not specifically allowed by the AEC license, AEC was aware of it. The ruptured fuel was packaged in three scrap drums which were placed in a 50-foot hole and encased in concrete. This waste contains all the same long-lived fission products and transuranic radionuclides in the same proportions that are found in the neutralized waste stored in tanks at the site. NRC must decide if the fuel elements should be retrieved. Retrieval will be difficult and costly.

Conclusion

The Federal Government will, at a minimum, have to provide technical assistance to NFS and New York for studying and correcting many of the site problems noted. In addition, NRC will have to establish guidelines and plans for (1) handling the spent fuel stored and buried there and decommissioning the reprocessing plant and (2) long term care requirements for the high- and low-level waste burial sites.

Recommendations

We recommend that the Chairman, NRC:

--Require New York State, since it has basic responsibility for the site, to report its plans on the future use of the West Valley site.

--Prepare for NFS and New York State guidelines for decommissioning the reprocessing plant and site in line with any planned future use.

--Require NFS and New York State to submit a decommissioning plan which meets NRC's guidelines and establishes long term care requirements for the site.

--Require New York State to submit a plan for correcting problems at the low-level burial site.

WHO IS RESPONSIBLE AND WHO IS GOING TO PAY FOR CLEANING UP THE WASTE PROBLEMS AT WEST VALLEY?

The ultimate legal responsibility for care and disposal of the radioactive wastes at West Valley belongs to the State of

New York. Under the agreement between NFS and the New York Energy Research and Development Authority 1/ governing the storage of these wastes, the responsibility for perpetual care of the waste and waste storage facilities after December 31, 1980 rests with the New York Authority--when the agreement and NFS' lease expires. In the event that the State of New York terminates the New York Authority, the State will assume the responsibility for care, management, use, and disposing of the wastes.

At present NFS is responsible for assuring public health and safety with respect to the facilities and waste materials located at West Valley. NFS can voluntarily surrender its responsibility to the State before the contractual arrangements expire. This surrender can take place only if the State determines that the facilities are in good condition and if the transfer is approved by NRC.2/ It should be noted that once the arrangements expire on December 31, 1980, the State would be required to assume responsibility for the waste storage facilities. Thus, even if NFS' voluntary surrender were frustrated now, the facilities would become the State's responsibility after 1980, assuming NRC approval.

Present NRC regulations require that high-level waste be solidified and stored on federally owned property. However, these regulations specifically exempted the West Valley plant because it was already licensed. This plant will be subject to a subsequent rulemaking which has not yet begun. The technology for long term storage and solidification of high-level wastes has not yet been fully developed. Therefore, resolution of these issues will have a bearing upon the State's continuing responsibility for wastes at West Valley. Since NRC must approve NFS' surrender of the waste storage facilities to New York, it is possible that NRC could place further restrictions on the surrender; for example, additional storage facility requirements.

NFS was required under the license issued by New York for the low-level waste burial ground to contribute to a State

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1/The successor agency to the New York Atomic Research and Development Authority.

2/Any readjustments of NFS' technical and financial responsibilities for waste management--either before or after expiration of its agreements with the Authority--must have NRC approval because it requires an amendment to the facility license.

long term care fund on the basis of the volume of waste buried. A State official told us that the State attempted to define long term requirements and establish related payments. Initially the State received 8 cents for each cubic foot of waste buried. The rate has been periodically increased over the years along with increases to charges NFS imposed on its customers. The charge at the time the burial site was shut down was 15 cents a cubic foot. When operation of the burial grounds stopped in March 1975, the amount in the long term care fund was approximately $190,000 including accumulated interest. This money is part of a larger cumulative fund, totaling about $2.9 million, which NFS has contributed toward waste stored in tanks at the site. The New York Authority's agreement with NFS requires a $4 million escrow fund balance. When site responsibility reverts to the Authority, NFS would be required to bring the fund up to that amount.

It is obvious that the New York escrow fund, as shown in the table below, is inadequate to cover the cost of (1) remedial action needed at the burial sites, (2) the high-level waste removal, solidification, and shipment offsite, and/or (3) the perpetual storage of this waste and the decommissioning of the reprocessing plant since the costs will probably be in the hundreds of millions of dollars.

Estimated Cost of Alternative Actions at West Valley (in 1976 dollars)

	Ranges for remedial action
Remedial action needed at burial sites (note a)	$ 34,000 - 431,000
High-level waste removal, solidification, and shipment offsite	$116,000,000 - 567,000,000
Perpetual storage of high-level waste at NFS	$ 58,000,000 - 357,000,000
Decommissioning the NFS reprocessing plant (note b)	$ 19,700,000 - 65,700,000

a/This estimate is for the low-level waste burial site. No estimates were available for the high-level waste burial site.

b/These estimates are for the Allied General Services' nuclear plant at Barnwell, South Carolina.

The Authority has asked ERDA to completely take over the site. To date, ERDA has not accepted the State's takeover request. We did not assess the pros and cons of an ERDA takeover of the site. We will, however, monitor ERDA's actions on the New York report. According to a recent Environmental Protection Agency report, "Summary Report on the Low Level Radioactive Waste Burial Site, West Valley, New York," dated February 9, 1977, there are four major studies related to the low-level burial ground currently being conducted--the Federal Government is already providing assistance on all of them. The studies include the following:

--USGS is collecting hydrogeological data to predict water migration rate (federally funded).

--The New York Geological Survey is collecting information on the rates and pathways of any migrating radioactivity (federally funded).

--The New York Authority has hired a consultant to identify long term solutions to the problem of trench water control and site erosion control (State and federally funded).

--The New York Department of Environmental Conservation is collecting through the monitoring system at the site, data on the type and concentration of radioactivity leaving the site (State and federally funded).

The costs of solving the waste problems at West Valley, as stated previously in this report, will be on the order of hundreds of millions of dollars and the State is probably incapable of providing the technical solutions to these problems.

Conclusion

Although ultimate responsibility for taking corrective action at the site rests with the State of New York, the State does not want to be burdened with the full financial responsibility for solving these problems. At a minimum, the Federal Government will have to provide technical assistance to NFS and New York for studying and correcting many of the site problems noted previously in our report.

A recent development may be important. On February 24, 1977, NRC proposed that the Federal Government increase its control over the disposal of low-level wastes by, among other things, requiring Federal ownership and federally administered

ENCLOSURE

perpetual care programs at low-level burial grounds. Adoption of the proposed policy may weigh heavily in future deliberations on who should bear how much of the technical and financial burden for disposing of the wastes and decommissioning the West Valley facilities and site. This policy proposal raises bigger issues concerning whether or not, and to what extent, the Federal Government should provide financial assistance to the nuclear industry by taking over the cost of managing activities in the back end of the fuel cycle. The implication of these issues is not within the scope of this report. However, we believe these are important issues and we plan to assess them in the future.

Recommendation

We recommend that the Chairman, NRC, develop in conjunction with the Administrator, ERDA, a policy on Federal assistance to New York State for the West Valley site.