DOE/EIS-0081

FINAL

Environmental Impact Statement

Long-Term Management of Liquid High-Level Radioactive Wastes Stored At The Western New York Nuclear Service Center, West Valley

June 1982

U.S. Department of Energy
Assistant Secretary for Nuclear Energy
Office of Terminal Waste Disposal and Remedial Action

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Washington, D.C. 20585

COVER SHEET
FINAL ENVIRONMENTAL IMPACT STATEMENT
LONG-TERM MANAGEMENT OF LIQUID HIGH-LEVEL RADIOACTIVE
WASTES STORED AT THE WESTERN NEW YORK
NUCLEAR SERVICE CENTER, WEST VALLEY
DOE/EIS-0081

a) Lead Agency: U.S. Department of Energy

b) Proposed Action: To construct and operate facilities necessary to solidify the liquid high-level wastes currently stored in underground tanks at West Valley, New York.

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d) Designation: Final EIS (FEIS)

e) Abstract: The statement assesses and compares environmental implications of possible alternatives for long-term management of the liquid high-level radioactive wastes stored in underground tanks at the Western New York Nuclear Service Center in West Valley, New York. Four basic alternatives, as well as options within these alternatives, have been considered in the EIS: (1) onsite processing to a terminal waste form for shipment and disposal in a Federal repository (the preferred alternative); (2) onsite conversion to a solid interim form for shipment to a Federal waste facility for later processing to a terminal form and shipment and subsequent disposal in a Federal repository; (3) mixing the liquid wastes with cement and other additives, pouring it back into the existing tanks, and leaving onsite; and (4) no action (continued storage of the wastes in liquid form in the underground tanks at West Valley). Mitigative measures

for environmental impacts have been considered for all alternatives. No significant stresses on supplies or irreversible and irretrievable resources are anticipated, and no scarce resource would be required.

f) The proposed action is intended to demonstrate the solidification and preparation of high-level wastes for disposal. As a result, it is possible that design changes or other similar actions may occur. If such changes or actions are determined to produce significant adverse environmental impacts beyond those described in this FEIS, appropriate documentation will be provided to comply with the National Environmental Policy Act under the Department of Energy's compliance guidelines.

g) A Record of Decision in connection with this proposed action will be prepared and published in the Federal Register and distributed to those who commented on the Draft EIS and received copies of the Final EIS.

FOREWORD

This Final Environmental Impact Statement (FEIS) is issued by the U.S. Department of Energy to assess the environmental impacts of the various alternatives for the long-term management of the liquid high-level radioactive wastes currently stored in underground tanks at the Western New York Nuclear Service Center, West Valley, New York. These wastes resulted from commercial reprocessing of nuclear reactor fuels from 1966-1972 by Nuclear Fuel Services, Inc. The plant is now being maintained in a shutdown condition by the Department of Energy.

The Federal Government's objective of long-term management of radioactive wastes is to isolate existing and future wastes from the biosphere so that these wastes pose no significant risk to public health and safety. The West Valley Demonstration Project Act of October 1, 1980, directed the Department of Energy to solidify the high-level liquid nuclear wastes at the Nuclear Service Center at West Valley into a form suitable for transportation and disposal. This document has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA) as implemented by regulations promulgated by the Council on Environmental Quality (CEQ) (40 CFR Parts 1500-1508, November 1978) and Department of Energy implementing guidelines (45 FR 20694, March 28, 1980).

The proposed action is to construct and operate facilities necessary to solidify the high-level liquid wastes at West Valley. The Department of Energy is issuing this FEIS, based on the best available information, before any decision is made to proceed with major detailed design efforts or other major activities. It is recognized that other decisions will flow from the proposed action. Using a tiering approach, the Department will provide appropriate documentation to comply with NEPA for future project decisions.

The Draft Environmental Impact Statement (DOE/EIS-0081D) was made available for public review and comment on July 31, 1981, and a notice of availability was published in the Federal Register on August 7, 1981. Federal, State, and local agencies were supplied copies of the draft statement and were requested to comment on its contents. Copies of the statement were also provided to interested groups and individuals. Additionally, the opportunity to comment on the draft statement was provided at public hearings conducted in West Valley, New York, on September 26, 1981. The comment period ended October 30, 1981.

The format of this FEIS follows the suggested format in the CEQ regulations. Additional appendices are included to provide detailed documentation of the analyses. Section 1 documents the purpose of the proposed action and the need for it. Section 2 describes the proposed action and alternatives to it. It also summarizes the impacts of the project on the environment and compares these impacts. Section 3 summarizes the affected environment at the site.

Section 4 analyzes the environmental consequences of the proposed action and alternatives to it during both the construction and operational phases of the project. Section 5 presents the names and professional qualifications of the persons responsible for preparing the statement. Appendix G presents comments received on the Draft Environmental Impact Statement and Appendix H presents the Department's responses.

Preparation of this FEIS has been coordinated with New York State to ensure that it meets requirements of the New York State Environmental Quality Review Act.

Single copies of this statement may be obtained from the following address:

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SUMMARY

The Western New York Nuclear Service Center is located near the town of West Valley, about 50 km (30 miles) south of Buffalo, New York. At this site, there are about 2 million liters (600,000 gallons) of liquid high-level radioactive wastes stored in underground tanks. These wastes resulted from commercial reprocessing of nuclear reactor fuels from 1966-1972 by Nuclear Fuel Services, Inc. The underground tank storage of liquid high-level radioactive wastes at West Valley is not consistent with the Federal Government's waste management objective of securing long-term permanent isolation of these wastes from the biosphere. In October 1980, the U.S. Congress directed the U.S. Department of Energy to carry out a high-level liquid radioactive waste management demonstration project at the Western New York Nuclear Service Center. Environmental impacts of alternatives for long-term management of the liquid high-level radioactive wastes at West Valley are described and discussed in this statement. These impacts will be considered by the Department of Energy in its decision on whether to construct and operate facilities to solidify those liquid high-level wastes.

ALTERNATIVES FOR LONG-TERM MANAGEMENT OF THE LIQUID HIGH-LEVEL RADIOACTIVE WASTES AT WEST VALLEY

After a public scoping process, public meeting, and review of oral and written comments, the Department determined that the following alternatives for management of the West Valley high-level wastes would be analyzed and compared in this Final Environmental Impact Statement (FEIS).

Alternative 1 - Onsite Processing to Terminal Waste Form

In alternative 1, the liquid high-level wastes would be removed from the underground storage tanks and processed onsite into a solid terminal waste form.* This alternative is subdivided into two subalternatives.

Alternative 1a - Separated Salt/Sludge (Preferred)

In the separated salt/sludge alternative, the sludge would be separated from the supernate. The radioactive components in the supernate would be chemically separated and combined with the sludge into a high-level waste terminal form (suitable for geologic disposal). A low-activity salt cake would remain after evaporating the supernate. The solidified high-level wastes would be stored onsite until a Federal repository became available and would then be transported offsite to a Federal repository for permanent disposal. For purposes of analysis in this EIS, it was assumed that the low-level wastes and salt

*Borosilicate glass was the terminal waste form assumed for purposes of an analysis and comparison of alternatives in this EIS (see Section 2.1).

cake (generated as a result of the solidification project) would be temporarily stored onsite and subsequently shipped to a regional burial ground (when one became available) for permanent disposal. The transuranic wastes* would be temporarily stored onsite and then shipped to a Federal repository. The high-level waste tanks would be decontaminated, filled with cement, and left onsite permanently (entombed).

For purposes of analysis, it was also assumed that the existing facility with modifications would be used for waste solidification and, after solidification, the facilities used for this project would be decontaminated and dismantled for disposal.

Alternative 1b - Nonseparated Salt/Sludge

In the nonseparated salt/sludge alternative, the sludge and supernate would be combined and processed to a high-level-waste terminal form. The radioactive components in the wastes would not be separated into the high-level-waste terminal form and the low-activity salt cake as in alternative 1a. This processing would result in a larger number of high-level waste canisters, but there would be no salt cake to dispose. The other components of this alternative are the same as those described for alternative 1a.

Alternative 2 - Onsite Processing to Interim Waste Form

In alternative 2, the liquid high-level wastes would be converted into a solid interim form** that would be shipped offsite to a Federal waste facility for temporary storage and later processing to a terminal form along with other wastes. Following processing to a terminal form, the wastes would be transported to a Federal repository for permanent disposal. As in alternative 1, it was assumed that the low-level wastes would be temporarily stored onsite and subsequently transported to a regional burial ground for permanent disposal, and the transuranic wastes would be temporarily stored onsite and then transported to a Federal repository for disposal. As in alternative 1, it was assumed that the emptied waste tanks would be decontaminated and stabilized in place with cement and that the facilities used would be decontaminated and dismantled following completion of solidification.

Alternative 3 - In-Tank Solidification

In alternative 3, the liquid high-level wastes would be mixed with cement and other additives, poured back into the existing tanks, and left onsite. All low-level wastes would be buried onsite in the existing NRC-licensed burial ground. The facilities used in the project would be decontaminated and filled with cement (entombed).

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*As used in this EIS, transuranic wastes (TRU) are non-high-level wastes that contain more than 10 nanocuries of transuranic elements per gram of wastes. These elements are man-made elements that have atomic numbers greater than 92 (uranium) and that are environmentally important because most transuranic elements have very slow rates of radioactive decay (long-lived).

**Fused salt in a monolithic form was the interim waste form assumed for purposes of analysis and comparison of alternatives in this EIS (see discussion in Appendix B, Section B-2).

Alternative 4 - No Action

Alternative 4 is the no-action alternative and is subdivided into two sub-alternatives.

Alternative 4a - Delay 10 Years

In alternative 4a, the liquid high-level wastes would continue to be stored in the tanks for 10 years, after which time solidification would be reconsidered.

Alternative 4b - Continued Storage in Tanks

In alternative 4b, the high-level liquid wastes would continue to be stored in the tanks indefinitely.

QUANTIFIABLE IMPACTS

Radiological Impacts

Radiological impacts were estimated for both workers and the general population. The total occupational doses would be similar for alternatives 1a, 1b, and 2 because the principal activities contributing to the total dose--decontamination, dismantlement, and transportation of wastes--are common to these alternatives. Alternative 3 (in-tank solidification) would have a lower worker dose because there would be less handling of wastes throughout the project, no dismantlement of facilities, and no offsite transportation. The occupational dose for the no-action alternatives would result from maintenance of the high-level wastes as liquids at West Valley.

Radiological impacts to the population were estimated for both the short term (100 years) and long term (100 to 10,000 years). It was assumed that there would be no institutional controls (monitoring, guarding) after 100 years. For the short term, several scenarios for the potential release of radioactivity to the environment were analyzed and the resultant risks determined. Most of the population risks during the short term for alternatives 1a, 1b, 2, and 3 would occur prior to completion of solidification and transportation to disposal sites. Subsequently, risks would be greatly reduced. The short-term population risks would be lowest for alternative 3, primarily because no offsite transportation of wastes would be needed. For the no-action alternatives, the short-term population risks would continue to be associated with a sabotage attempt, a potential airplane crash into the liquid wastes, and natural disasters, as well as the transfers of wastes to new tanks every 40 years. The risks would decrease to about one-third of the current amount over the 100 years because of radioactive decay.

The largest population risks during the long term would be due to potential human intrusion into the wastes at West Valley or at the low-level-waste disposal site and potential contamination of groundwater. The risks would be greatest for alternative 4b. The estimates of long-term impacts must be viewed with caution since natural disasters, technical and social changes, and medical progress cannot be predicted with scientific accuracy.

Table S.1. Quantifiable Environmental Impacts Associated with the Alternatives for Management of the West Valley Liquid High-Level Wastes

Alternative	Radiological†[1] - Occupational		Radiological†[1] - Population†[2]: Short-Term (100 years)		Radiological†[1] - Population†[2]: Long-Term†[3] (100 to 10,000 years)		Nonradiological	
	Dose (person-rem)	Health Effects†[4]	Dose Risk (person-rem)	Health Effects†[4]	Dose Risk (person-rem)	Health Effects†[4]	Injuries	Deaths
1a Terminal form, separated salt/sludge	1,800	0.2 - 1.4	340	0.03 - 0.27	210	0.02 - 0.17	53	0.8
1b Terminal form, nonseparated salt/sludge	2,100	0.2 - 1.7	390	0.04 - 0.31	70	0.007 - 0.06	56	1.0
2 Interim form, fused salt	2,200	0.2 - 1.8	420	0.04 - 0.34	70	0.007 - 0.06	61	1.1
3 In-tank solidification	1,100	0.1 - 0.9	37	0.004 - 0.03	5,200	0.52 - 4.2	25	0.27
4a No action, delay for 10 years†[5]	80+	0.008+ - 0.06+	120+	0.01+ - 0.1+	NA†[6]	NA	NA	NA
4b No action, continued storage in tanks	880	0.09 - 0.7	460	0.05 - 0.37	120,000	12 - 96	40	0.42

†[1] Radiological impacts include both normal events and accidents. To obtain the risk, the consequences of each event is multiplied by the probability of the event. Total risk equals the sum of all risks.

†[2] To put population risks in perspective, background radiation doses to the population within 80 km of West Valley (or a regional burial ground) over the respective time periods would be: 15 million person-rem in 100 years and 1.5 billion person-rem in 10,000 years. To put population health effects in perspective, the normal incidence of fatal cancers in that population (based on cancer deaths as 20% of all deaths) would be: 300,000 deaths in 100 years and 30 million deaths in 10,000 years.

†[3] For the long-term radiological impacts, it was assumed that there would be no institutional controls, i.e., that the facilities and wastes would be abandoned. There would be no monitoring, maintenance, mitigating measures, or prevention of human intrusion.

†[4] Health effects are defined as both fatal cancers and genetic defects (see Section 4.1) and are based on 100-800 health effects per million person-rem.

†[5] For alternative 4a, only the impacts for the 10 years of continued storage are given. The impacts from an action alternative would have to be added on.

†[6] NA = not applicable. The long-term radiological impact would be appropriate to the alternative chosen after the 10-year delay.

For alternatives 1a, 1b, and 2, the estimated health effects are less than 1 (0.007 to 0.17). For alternative 3, the number of health effects is in the range 0.52 to 4.2. For the no-action alternative 4b, the number of health effects is in the range 12 to 96 in a population that would normally incur about 30 million fatal cancers during this 10,000-year period (assuming a constant population of 1.5 million).

Nonradiological Impacts

Over the 100 years of assumed institutional controls, the estimated number of worker injuries and deaths associated with nonradiological risks during the various activities would be similar for alternatives 1a, 1b, and 2, with the interim-form alternative 2 being the largest due to the need for increased transportation (Table S.1). Alternative 3 would have the lowest risk. Industrial workers normally take such risks even with the best safety practices. For the short term (100 years), the risks of such injuries and deaths would be greater than the risks of health effects (cancers and genetic defects) for all the alternatives due to exposure to radioactivity.

NONQUANTIFIABLE FACTORS

Impacts associated with construction/operations/decommissioning activities, influx of workers, land use, commitment of natural resources, and nonradiological pollutants released to the environment would be small for any of the alternatives and would be similar to other construction projects of like magnitude.

Social impacts would be associated with public perception of radiological risks and unequitable distribution of such risks. It is not clear which of the alternatives would be perceived by the entire affected population (at West Valley, along transportation routes, and at disposal sites) to be the most acceptable. With respect to distribution of risks, the radiological risks for alternatives 1a, 1b, and 2 would occur in the vicinity of the West Valley area, along transportation routes, and at the offsite processing and/or disposal sites. For alternatives 3 and 4, all risks would remain at West Valley. For all the action alternatives 1a, 1b, 2, and 3, workers of the current generation would incur the risks associated with exposure to radioactivity and industrial activities (injuries); however, risks to future generations would be reduced as a result of implementation of an action alternative.

There are several institutional factors that would affect both the decision-making and implementation of the various alternatives. For the action alternatives 1a, 1b, and 2, major factors would include: U.S. Environmental Protection Agency/U.S. Nuclear Regulatory Commission low-level and high-level waste standards for permanent disposal; transportation regulations and jurisdictions for shipping the wastes to other sites; availability of a regional burial ground for disposing of the low-level wastes generated as a result of the project; and availability of a Federal repository for disposal of the solidified high-level wastes. Transportation and the availability of a Federal repository would not be issues for alternatives 3 and 4b because the wastes would remain at the West Valley site. An advantage of alternative 4a (delay 10 years) is that it would allow more time for these institutional issues to be wholly or partially resolved.

Mitigative measures for environmental impacts have been considered for all the alternatives.

DECISIONS TO BE MADE

The basic decision to be made is whether to construct and operate facilities necessary to solidify the liquid high-level wastes currently stored in tanks at West Valley in accordance with the West Valley Demonstration Project Act of 1980. Should the Department decide to proceed with this action, additional decisions would be made with regard to constructing and operating such facilities to solidify these wastes into a terminal or interim waste form. Certain implementation decisions would be made at a later time. These include (1) terminal waste-form selection in the early 1980s, (2) geologic repository selection in the mid-1980s, and (3) decommissioning of solidification facilities about 1990. Each of these decisions will be subject to appropriate documentation to comply with the National Environmental Policy Act (NEPA) as provided for by Department of Energy compliance guidelines. If the interim-form alternative 2 is selected, an additional decision to be made is the choice of interim form, which would be made in the early 1980s. Selection of the terminal waste form for alternative 2 will be made in conjunction with the selection of the offsite Federal waste facility for final processing to the terminal waste form.

Alternatives 1a and 1b correspond to the intent of the West Valley Demonstration Project Act of 1980. Since the high-level wastes would permanently remain at West Valley for alternatives 3 and 4b, reviews by the Nuclear Regulatory Commission would be required to assess the adequacy of high-level waste disposal at West Valley. For alternative 4a (10-year delay), decisions similar to those discussed above would be made by the Department of Energy at a future date.

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1. PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

The Western New York Nuclear Service Center is located in a rural area about 50 km (30 miles) southeast of Buffalo; the communities of West Valley, Riceville, Ashford Hollow, and Springville are located within 8 km (5 miles) of the Center. The Center's facilities include a commercial nuclear fuel reprocessing plant, a spent nuclear fuel receiving and storage facility, burial areas for solid radioactive wastes, and underground tanks containing liquid high-level radioactive wastes.

The facilities were constructed on land leased from New York State to Nuclear Fuel Services, Inc. (NFS), the former commercial operator of the Center. Nuclear Fuel Services reprocessed both commercial nuclear power reactor fuels and defense production reactor fuels at the Center from 1966 to 1972. Approximately 2 million liters (600,000 gallons) of liquid high-level radioactive wastes, currently stored in underground tanks, resulted from this reprocessing. These activities were regulated pursuant to a license from the U.S. Nuclear Regulatory Commission (NRC) and its predecessor agency, the Atomic Energy Commission. The plant is now being maintained in a shutdown condition.

The lease between New York State and NFS provided that the first term of the lease would terminate at the end of 1980, and NFS advised the State of its intention not to renew the lease thereafter. In 1976, New York State requested that the Federal government take over the site.

In 1978, the U.S. Congress directed the Department of Energy to conduct a study to explore technical and institutional options for the possible decontamination and decommissioning of the Center as well as possible continued uses of the Center (U.S. Congress 1978). The two-volume report of this study, "Western New York Nuclear Service Center Study," was published for public comment in November 1978. A detailed history of West Valley and references to numerous technical and government documents on West Valley were given in that report (U.S. Dep. Energy 1978). The report was transmitted to Congress, along with the results of the public review, in February 1979. A major recommendation from the public review was that the liquid high-level wastes be solidified as soon as practicable.

In October 1980, Congress enacted the West Valley Demonstration Project Act, which directed the Department of Energy to carry out solidification of the high-level wastes at West Valley (see Section 1.3). The Department of Energy is now the site administrator, and West Valley Nuclear Services Company, Inc. (a wholly owned subsidiary of Westinghouse Electric Corporation), is the site operator.

For additional sources of West Valley history, the reader is referred to the U.S. Department of Energy (1978) report; hearings before the House Subcommittee on Energy Research and Production (U.S. House Committee on Science and Technology 1979); Senate report No. 96-787 on the West Valley Demonstration Project Act (U.S. Senate 1980); and the U.S. General Accounting Office (1980) report on the "Status of Efforts to Clean Up the Shut-Down Western New York Nuclear Service Center."

1.2 CHARACTERISTICS OF HIGH-LEVEL WASTES

Two types of liquid high-level wastes (HLW) are stored at West Valley: (1) alkaline Purex wastes in Tank 8D2 and (2) acidic Thorex wastes in Tank 8D4. The wastes were generated in the reprocessing of spent fuel during plant operation from 1966 to 1972. In 1987, the assumed startup date for the solidification of the liquid HLW at West Valley, the fuels will have had an average out-of-reactor time of about 20 years.

The HLW that left the Purex process were highly acidic (in nitric acid), but were neutralized with sodium hydroxide before being transferred to Tank 8D2. The wastes now consist of an upper supernatant liquid layer, which has a high concentration of salts, and a bottom layer of sludge. Although the bottom layer consists largely of iron and aluminum hydroxides, its volume, chemical composition, and physical condition are not precisely known. The high-level wastes in Tank 8D4 are acidic Thorex wastes. These wastes are considered to be a single-phase solution.

The radioactive nuclides in both tanks continue to decay with time, thereby reducing the curie level of the wastes. The estimated radioactivity of the two wastes in 1987 are given in Appendix B, Tables B.1 and B.2. The dominant radioactivities in Tank 8D2 and 8D4 are due to cesium-137 (half-life, 30.2 years) and strontium-90 (half-life, 28.1 years). These wastes are discussed in greater detail in Appendix B.

1.3 LEGISLATION

The "West Valley Demonstration Project Act of 1980" (reproduced in Appendix C) authorizes the Department of Energy to "carry out a high level nuclear waste management demonstration project at the Western New York Nuclear Service Center in West Valley, New York (U.S. Congress 1980)." The principal activities mandated by Congress, which are set forth in Section 2(a) of the Act, include:

"(1) The Secretary [of the Department of Energy] shall solidify, in a form suitable for transportation and disposal, the high level radioactive waste at the Center by vitrification or by such other technology which the Secretary determines to be the most effective for solidification.

(2) The Secretary shall develop containers suitable for the permanent disposal of the high level radioactive waste solidified at the Center.

(3) The Secretary shall, as soon as feasible, transport, in accordance with applicable provisions of law, the waste solidified at the Center to an appropriate Federal repository for permanent disposal.

(4) The Secretary shall, in accordance with applicable licensing requirements, dispose of low level radioactive waste and transuranic waste produced by the solidification of the high level radioactive waste under the project.

(5) The Secretary shall decontaminate and decommission--
  (A) the tanks and other facilities of the Center in which the high level radioactive waste solidified under the project was stored,
  (B) the facilities used in the solidification of the waste, and
  (C) any material and hardware used in connection with the project,
  in accordance with such requirements as the Commission [Nuclear Regulatory Commission] may prescribe."

1.4 PROPOSED ACTION

1.4.1 Need for Action

The need for this solidification project results from the existence of about 2 million liters (600,000 gallons) of high-level liquid radioactive wastes stored in underground tanks at West Valley. In November 1970, the Atomic Energy Commission (now the Nuclear Regulatory Commission) issued regulations (10 CFR 50 Appendix F) which required that, in the future, all high-level wastes generated at licensed fuel reprocessing facilities be solidified within five years after reprocessing the spent fuel. The existing West Valley wastes were specifically exempted from these regulations and are subject to further rule-making. Storage of the liquid HLW in tanks is not consistent with the Federal Government's waste management goal of permanent isolation from the biosphere, although these wastes currently pose no immediate risk to public health and safety (U.S. Dep. Energy 1980). Consequently, solidification of the West Valley HLW is now being considered.

1.4.2 Proposed Action and Decision to be Made Now

The proposed action is to design, construct, and operate facilities necessary to solidify the HLW stored at West Valley. The Department's preferred alternative for proceeding with this action is solidification of the wastes to a terminal form at West Valley for shipment to a Federal repository. Other major alternatives considered are: (a) solidification of the wastes to an interim form for shipment to an offsite to-be-constructed Federal waste facility (with later solidification to a terminal form and shipment to a Federal repository), (b) solidification of the wastes in the tanks, and (c) continued storage of the wastes in the tanks at West Valley (no action).

With respect to the preferred alternative, the Department also prefers to process the wastes by separating the inert salts from the HLW (separated salt/sludge process) and to modify the existing process building to carry out the solidification. Other options under consideration are processing of the wastes by the nonseparated salt/sludge process and construction of a new processing building.

Thus, the decision to be made now is to choose one of the alternatives discussed in this environmental impact statement (EIS). If the preferred alternative and options are chosen, the Department will proceed with the design, decontamination, construction, and operation of facilities to process the wastes based on the reference borosilicate glass waste form and separated salt/sludge process.

This EIS has been prepared to provide environmental input to this decision. Detailed information on the scoping process for this EIS is presented in Appendix D. Responses to comments on the Draft EIS are given in Appendix H. In reaching a decision, the Department will consider the environmental impacts and public comments, along with other factors such as the West Valley Demonstration Project Act. A Record of Decision will be published in the Federal Register in 1982.

1.4.3 Decisions to be Made Later

If a decision is made to proceed with the preferred alternative, there will be several subsequent implementation decisions that will not be made until more technical information is available and/or some major institutional issues have been wholly or partially resolved.

Decisions that will be made at a later date include: (1) specific terminal waste form and associated solidification technique so as to proceed with construction and installation of equipment; (2) final decontamination and decommissioning of facilities used; (3) location and design of a Federal waste repository; and (4) location and methods of disposal for the low-level wastes (LLW) associated with solidification and final decontamination and decommissioning.

It is expected that the final decision on the specific terminal waste form and solidification technique will be made by 1984. The current status of waste-form technologies is discussed in Appendix B, Section B.2.

A decision on the location and design of a Federal repository will be part of a separate ongoing decision-making process. The Department estimates that this decision will be forthcoming in the mid-1980s. Evaluations of various geologic media, search for a suitable site, conceptual design work, and safety analyses are underway in a national program (Section 4.3.3).

The Department's decisions concerning the final decontamination and decommissioning of the facilities used for the solidification project must necessarily take into account the then-current NRC requirements for decommissioning nuclear facilities and the status and plans by the state of New York for other parts of the Center. The Department has no authority with respect to the final disposition of other parts of the West Valley Center, and any decisions in this regard will have to be based on further environmental analysis by the responsible agency. Decisions on decontamination and decommissioning procedures will be made by the end of the solidification campaign.

Another later decision is where and how to dispose of the LLW generated as a result of the solidification project. There are currently two options under consideration: (1) disposal of the wastes in the existing NRC-licensed burial ground* at West Valley, and (2) transport of the LLW offsite to a regional burial ground. In order to provide more information on which to base this decision, the Department (in collaboration with the NRC, U.S. Geological Survey, and New York State Geological Survey) plans to conduct geohydrological studies of the NRC-licensed burial ground and perform associated engineering studies of waste packaging and disposal techniques. The regional burial ground would be under the control of the states involved in a regional compact. There is a possibility that a regional burial ground may not be available for some time, thus necessitating the construction of a temporary storage facility at West Valley. Thus, factors that will be taken into consideration when making this decision include: (1) the suitability of the NRC-licensed burial ground, (2) more specific information on the nature of the LLW and disposal techniques, (3) the availability of an offsite regional burial ground, (4) potential environmental and health/safety impacts, and (5) costs.

For the above-mentioned decisions, the Department will provide appropriate documentation to comply with NEPA according to Department of Energy compliance guidelines.

1.5 RELATED FEDERAL PROJECTS

1.5.1 Away-From-Reactor Spent Fuel Storage Program

There is some spent fuel in the existing West Valley spent fuel storage pool which was left over when the reprocessing activities ceased. Although the Department of Energy had been considering use of the West Valley pool in an Away-From-Reactor (AFR) storage program, the Department is discontinuing its efforts to provide Federal AFR spent fuel storage. Spent fuel storage program activities will be redirected to concentrate on the development of technology to increase storage capabilities at the individual reactor sites. Since the Department is no longer considering having an AFR at West Valley, this EIS on the West Valley solidification project will not address cumulative impacts with an AFR.

1.5.2 National Program for High-Level Waste Management

The proposed West Valley project is related to several other major components of the national program for HLW. The West Valley wastes are similar to defense HLW (although there are some differences as discussed in Appendix B) and represent less than one percent of the amount of defense wastes. There are approximately 83 million liters (22 million gallons) of HLW at the Savannah River Plant in Aiken, South Carolina; 190 million liters (50 million gallons) of HLW at the Hanford Reservation, Richland, Washington; and 1,500 cubic meters (52,000 cubic feet) of solid HLW at the Idaho National Engineering Laboratory, Idaho Falls, Idaho. These wastes were produced during reprocessing of nuclear reactor fuels used for the production of defense nuclear materials. The Department of Energy has issued environmental impact statements for its

*The NRC-licensed burial ground was formerly used by Nuclear Fuel Services under an NRC license. It is now controlled by the Department of Energy for the duration of the solidification project under an NRC license amendment (U.S. Nucl. Reg. Comm. 1981).

current HLW management operations at Hanford, Idaho, and Savannah River (U.S. Energy Res. Dev. Admin. 1975, 1976, 1977d); and documents describing the alternatives for long-term management of defense wastes at these sites (U.S. Energy Res. Dev. Admin. 1977a, 1977b, and 1977c). A final environmental impact statement for the proposed Defense Waste Processing Facility at Savannah River was issued in February 1982 (U.S. Dep. Energy 1982).

Recently, a number of alternatives for disposal of high-level radioactive wastes have been identified and evaluated in the "Final Environmental Impact Statement, Management of Commercially Generated Radioactive Wastes" (U.S. Dep. Energy 1980). These alternative technologies are:

1. Geologic disposal using conventional mining techniques (preferred alternative).
2. Rock-melting disposal.
3. Island disposal.
4. Subseabed disposal.
5. Icesheet disposal.
6. Deep-well injection disposal.
7. Partitioning and transmutation.
8. Space disposal.
9. Chemical resynthesis.

The proposed action identified by the U.S. Department of Energy (1980) is to adopt a national strategy to develop mined geologic repositories for disposal of commercially generated high-level radioactive and transuranic wastes and to conduct the necessary research and development programs to ensure the safe long-term containment and isolation of the wastes. This proposed action was adopted by the Department as indicated in the Record of Decision (U.S. Dep. Energy 1981). Also, as mentioned in Section 1.3, the Department has a nuclear waste-isolation project that is concerned with the establishment of Federal HLW repositories. The EPA and the NRC are developing standards and criteria for Federal HLW repositories.

Research and development programs covering a wide range of terminal waste forms (suitable for permanent disposal) are being conducted at various Department of Energy, university, and industrial laboratories. Interim waste forms are also being developed that may allow safe shipment of wastes from one site to another for further processing into a terminal form. The Department has established a Transportation Technology Center at Sandia Laboratories for research and development, design, fabrication, and testing of containers for transporting nuclear materials.

More detailed discussions of the above-mentioned Federal activities as they relate to the proposed West Valley project are included elsewhere in this EIS, especially in Section 4.3 (institutional issues) and throughout Section 2 and Appendix B.

1.6 OTHER APPLICABLE FEDERAL LAWS

The West Valley solidification project will comply with appropriate Federal and State laws, regulations, and Executive Orders. The major Federal laws and Executive Orders potentially applicable are listed in Appendix E.

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U.S. Nuclear Regulatory Commission. 1981. "Amendment (Change No. 31) to Facility License No. CSF-1, Docket No. 50-201, Nuclear Fuel Services, Inc., and New York State Energy Research and Development Authority (Western New York Nuclear Service Center)." September 1981.

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2. COMPARISON OF ALTERNATIVES

The major alternatives for management of the liquid high-level wastes (HLW) at West Valley are described and compared in Section 2.1. These include:

- Alternative 1a (Preferred) - Onsite Processing to Terminal Waste Form (Separated Salt/Sludge). In alternative 1a, the radioactive components of the wastes would be separated, concentrated, and converted into a solid, terminal high-level waste form suitable for transportation offsite and disposal in a Federal geologic repository.

- Alternative 1b - Onsite Processing to Terminal Waste Form (Nonseparated Salt/Sludge). Alternative 1b is the same as alternative 1a except that all the liquid high-level wastes would be converted to a terminal waste form (no separation and concentration).

- Alternative 2 - Onsite Processing to Interim Waste Form. In alternative 2, the liquid high-level wastes would be converted to a solid interim form which would be shipped offsite to a to-be-constructed Federal waste facility for later processing to a terminal form and disposal in a Federal repository.

- Alternative 3 - In-Tank Solidification. In alternative 3, the liquid high-level wastes would be mixed with cement and other additives, poured back into the existing tanks, and left onsite.

- Alternative 4a - No Action (Delay 10 Years). In alternative 4a, the liquid high-level wastes would continue to be stored in the tanks for 10 years, after which time solidification would be reconsidered.

- Alternative 4b - No Action (Continued Storage in Tanks). In alternative 4b, the high-level wastes would continue to be stored in the tanks indefinitely.

Another alternative, shale fracturing, was described in an earlier U.S. Department of Energy (1978) report, but was rejected from further detailed consideration in this EIS (see Section 2.3).

Alternative methods for disposal of terminal-form high-level wastes--such as very deep hole, rock melting, subseabed, space, and transmutation--were not considered in this EIS. These alternatives were considered in the Department's "Final Environmental Impact Statement, Management of Commercially Generated Radioactive Waste" (U.S. Dep. Energy 1980). On May 14, the Department of Energy issued a Record of Decision for the selection of a strategy for disposal of commercially generated wastes. Geologic disposal using conventional mining techniques has been selected as the national disposal strategy (U.S. Dep. Energy 1981). The West Valley terminal-form high-level wastes would be similar to the commercial high-level wastes discussed in the U.S. Department of Energy (1980) report (similar heat content and radionuclide composition; see Appendix B, Section B.2). Thus, geologic disposal in a Federal repository was assumed for alternatives 1a, 1b, and 2 in this EIS. As noted in Section 1.4.3, siting and design of the repository is being covered under separate EISs.

Descriptions of the alternatives as assumed for purposes of analysis and comparisons of technical aspects, radiological and nonradiological impacts, and institutional issues, are presented in Section 2.1. The technologies for implementing each alternative are discussed in detail in Appendix B. The action alternatives 1a, 1b, 2, and 3 are composed of a number of steps, which are concerned with the following activities and facilities: removal of the wastes from the tanks (Section B.1); solidification processing (Section B.2); use of facilities (presolidification decontamination, modifications, LLW treatment facility, and new temporary storage facilities, Section B.3); management of high-level, transuranic, and low-level wastes (packaging, handling, disposal, Section B.4); transportation of wastes (Section B.5); and final decontamination and decommissioning of the facilities used for the solidification project (Section B.6). The no-action alternative, continued storage in tanks, is discussed separately (Section B.7).

For some of the steps, several options were considered--e.g., using the existing facility or constructing a new one to house the solidification equipment, dismantling the empty tanks rather than emtombing them, using the existing spent fuel pool for temporary storage of the solidified high-level wastes rather than constructing a new storage facility, transporting the HLW by truck rather than by rail, and using the NRC-licensed burial ground rather than a regional burial ground. However, inclusion of all the options would have resulted in an unwieldy array of alternatives for comparison. A discussion of options is given in Appendix B. Ongoing studies of costs or mitigation of potential environmental impacts may lead to the substitution of an option not included in one of the alternatives. Major options that were not used in the definitions of alternatives, but may be considered in further decisions, are summarized in Section 2.2.

2.1 COMPARISON OF KEY IMPACTS

2.1.1 Alternative 1a (Preferred) - Onsite Processing to Terminal Waste Form (Separated Salt/Sludge)

2.1.1.1 Description and Technical Aspects

In alternative 1a (Figure 2.1), the liquid high-level wastes (HLW) would be removed from the tanks and processed into a solid terminal form. The small amount of acidic Thorex waste (47,000 L) may first be removed from Tank 8D4 and processed into a terminal high-level waste form, borosilicate glass.* Then, the large amount of neutralized Purex waste in Tank 8D2 (2,000,000 L) would be homogenized, i.e., the sludge in the bottom of the tank would be mixed with the overlying supernatant liquid. The wastes would be pumped in batches to a holding tank and thence to the main process building. The sludge would be separated out again by centrifugation, or settling, and filtration. The radioactive materials dissolved in the supernate would be removed onto ion-exchange resins. The highly radioactive sludge and the radioactive concentrates from the ion-exchange resins would then be mixed together and incorporated into a terminal high-level waste form (borosilicate glass). The liquid that remained after the ion-exchange treatment would be evaporated down to a low-level radioactive salt cake (primarily nitrate salts). Variations on these processing steps are under also consideration: blending the Thorex wastes into the Purex wastes for the solidification processing, decanting the supernate from Tank 8D2 rather than homogenizing it with the sludge, and using precipitating agents to remove cesium from the supernate prior to decantation. Details are given in Appendix B on removal from the tanks (Section B.1), processing (Section B.2), and use of facilities (Section B.3).

It was assumed that the existing facility with modifications would be used for waste solidification. (See Section 2.2.1 for discussion of the new facility option.) Parts of the building would have to be decontaminated and the existing contaminated equipment removed. Modifications would then be made to accommodate the new solidification equipment.

The solidified HLW would be contained in about 300 large steel canisters (0.6 m [2 ft] in diameter by 3 m [10 ft] tall). These canisters would be stored onsite

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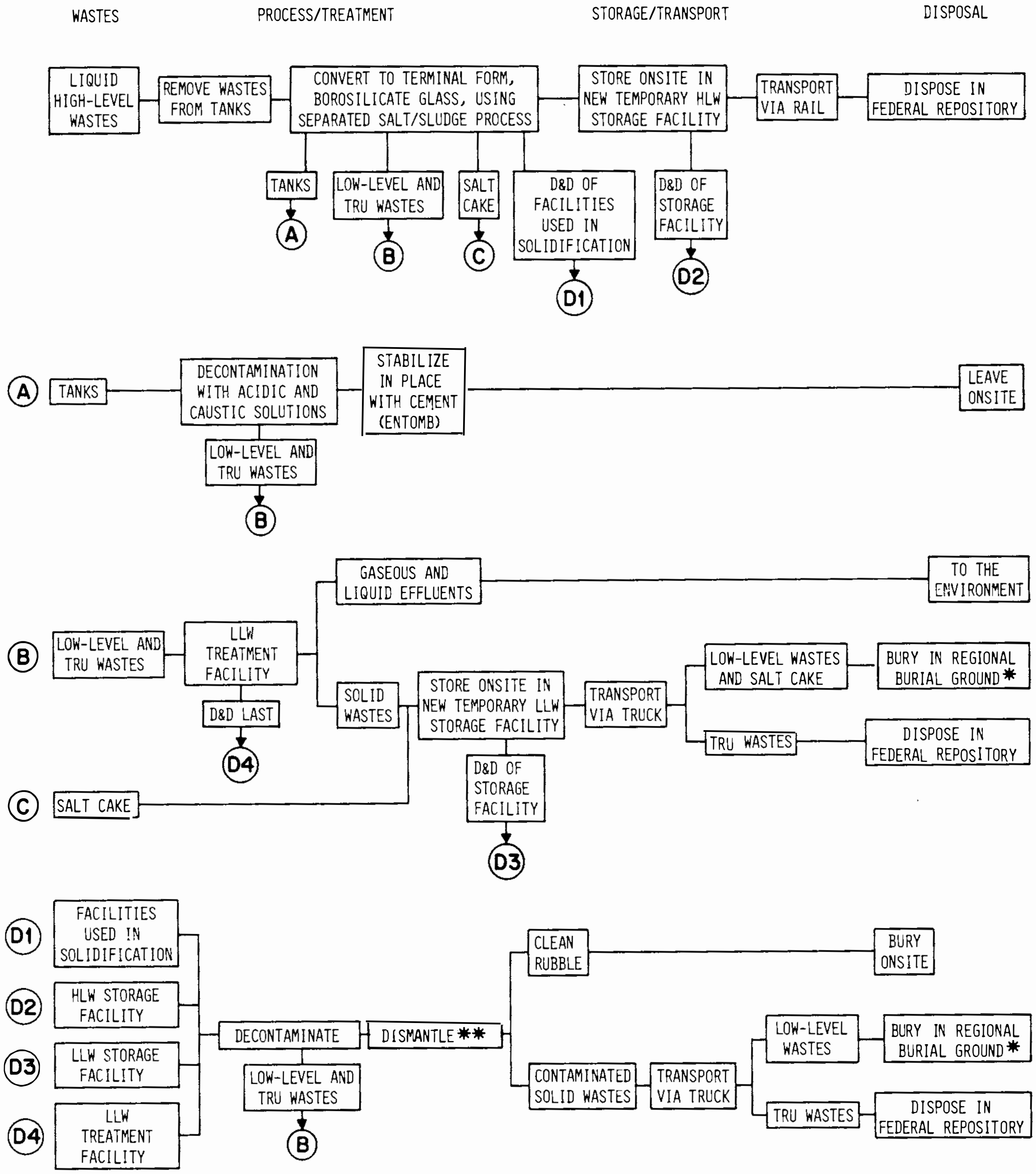
*Because of their advanced stage of development, borosilicate glass monoliths are utilized as the reference terminal waste form for purposes of analysis in this EIS. However, this does not imply a decision to actually use this waste form. An updated environmental review of the waste form options will be prepared at the time the waste form selection is made. The analysis in this EIS has been carried out using glass properties and characteristics that are believed to be reasonably attainable with near-term technology. Since another waste form would not be chosen unless it had equal or better processing and product characteristics than assumed herein for borosilicate glass monoliths, the EIS calculations can be considered limiting for any waste form in that they should represent the worst conditions expected. A large research and development program is being conducted on other waste forms at a variety of national laboratories, universities, and industrial plants. The decision on waste form is expected by 1984. See Appendix B, Section B.2, for a discussion of terminal waste forms.



* THE OPTION OF DISPOSING THE LOW-LEVEL WASTES IN THE EXISTING NRC-LICENSED BURIAL GROUND IS DISCUSSED IN SECTION 2.2.6.

** THE EXISTING SPENT FUEL POOL IS CONSIDERED TO BE PART OF THE MAIN PROCESS BUILDING THAT MAY BE USED IN SOLIDIFICATION. BEFORE IT COULD BE DISMANTLED, THE EXISTING SPENT FUEL WOULD HAVE TO BE TRANSPORTED OFFSITE TO SOME UNIDENTIFIED LOCATION. EVENTUAL TRANSPORTATION AND DISPOSAL OF THIS SPENT FUEL WOULD BE COMMON TO ALL THE ALTERNATIVES.

Figure 2.1. Alternative 1a - Onsite Processing to Terminal Waste Form (Separated Salt/Sludge).

(Appendix B, Sections B.3 and B.4) in a new temporary HLW storage facility. (See Section 2.2.3 for discussion of the option of storing the solidified HLW in the existing spent fuel pool.) The canisters would eventually be transported (Appendix B, Section B.5) in about 40 shipments in special railcar casks to a Federal repository when it became available for permanent disposal.* The special transportation casks are being designed as part of the Department's radioactive waste technology program. (See Section 2.2.7 for discussion of the option of transporting the HLW by truck.)

The empty tanks would be decontaminated with acids, filled with cement, and left onsite permanently (Appendix B, Section B.6). (See Section 2.2.4 for discussion of the tank dismantlement option.)

There would also be a large volume of non-high-level radioactive wastes generated as a result of project activities. For purposes of analysis in this EIS, these wastes were divided into three categories: (1) transuranic (TRU)** wastes, (2) salt cake, and (3) miscellaneous low-level wastes (LLW). These solid, liquid, and gaseous wastes would be treated in a LLW treatment facility (Appendix B, Section B.4). Most of the LLW and TRU wastes would be generated during the presolidification decontamination and during the final decontamination and decommissioning of the facilities. They would be temporarily stored onsite in a new temporary storage facility until a burial ground became available (Appendix B, Section B.3).

The LLW and salt cake would be transported via trucks in about 1700 shipments (Appendix B, Section B.5) to a regional burial ground for permanent disposal. These wastes would mostly be contained in ordinary 55-gallon steel drums and in steel boxes. For purposes of analysis in this EIS, it was assumed that the regional burial ground would be available in 1990, it would be located 640 km (400 miles) from West Valley, and the natural features would be similar to West Valley. (See Section 2.2.6 for discussion of the option of disposing the LLW in the existing onsite NRC-licensed burial ground.)

The TRU wastes would be transported via trucks in about 600 shipments (Appendix B, Section B.5) to a Federal repository for disposal. They would be shipped in special metal containers. There is uncertainty about the amounts of wastes that would have to be classified as TRU which requires costly special handling, transportation, and repository disposal. This uncertainty cannot be resolved until the activities are undertaken.

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*For purposes of analysis in this EIS, it was assumed that: (1) the repository would be available in 1997, (2) it would be a deep geologic type (deep underground), and (3) it would be located 4800 km (3000 miles) from West Valley.

**As used in this EIS, transuranic (TRU) wastes are non-high-level wastes that contain more than 10 nanocuries of transuranic elements per gram of wastes. These elements are man-made elements that have atomic numbers greater than 92 (uranium) and are environmentally important because they generally have very slow rates of radioactive decay (long-lived). (Most of the TRU elements that are currently in the liquid HLW would be immobilized in the solidified HLW.)

All of the wastes would be routed to the disposal sites by the route which was consistent with regulations. Main rail lines and interstate (or primary) highways would probably be used (Appendix B, Section B.5). A major uncertainty about the transportation and final disposal of the wastes is their final destination.

Eventually, all the facilities used for the solidification project would be decontaminated and dismantled--including the main building used in the solidification process,* the temporary HLW storage facility, the temporary LLW storage facility, and the LLW treatment facility. The nonradioactive rubble would be buried onsite. (See Section 2.2.5 for discussion of the building entombment option.)

A schedule assumed for purposes of analysis of alternative la is given in Table 2.1. Most of the effort would occur in two periods. The initial period would encompass decontaminating the facilities, solidifying the wastes, and placing all the wastes in temporary storage; the final period would include offsite transportation and disposal of the wastes and the final decontamination and decommissioning of the facilities used in the solidification project. As currently envisioned, the actual solidification operations would require three years, from 1987 to 1990. The total time to complete alternative la would be about 20 years, ending about the year 2000 (assuming that a Federal repository will be available in 1997). It is assumed that institutional controls (monitoring, maintenance, prevention of intrusion, possible mitigative measures) would remain for about 80 more years, or a total of 100 years. The 100 years of institutional control was assumed in order to be consistent with current regulatory philosophy as expressed in draft standards for radioactive waste disposal (U.S. Environ. Prot. Agency 1981).

There are several major uncertainties that may affect this schedule. First, there are uncertainties about front-end activities--including Congressional appropriations, progress in research and development studies, detailed safety analyses, and U.S. Nuclear Regulatory Commission review and consultation. Second, several institutional issues (Section 4.3) must be resolved before implementation. Third, although 1997 is the projected date that a Federal repository may be available, it may be available earlier or later; thus, shipment of the wastes and final decontamination and decommissioning of the facilities would be similarly affected.

Some engineering and scientific effort would be necessary before alternative la could be implemented. Much of this effort is part of ongoing and planned West Valley programs including: better characterization of the chemical, physical, and radiological nature of the wastes; evaluation of the tank structural condition; development of waste-removal and tank decontamination procedures;

*For purposes of analysis in this EIS, the existing spent fuel receiving and storage facility is considered to be a part of the main reprocessing building. Before this building could be dismantled, the existing spent fuel would have to be transported offsite to some presently unidentified location. Transport and disposal of this spent fuel is not considered by the Department to be part of this alternative and would be subject to separate decision-making. Eventual transport of this spent fuel would be common to all the alternatives (Section 4.4, Cumulative Impacts).

Table 2.1. Schedule Assumed for Purposes of Analysis of Alternative 1a†[1]

Activity	Start	Finish
Preconceptual Design Studies	1982	1983
Construction/Modifications:		
Temporary low-level-waste storage facility		1984
Temporary high-level-waste storage facility		1987
Decontamination of existing facilities	1983	1985
Installation and checkout of equipment	1985	1987
Operations:		
Processing wastes to terminal form	1987	1990
Decontamination and Decommissioning:		
Shipment of spent fuel offsite		1992
Decontamination of tanks and entombment with cement		1992
Dismantlement of processing facility	1992	1996
Shipment of high-level and transuranic wastes to a Federal repository	1997	2000
Dismantlement of temporary high-level-waste storage facility		2000
Dismantlement of temporary low-level-waste storage facility		2000
Dismantlement of low-level-waste treatment facility		2000

†[1] NOTE: These dates were used for purposes of analysis in this EIS. However, they may change as a result of ongoing engineering design and project planning.

further research and development of equipment used for physical and chemical separation of the wastes; development of borosilicate glass formulations based on the specific nature of the West Valley wastes; and engineering design for facility modifications and new construction. A safety analysis would be performed, based on the detailed engineering design of the facilities and equipment.

2.1.1.2 Radiological Impacts

There would be some unavoidable exposure of both workers and the public to radioactivity. (Detailed discussions of the analysis of radiological impacts are given in Section 4.1 and Appendix B).

Occupational Dose

Most of the occupational dose would be associated with presolidification decontamination, final decontamination and decommissioning of the facilities, and transportation (see Section 4.1.6). During implementation of Alternative 1a, the workers would receive a total dose of 1800 person-rem (Table 2.2). This would lead to about 0.2 to 1.4 adverse health effects* (hereditary defects or cancer deaths) (Section 4.1). It is anticipated that workers would receive a dose below that permitted by regulations, in keeping with the as-low-as-reasonably-achievable (ALARA) philosophy and based on experience in similar activities at other Department facilities.

Short-Term Population Risk**

The radiological impacts to the population were evaluated in terms of short-term (100-year) and long-term (100- to 10,000-year) impacts. It was assumed that there would be institutional controls (monitoring, maintenance, prevention of intruders, mitigating measures) during the short term, but not during the long term. The 100 years of institutional controls and the 10,000-year assessment period were assumed in order to be consistent with the latest U.S. Environmental Protection Agency (1981) recommendation for disposal of radioactive wastes.

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*Fractional health effects can be viewed as the probability of a health effect in the affected population. Thus, 0.2 health effects associated with the occupational dose implies a one in five chance of this dose producing a hereditary defect or cancer death.

**In order to have a common basis for the comparison of highly diverse events, the risks were calculated. The risk of an event equals the consequences of that event multiplied by the probability of that event occuring (Risk = Consequences x Probability). Total risk equals the sum of all "normal" risks and "accident" risks. For example, if an event results in a calculated radiation dose of 5 person-rem, and there is a probability of two such events occurring per year, the risk would be 10 person-rem/year ($5 \times 2 = 10$). If an accident event results in a dose of 1 million (10^6) person-rem, but the probability of the event occurring is very low (e.g., once in a million years), then the risk would be only 1 person-rem/year ($10^6 \times 10^{-6} = 1$). Thus, although the consequences of the accident would be much higher than the consequences of the normal event, the accident risk is less than the normal event risk. The total risk in this case is 11 person-rem/year, with the dominant risk being the normal event.

Table 2.2. Summary Comparison of Radiological Impacts Associated with the Alternatives†[1]

Alternative	Occupational		Population†[2]			
			Short-Term (100 years)		Long-Term†[3] (100 to 10,000 years)	
	Dose (person-rem)	Health Effects†[4]	Dose Risk (person-rem)	Health Effects†[4]	Dose Risk (person-rem)	Health Effects†[4]
1a Terminal form, separated salt/sludge	1,800	0.2 - 1.4	340	0.03 - 0.27	210	0.02 - 0.17
1b Terminal form, nonseparated salt/sludge	2,100	0.2 - 1.7	390	0.04 - 0.31	70	0.007 - 0.06
2 Interim form, fused salt	2,200	0.2 - 1.8	420	0.04 - 0.34	70	0.007 - 0.06
3 In-tank solidification	1,100	0.1 - 0.9	37	0.004 - 0.03	5,200	0.52 - 4.2
4a No action, delay for 10 years†[5]	80+	0.008+ - 0.06+	120+	0.01+ - 0.1+	NA†[6]	NA
4b No action, continued storage in tanks	880	0.09 - 0.7	460	0.05 - 0.37	120,000	12 - 96

†[1] Radiological impacts include both normal events and accidents. To obtain the risk, the consequences of each event is multiplied by the probability of the event. Total risk equals the sum of all risks.

†[2] To put population risks in perspective, background radiation doses to the population within 80 km of West Valley over the respective time periods would be: 15 million person-rem in 100 years and 1.5 billion person-rem in 10,000 years. To put population health effects in perspective, the normal incidence of fatal cancers in that population (based on cancer deaths as 20% of all deaths) would be: 300,000 deaths in 100 years and 30 million deaths in 10,000 years.

†[3] For the long-term radiological impacts, it was assumed that there would be no institutional control, i.e., that the facilities and wastes would be abandoned. There would be no monitoring, maintenance, mitigating measures, or prevention of human intrusion.

†[4] Health effects are defined as both fatal cancers and genetic defects (see Section 4.1) and are based on 100-800 health effects per million person-rem.

†[5] For alternative 4a, only the impacts for the 10 years of continued storage are given. The impacts from an action alternative would have to be added on.

†[6] NA = not applicable. The long-term radiological impact would be appropriate to the alternative chosen after the 10-year delay.

Most of the short-term (100-year) population risk of 340 person-rem (Table 2.2) would be incurred during operations, with the major component of the risk (85%) resulting from exposure of people along the transportation routes to the Federal repository and regional burial ground (under normal transport conditions). The population risk from transportation results mainly from the radiation that penetrates the waste packages and irradiates the people residing along the transportation route.

About one percent of the transportation risk is associated with transportation accidents. Several types of accidents involving the different kinds of wastes and different probabilities of occurrence were analyzed. The accident risk is dominated by accidents involving LLW and TRU wastes (primarily because of the large number of shipments of these types of waste). However, the accident that would result in the maximum dose of radiation to an individual (0.6 rem) would be a very improbable accident (6×10^{-5} events/year) involving a canister of HLW (direct radiation). (See Section 4.1 and Appendix B, Section B.5, for more details.)

Until all of the HLW are solidified, the events that would have the most severe radiological consequences to an individual at West Valley would be sabotage (2 rem) and a crash of a large airplane into the wastes (30,000 rem). These events have a very low probability of occurrence (1×10^{-5} and 1×10^{-8} events/year, respectively) and contribute less than 5% to the short-term public risks at West Valley. These events are discussed in more detail under the no-action alternative 4b (continued storage in tanks), an alternative for which these risks contribute significantly to the total risk.

To put the 340 person-rem short-term population risk in perspective, the population within 80 km (50 mi) of West Valley would receive 15,000,000 person-rem from natural background radiation over the 100-year period. Thus, the addition of 340 person-rem would be a very small increment. The risk of health effects from this additional exposure to radioactivity would be very small: in the range of 0.02 to 0.27 additional health effects (includes cancer deaths and genetic defects; see Table 2.2 and Section 4.1). This can be compared to the 300,000 fatal cancers from all causes that the population near West Valley would normally incur over the 100-year period.

Long-Term Population Risk

Most of the long-term (100- to 10,000-year) population risks of 210 person-rem (Table 2.2) would be associated primarily with the potential for human intrusion into the buried wastes and secondarily with the potential for groundwater contamination. The consequences to the intruder would be much less than one health effect (the intruder would receive a dose of about 1 rem, which is twice the nonoccupational annual limit). To put the 210 person-rem in perspective, the population within 80 km (50 mi) of the regional burial ground (assumed population similar to West Valley) would receive 1.5 billion person-rem from natural background radiation over the 10,000-year period. Also, the risk of adverse health effects (fatal cancers plus genetic defects) from the 210 person-rem would be much less than one (0.02-0.17), which can be compared to 30 million fatal cancers from all causes that same population would normally incur over the 10,000 years. These estimates of long-term impacts must be viewed with caution since rare natural events, technical and social changes, and medical progress cannot be predicted so many years into the future. Furthermore, it should be pointed out that the radioactivity in the wastes would decrease to about 0.3% of the current levels in about 300 years because of radioactive decay.

2.1.1.3 Nonradiological Impacts

Nonradiological impacts associated with the construction, operations, and demolition activities at West Valley (e.g. dust, noise, and use of land) would be small (Section 4.2.1). Only about 4 hectares (10 acres) of land that is currently in grass and gravel and is already dedicated to nuclear use would be disturbed by new construction. The gaseous releases, such as NO_2 and SO_2, from implementation of any of the alternatives are estimated to be well below primary air standards. Also, all liquid effluents will meet all appropriate State and Federal standards. Although details are not available, it is estimated that uses of water, natural gas, and electricity would be about the same as when the fuel reprocessing plant was operating. There would be risk of about 53 nonfatal worker injuries and 0.8 worker deaths of the types associated with any industrial project, particularly during modifications/construction, transportation, and final decontamination and decommissioning activities (Section 4.2).* In the long term, there would be a potential for release of water contaminated with nitrate salts from the salt cake buried in the regional burial ground; some mitigative measures, such as use of a binder, would decrease this risk (Section 4.2.1.5). The maximum volume of LLW to be generated has been calculated to be less than 1% of the existing commercial disposal capacity and would not appreciably affect commercial waste disposal.

Socioeconomic impacts--such as effects on the local economy, taxes, community services and housing--would not be significant (Section 4.2.2). However, social impacts due to public perceptions (such as fear and changes in social and governmental relationships) and inequitable geographic distribution of risks might be significant (Section 4.2.2). Social studies have shown that the public tends to focus primarily on potential consequences of worst-case events, as opposed to estimating risks by multiplying the consequences from an event times the probability of occurrence of that event. Thus, the public would likely have a different perception of the risks associated with alternative la than is estimated by technical analysis. Exactly how the entire affected public (at West Valley, along transportation routes, and at disposal sites) would perceive the risks associated with this alternative is not known.

2.1.1.4 Institutional Issues

There are several major institutional issues that need to be wholly or partially resolved and that could affect the actual implementation of this alternative la (Section 4.3), especially:

- U.S. Environmental Protection Agency/U.S. Nuclear Regulatory Commission (EPA/NRC) standards for HLW disposal, which have not been finalized and may delay implementation of this alternative.

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*Some of the injuries/deaths would occur during transportation activities and would involve members of the general public as well as workers. However, it was not possible to separate out the public component (Section 4.2.1.4).

- Transportation regulations and jurisdictions (particularly the recent attempts by states and local governments to control transportation of radioactive materials), which may delay or modify implementation of this alternative.

- Availability of a Federal repository, which is subject to a separate Department of Energy decision-making process and which may cause longer or shorter temporary storage of the solidified HLW and TRU wastes at West Valley.

- Availability of a regional burial ground, which will be determined by the states involved and which may cause longer or shorter temporary storage of LLW and salt cake before disposal.

2.1.2 Alternative 1b - Onsite Processing to Terminal Waste Form (Nonseparated Salt/Sludge)

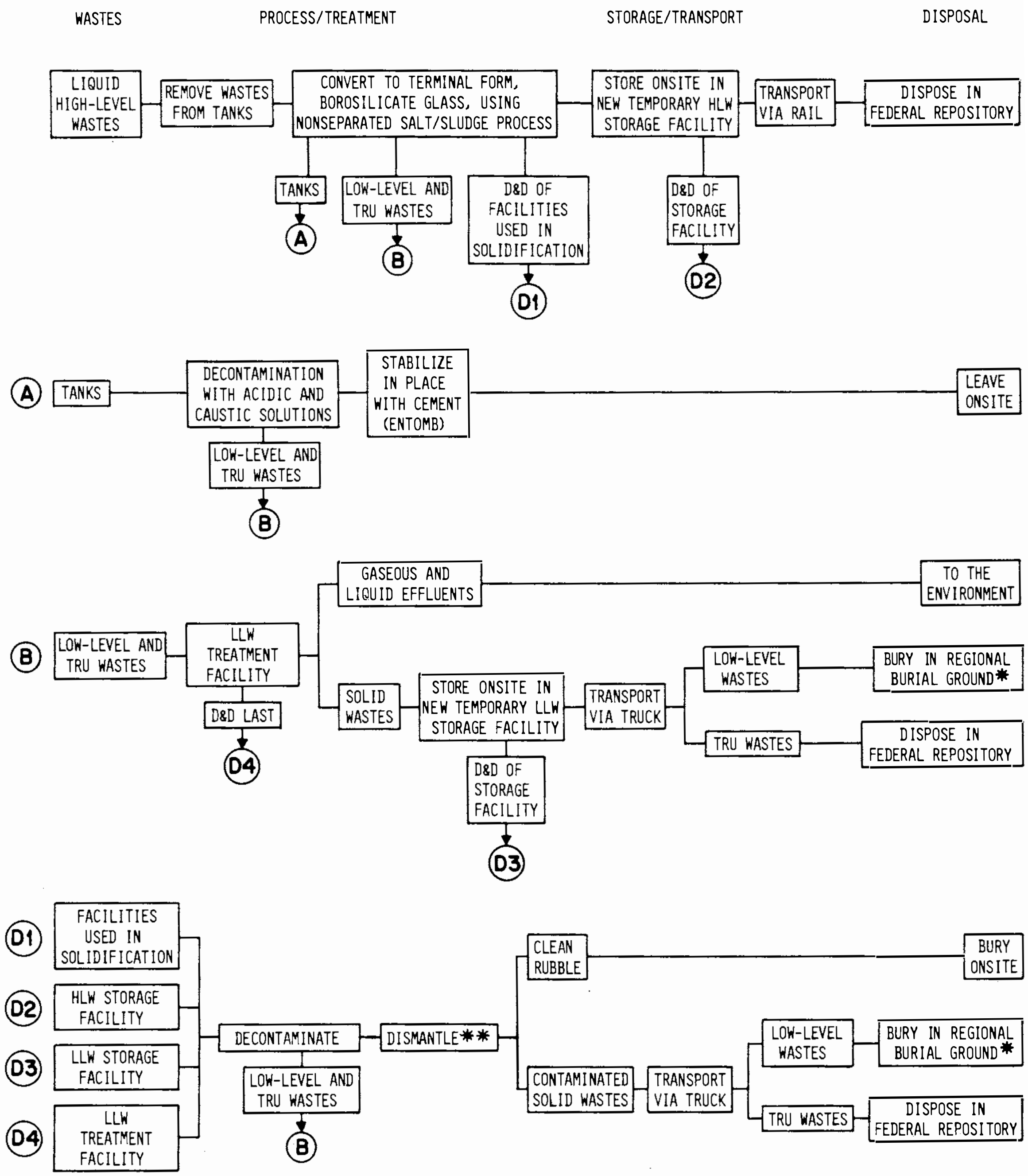
2.1.2.1 Description and Technical Aspects

Alternative 1b (Figure 2.2) is a variation of alternative 1a. In processing the wastes, there would be no separation of the supernate from the sludge, no ion-exchange and concentration of radioactive elements from the supernate, and, hence, no production of salt cake. Instead, the sludge plus supernate mixture would be solidified in borosilicate glass (Appendix B, Section B.2). There is less technical experience with this process than with the process for alternative 1a. Also, a much greater volume of solidified HLW (1300 canisters) would have to be stored, transported, and disposed in a Federal repository (Appendix B, Sections B.4 and B.5). The absence of salt cake, however, would reduce the volume and thus the number of shipments of non-HLW.

The facility needs would be basically the same as for alternative 1a, except that the size of the building for the temporary storage of HLW onsite would have to be about four times as large to accommodate the greater volume of solidified wastes, and the size of the building for the temporary storage of LLW would be smaller because of the absence of salt cake. The treatment of the tanks, LLW, and TRU wastes, and the decontamination and dismantlement of the facilities would be the same as for alternative 1a. (See Appendix B for details.)

The start of solidification would be delayed because of greater research and development needs. Also, the actual solidification process would take longer. However, the time needed for completion of this alternative depends mostly on the availability of a Federal repository and hence the total time to complete the project would be about the same as for alternative 1a, that is, 20 years. If preliminary research and development and design work were supported at the same levels as for alternative 1a, the actual solidification could begin about the same time, and the entire project could be completed by about the same time (2000). It is similarly assumed that institutional controls would remain another 80 years or a total of 100 years. Uncertainties regarding this schedule would be the same as discussed for alternative 1a.

Much of the engineering and scientific effort necessary before implementation would be the same as for alternative 1a and would include: characterization of the wastes, assessment of the current condition of the tanks and waste



* The option of disposing the low-level wastes in the existing NRC-licensed burial ground is discussed in Section 2.2.6.

** The existing spent fuel pool is considered to be part of the main process building that may be used in solidification. Before it could be dismantled, the existing spent fuel would have to be transported offsite to some unidentified location. Eventual transportation and disposal of this spent fuel would be common to all the alternatives.

Figure 2.2. Alternative 1b - Onsite Processing to Terminal Waste Form (Nonseparated Salt/Sludge).

removal procedures, design of the modified and new facilities, and detailed safety analysis. The differences in effort relate to the different processes. Alternative 1b would require more development of systems for removal of nitrogen oxides and sulfur oxides from the off-gases; design and testing of a remotely operated ceramic melter under corrosive conditions for a long period of time at high temperature (1400°C); development of glass formulations with high nitrate and sulfate contents; and development of materials for operating at higher temperatures in a corrosive environment.

2.1.2.2 Radiological Impacts

The occupational doses for alternative 1b (2100 person-rem) would be slightly greater than for alternative 1a (Table 2.2), due to the handling of much larger numbers of HLW canisters. The short-term (100-year) population risk (390 person-rem, 0.04-0.31 health effects) would also be slightly greater due to the larger number of shipments of HLW. However, the long-term population risks (70 person-rem, 0.007-0.06 health effects) would be less because there would be no radioactive salt cake at the regional burial ground and, thus, less potential risks from human intrusion and groundwater contamination. The accident considerations would be about the same as for alternative 1a. (See Section 4.1 and Appendix B for details.)

2.1.2.3 Nonradiological Impacts

For alternative 1b, there would be risk of slightly more worker injuries (56) and deaths (1.0), primarily because of the larger number of shipments of radioactive wastes (Section 4.2.1). Alternative 1b has no potential for nitrate contamination of wastes because there would be no salt cake. Otherwise, the nonradiological and social impacts for alternative 1b would be about the same as for alternative 1a.

2.1.2.4 Institutional Issues

The institutional issues would be basically the same for alternative 1b as for alternative 1a (Section 4.3).

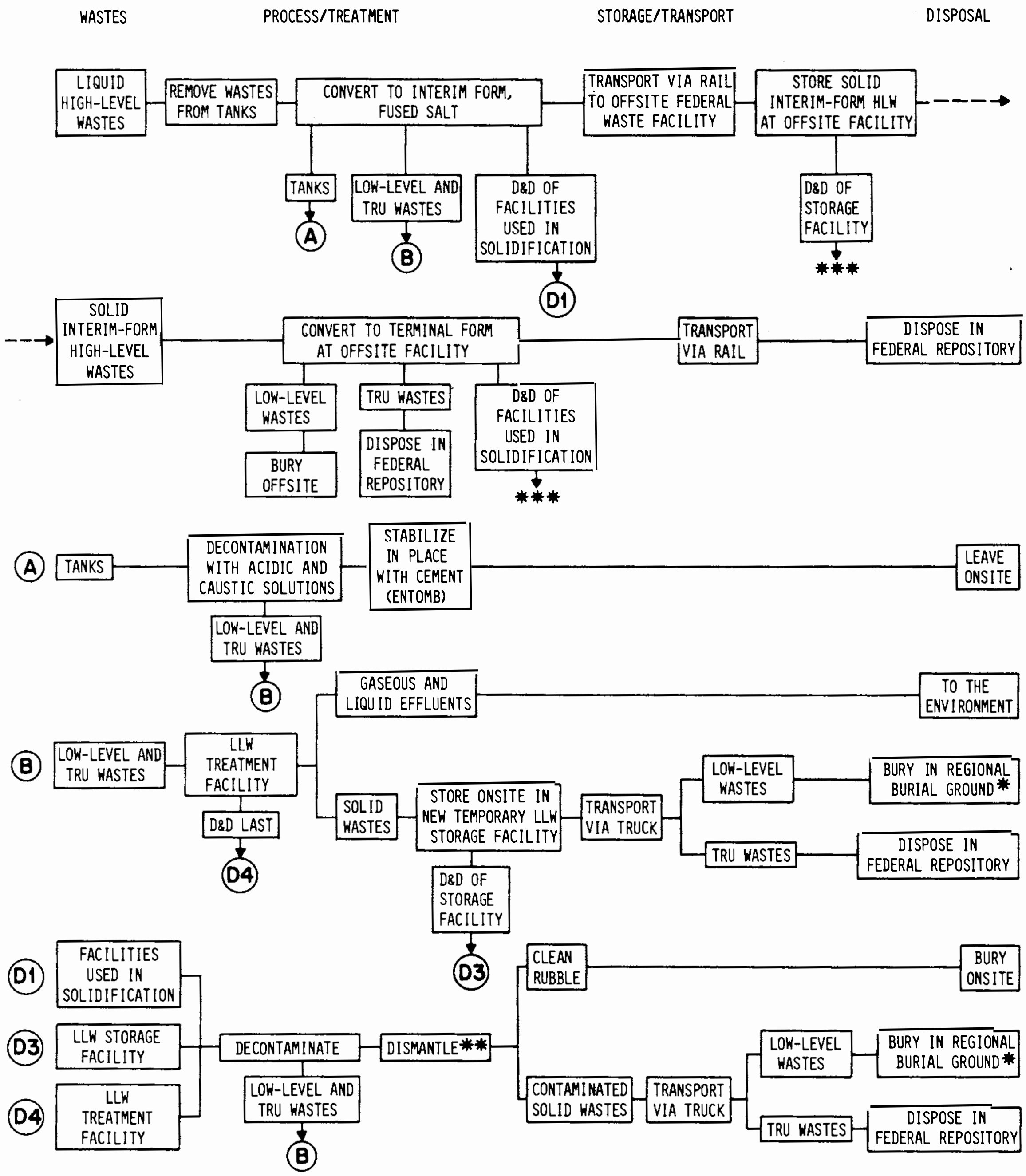
2.1.3 Alternative 2 - Interim Waste Form

2.1.3.1 Description and Technical Aspects

In alternative 2 (Figure 2.3), the liquid HLW would be removed from the tanks as in alternative 1a. However, the HLW would then be converted to an interim form, fused salt,* which could be immediately shipped to a Federal waste facility. The HLW would later be processed to a terminal form, borosilicate glass,** along with the much larger volume of other HLW. Implementation of

*Fused salt, a term used here to indicate a monolithic resolidified salt, is the interim form assumed for purposes of analysis in this EIS. Fused salt is HLW whereas the salt cake in alternative 1a is LLW. The final decision on interim waste form, if alternative 2 is selected, will be made by 1984. See Appendix B, Section B.2, for a discussion of interim waste forms.

**Borosilicate glass, produced by the nonseparated process, is the terminal form produced at an offsite Federal waste facility assumed for purposes of analysis in this EIS.



* The option of disposing the low-level wastes in the existing NRC-licensed burial ground is discussed in Section 2.2.6.

** The existing spent fuel pool is considered to be part of the main process building that may be used in solidification. Before it could be dismantled, the existing spent fuel would have to be transported offsite to some unidentified location. Eventual transportation and disposal of this spent fuel would be common to all the alternatives.

*** Decontamination and decommissioning of the offsite facilities would be part of the department's waste program and is not considered to be part of this alternative.

Figure 2.3. Alternative 2 - Onsite Processing to Interim Waste Form.

this alternative has the advantage of delaying the decision on the appropriate terminal waste form for the West Valley high-level wastes. Solidification of the HLW at West Valley would involve evaporation of the water, heating the resulting salt until it melted, and allowing the salt to solidify as it cooled (Appendix B, Section B.2). The processing temperature at West Valley would be much lower (about 350°C as compared to 1050°C) and, therefore, off-gas control would be less difficult.* However, the radiation and chemical stability of the fused-salt interim waste form may present difficulties with regard to storage safety--e.g., interactions with containers, gas production leading to possible container pressurization, and high solubility of the fused salt in water. This method was the subject of a Department research and development program (Appendix B, Section B.2).

The interim-form wastes would be packaged (in steel canisters) and transported by rail (in casks) to a Federal waste facility, where the wastes would be temporarily stored.** Later, the wastes would be processed into a terminal form along with the much larger volume of other HLW. Eventually, the terminal-form HLW would be transported by rail to a Federal repository for permanent disposal. (See Appendix B for details.)

As in alternative 1a, the existing reprocessing building would be decontaminated, and the facilities would be modified to accommodate the solidification equipment. However, the modifications would not have to be as extensive and there would be no need to build a new facility for temporary storage of solidified HLW. On the other hand, there would be a need for an additional facility at an offsite Federal waste solidification facility that would provide for temporary storage of the wastes, handling of the waste containers, transfer of the wastes to terminal-form processing, and decontamination of the empty canisters.

As in alternative 1a, large amounts of LLW and TRU wastes would be generated at West Valley and transported and disposed in a regional burial ground and Federal repository, respectively (Appendix B, Sections B.4 and B.5). However, no salt cake would be generated. Small additional amounts of low-level and TRU wastes would be generated at the offsite facility during terminal-form processing.

Other actions at West Valley would be the same as in alternative 1a with respect to entombment of the tanks and the decontamination and dismantlement of the buildings. (See Appendix B, Section B.6, for details.) The total time

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*At the assumed Federal waste facility where the wastes would eventually be processed to a terminal form, the off-gas control considerations would be similar to those discussed for alternatives 1a and 1b.

**For purposes of analysis in this EIS, it was assumed that: an offsite Federal waste facility would be 1600 km (1000 miles) from West Valley; the site would have natural features similar to those at the Savannah River site in South Carolina; the terminal-form process would be similar to the process described for alternative 1b (nonseparated salt/sludge); decontamination and decommissioning of the offsite facilities would be part of the Federal waste program and not part of the West Valley project; and the distance from the offsite facility to a Federal repository would be 4800 km (3000 miles).

to complete the activities at West Valley would be about the same for alternative 2 as for alternative 1a. The uncertainties regarding time that were discussed for alternative 1a are also applicable to alternative 2. Moreover, since alternative 2 would involve offsite processing, there would be additional uncertainty associated with date of completion.

Much of the engineering and scientific effort necessary before implementation of alternative 2 would be the same as for alternative 1a. Additional work necessary would include: (1) better characterization of the physical and chemical properties of fused salt and (2) development of wiped-film evaporators for use with radioactive solutions for extended periods in a remote environment so as to minimize the need for maintenance and associated occupational exposures. (See Appendix B, Section B.2, for details.)

2.1.3.2 Radiological Impacts

There would be slightly higher occupational doses (2200 person-rem) and short-term population risks (420 person-rem, 0.04-0.34 health effects) for alternative 2 (Table 2.2), primarily because of the greater distances for transportation of the HLW (transported twice for a total distance of 6400 km instead of 4800 km). The long-term population risk (70 person-rem, 0.007-0.06 health effects) would be less because there would be no salt cake to dispose at the regional burial ground and, thus, less risks from potential human intrusion and groundwater contamination. There would be a small additional amount of LLW produced, and probably disposed, at an offsite Federal waste facility. However, this amount would be far less than the large amount of salt cake associated with alternative 1a. (See Section 4.1 and Appendix B for details.)

2.1.3.3 Nonradiological Impacts

There would be slightly greater risk of worker injuries (61) and deaths (1.1) (Section 4.2.1). Otherwise, the nonradiological and social impacts would be about the same for alternative 2 as for alternative 1a (Section 4.2).

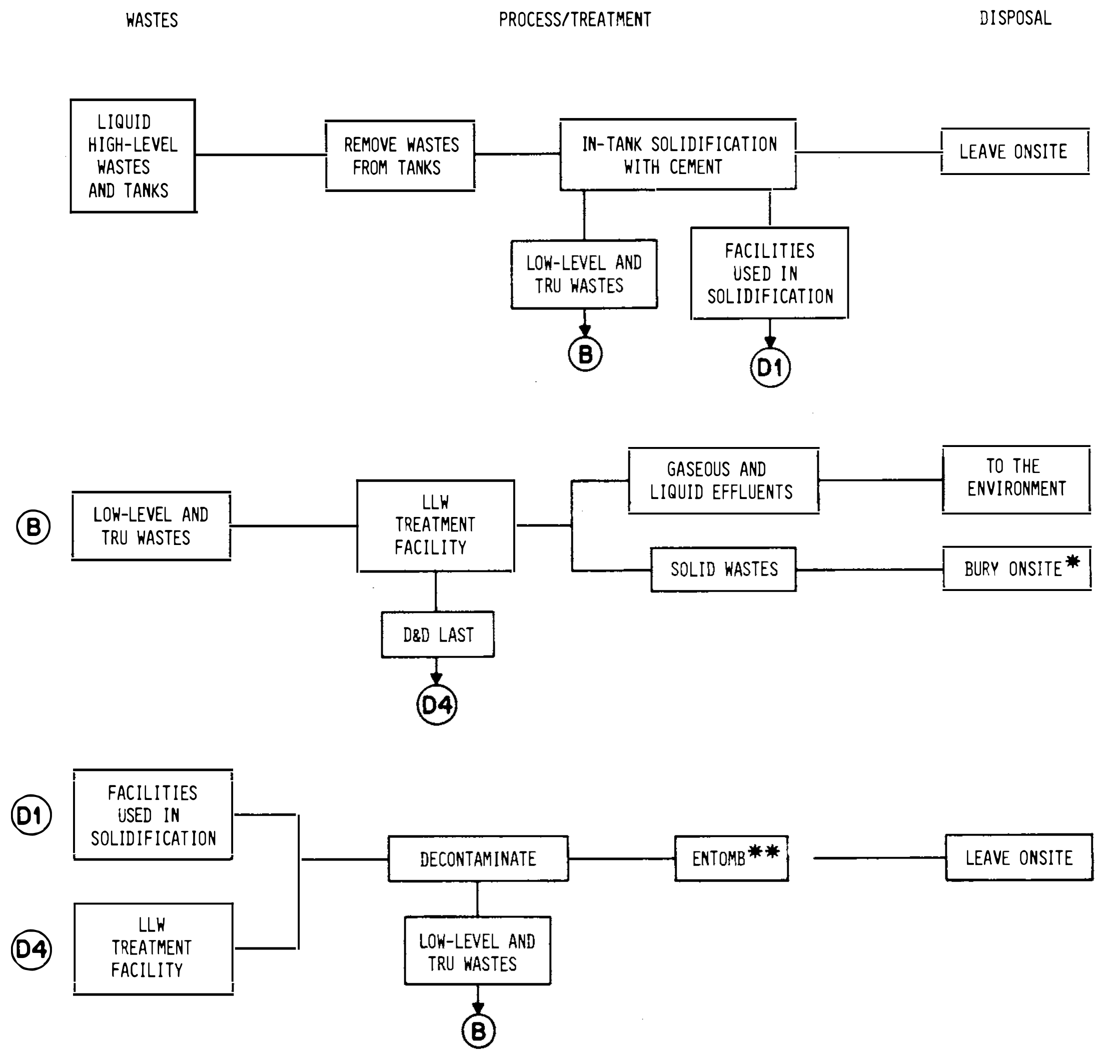
2.1.3.4 Institutional Issues

The institutional issues would be about the same as for alternative 1a, except that (1) additional negotiations may be required with another state for temporary storage of the interim-form wastes until further processing to a terminal form, (2) legal provisions may be necessary for acceptance of the West Valley commercial wastes for processing at a Federal waste facility (Section 4.3), and (3) there is uncertainty about when and where a Federal waste-solidification facility will be available.

2.1.4 Alternative 3 - In-Tank Solidification

2.1.4.1 Description and Technical Aspects

Alternative 3 (Figure 2.4) is substantially different from alternatives 1a, 1b, and 2. The process appears to be less complex, but there has been very little technical experience with it. The wastes would be removed from the tanks in batches, evaporated to reduce the volume, mixed with cement and other additives, and the mixture returned to an existing empty spare tank (Appendix B, Section B.2). The solidified wastes would require active cooling for about



* Assumes burial in existing NRC-licensed burial ground.

** It may, or may not, be necessary to remove the existing spent fuel prior to entombment of the rest of the facilities. Eventual removal of the spent fuel is common to all the alternatives.

Figure 2.4. Alternative 3 - In-Tank Solidification.

10 years (via water pipes through the cement). The other tanks that had been emptied of the liquid wastes would be filled with cement (Appendix B, Section B.6).

The existing reprocessing facility would need to be decontaminated and a few modifications would be necessary. A LLW treatment facility would be used, but the two buildings for temporary storage of high-level and low-level wastes would not be needed. There would also be no need for transportation of the TRU wastes to a Federal repository, since all wastes would remain at West Valley. Solid low-level and TRU wastes would be buried in the existing NRC-licensed burial ground. Such onsite burial was assumed because the much more potentially hazardous HLW containing most of the TRU elements would be left onsite in cement in the tanks. The volume of solid LLW and TRU wastes would be smaller because the facilities used for solidification would not be dismantled. Temporary storage, transportation, and offsite disposal of these wastes would not be necessary.

The facilities used for the mixing of the HLW with the cement and the LLW treatment facility would be decontaminated, entombed (instead of dismantled, Appendix B, Section B.6), and left onsite.* Since the HLW would be left onsite, it would be more reasonable to entomb the facilities rather than to dismantle them, thus avoiding some occupational exposures and dollar costs.

The time for completion of HLW solidification and final decontamination and decommissioning would be about 8 years (for contracts, construction/modifications, solidification, and decontamination and entombment) instead of the 20 years for alternative 1a. An additional 10 years would be required for the active cooling of the wastes. Thus, the completion date would still be about the year 2000. Institutional controls would remain in effect for a total of 100 years. The uncertainties in the schedule would be similar to those discussed for alternative 1a, except that the availability of a Federal geologic repository would not be a factor.

The engineering and scientific effort necessary for alternative 3 would be similar to that for alternative 1a because the following would still be required: waste characterization, assessment of the tanks and development of waste removal procedures, and safety analyses. Other needed work would include studies on concrete formulations, chemical and radiological stability, structural analysis of the spare Tank 8D1, distribution of the poured cement in the tank, and design of the cooling system.

2.1.4.2 Radiological Impacts

The occupational dose for alternative 3 (1,100 person-rem; Table 2.2) would be less than that for alternative 1a because the process is less complex, the high- and low-level wastes would require less handling and no offsite transportation, and the facilities would be entombed rather than dismantled. The short-term population risks (37 person-rem, 0.004-0.03 health effects) would

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*In contrast to alternative 1a, it might be possible to leave the spent fuel pool and existing spent fuel for a longer period of time because the buildings would not be dismantled.

be much less, primarily because no offsite transportation of wastes would be needed. However, the long-term (100- to 10,000-year) population risks (5,200 person-rem, 0.52-4.2 health effects) would be much greater than for alternative 1a, primarily because it is assumed that there would be no institutional controls (no monitoring, prevention of intrusion, etc.) and, thus, potential risks from human intrusion into and groundwater contamination from the solidified wastes left in the ground near the surface. The dose to a person intruding into the concrete wastes after 300 years would be 3 rem, primarily because of the decay of radioactivity in the wastes and the attenuation of radiation due to the effects of the shielding concrete. The health risks would still be low--between 0.52 to 4.2 additional health effects (fatal cancers plus genetic defects) in the exposed population, as compared with 30 million cancer deaths from all causes over the 10,000-year period in the population within 80 km (50 mi) of West Valley. As in alternative 1a, the amount of radioactivity in the wastes would be reduced to about 0.3% of the current level in about 300 years because of radioactive decay. (See Section 4.1 and Appendix B for details).

2.1.4.3 Nonradiological Impacts

For alternative 3, the risk of worker injuries (25) and deaths (0.27) would be much less and would occur mostly during modifications/construction and onsite disposal (instead of modifications/construction, decontamination and decommissioning, and transportation) (Section 4.2.1). The major social impact would still be fear and changes in social and governmental relationships due to public perception of risks, but the geographic distribution of risks would be very different because all risks would remain at West Valley (Section 4.2.2).

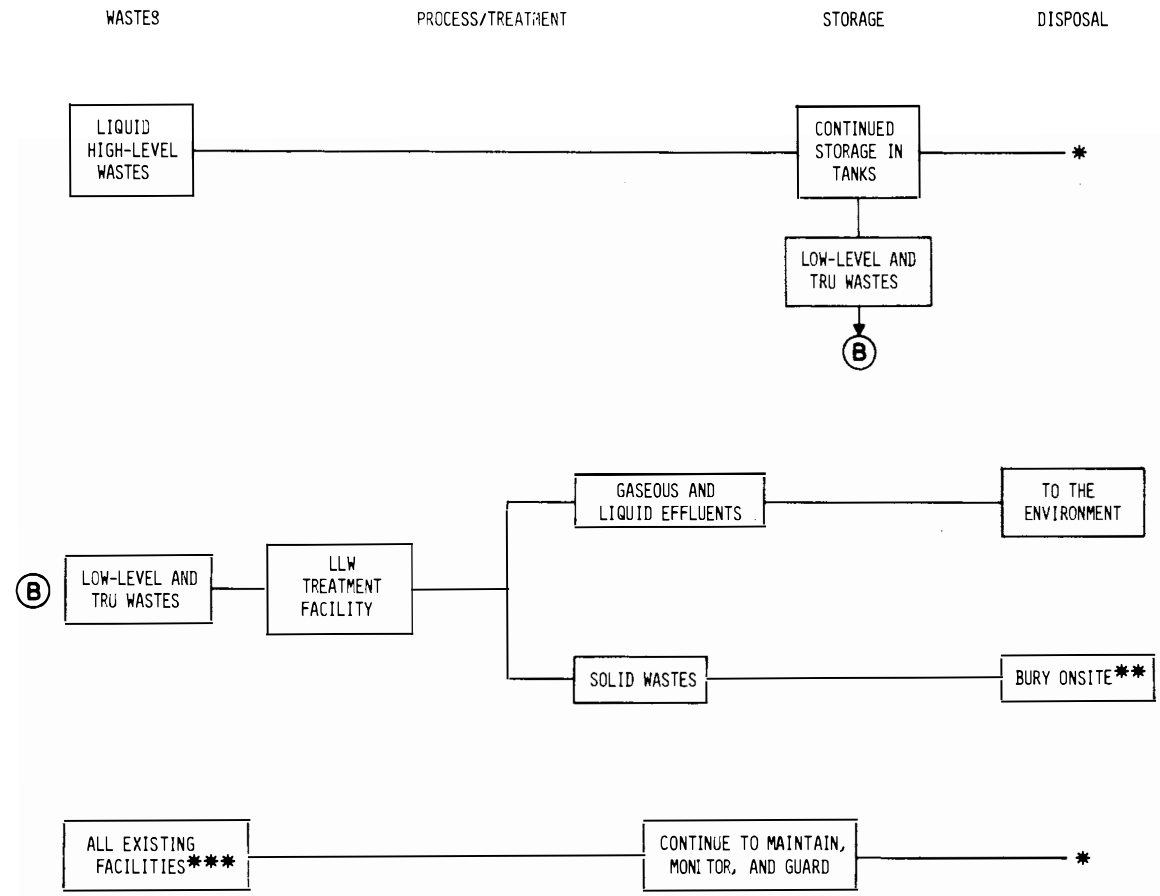
2.1.4.4 Institutional Issues

The availability of a Federal repository would not be an issue in this alternative. However, the solidified wastes would probably not meet the final EPA/NRC standards for HLW disposal because of the higher risk after 100 years when institutional controls are assumed to be withdrawn. The permanent disposal of the HLW at West Valley would make the site a defacto high-level radioactive waste repository and NRC licensing might be required. In addition, the existing legislation (Appendix C) would have to be changed because it currently calls for transportation and disposal of the West Valley wastes in a Federal repository. The various other institutional issues would be basically the same as for alternative 1a (Section 4.3).

2.1.5 Alternative 4a - No Action (Delay 10 Years)

2.1.5.1 Description and Technical Aspects

In alternative 4a (Figure 2.5), the project would be delayed for 10 years and then the solidification alternatives would be reconsidered. During the 10-year delay period, monitoring and maintenance of the existing facilities would be continued. After 10 years, one of the other alternatives (1a, 1b, 2, 3, or 4b) or a new alternative would be chosen. The facility needs, processing, wastes generated, transportation, time, and engineering and scientific effort necessary before implementation would be appropriate to the alternative chosen. The site-specific engineering and scientific effort necessary might be less because there would be 10 more years of research and development before a



* ACTION DELAYED FOR 10 YEARS; THEN ONE OF THE OTHER ALTERNATIVES OR A NEW ALTERNATIVE IS SELECTED.

** ASSUMES CONTINUED BURIAL IN EXISTING NRC-LICENSED BURIAL GROUND.

*** INCLUDES THE MAIN REPROCESSING BUILDING, THE SPENT FUEL POOL, THE TWO BURIAL GROUNDS, AND THE LOW-LEVEL-WASTE TREATMENT FACILITY.

Figure 2.5. Alternative 4a - No Action (Delay 10 Years).

decision was made. Also, ongoing systems analysis studies of waste form/ repository interactions might allow for a better choice of waste form at that time. (See Appendix B, Section B.7, for details.)

2.1.5.2 Radiological Impacts

There would be occupational exposure in alternative 4a (80 person-rem; Table 2.2) during monitoring and maintenance activities for 10 more years. However, there is a possibility that the total occupational dose would be less because temporary storage of the wastes at West Valley would not be needed if a Federal repository and regional burial ground were available for immediate disposal as these wastes were generated (workers would not have to handle the wastes as much). (See Section 4.1 and Appendix B, Section B.4, for details.)

In the 10 years, the radioactivity would decrease by about 25% of the current amount, hence tending to lower the population risk. On the other hand, the additional 10 years of storage of the HLW in the more hazardous liquid form would tend to increase the short-term population risk. Also, during the short term, the question of the current condition of the tanks would be more important (Appendix B, Sections B.1 and B.7). On balance, the 10-year delay would slightly increase the overall short-term population risk at West Valley (120 person-rem, 0.01-0.1 health effects during 10 years plus the risk associated with another alternative). The long-term population risk would be appropriate to the action alternative chosen after the 10-year delay. (See Section 4.1 for details.)

2.1.5.3 Nonradiological Impacts

The nonradiological impacts for alternative 4a would be the same as those for whatever alternative was chosen after 10 years; they would simply be delayed. The social impacts at West Valley associated with public perception of risks would probably increase, although social impacts elsewhere (transportation routes, disposal sites, etc.) would be delayed.

2.1.5.4 Institutional Issues

The major advantage for alternative 4a is that a delay of 10 years would allow more time for several institutional issues to be wholly or partially resolved (Section 4.3). Delays would also allow more time to study technical issues such as the HLW disposal criteria and the siting and construction of a Federal repository and a regional burial ground. Resolution of these issues might cause the various alternatives to be viewed differently from both a technical and social point of view, and new reasonable alternatives might become evident. However, solidification of the wastes has already been delayed for 16 years. Although the containment has not failed and there have been no releases of the liquid wastes to the environment, the greater the delay, the greater the chance for such releases.

If alternative 4a were chosen, there might also have to be amendments to the existing legislation and agreements because if the Department of Energy takes no action, responsibility for the monitoring and maintenance of the site might revert to the State of New York.

2.1.6 Alternative 4b - No Action (Continued Storage in Tanks)

2.1.6.1 Description and Technical Aspects

If the Department of Energy took no action to solidify the liquid HLW, storage in the tanks would continue (alternative 4b; Figure 2.6). Over the next 100 years of assumed institutional control, the wastes would be transferred to new tanks as necessary (three transfers during the 100-year period were assumed for purposes of analysis in this EIS). New tanks would be constructed to replace the old tanks. The first removal of wastes from the tanks would be the same as in alternative 1a. Subsequent removals would not be as difficult because the new tanks would be designed to facilitate waste transfer, as well as cleaning of the old emptied tanks. The existing tank ventilation and off-gas system would have to be replaced about every 25 years. Some provision for evaporation of the wastes would be needed to compensate for the addition of water to rinse the old tank at each transfer. See Appendix B, Section B.7, for details.)

It was assumed that the emptied tanks would be filled with cement and left onsite. The LLW and TRU wastes generated during storage and tank transfers would be treated in the existing LLW treatment facility, with both gaseous and liquid effluents being released. The solid LLW and TRU wastes would be buried onsite in the NRC-licensed burial ground. All existing buildings would continue to be left onsite and guarded. In contrast to alternative 1a, the following activities would not occur: decontamination and decommissioning (except for the emptied tanks), modification and building of major new aboveground facilities, and offsite transportation and disposal of wastes.

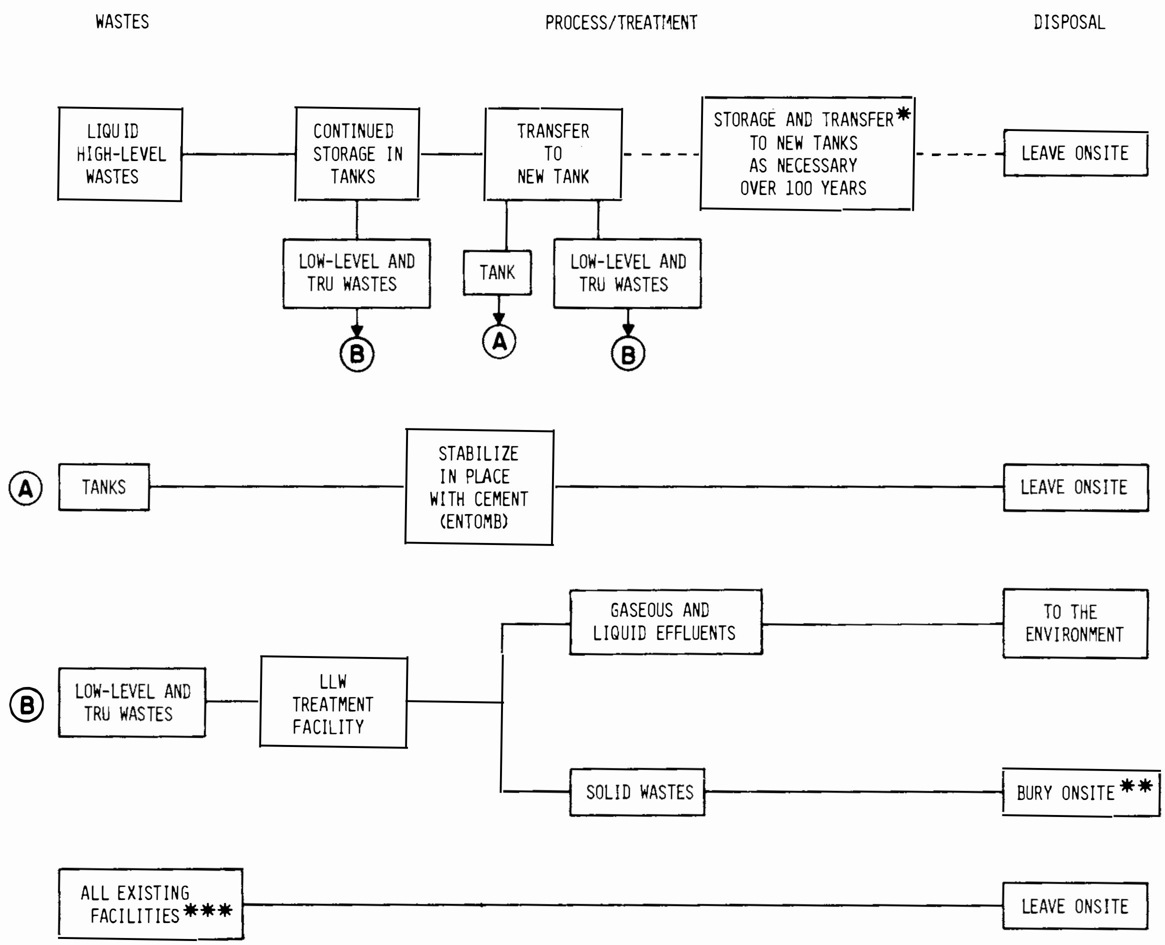
The above-mentioned activities would continue throughout the 100 years of institutional control. Storage of the wastes in the last tanks would then continue indefinitely, but without institutional control.

Very little engineering and scientific effort would be necessary before implementation of alternative 4b. The new tanks would have to be designed to facilitate future transfers.

2.1.6.2 Radiological Impacts

The occupational dose for alternative 4b (880 person-rem; Table 2.2) would be less than for alternative 1a and would be spread out over the 100-year period. It would be associated with the continued monitoring and maintenance of the HLW and with the three tank transfers (Section 4.1).

Although there would be no short-term population risk associated with transportation of wastes, the total short-term population risk for alternative 4b (460 person-rem, 0.05-0.37 health effects; Table 2.2) would be higher than for alternative 1a because the wastes would remain in the liquid form in the tanks for the entire 100 years. The major contributors to this risk would be the potential for sabotage or a crash of a large airplane into the wastes during this period of time. Although these events would be extremely improbable (assumed to be one chance in a hundred thousand and once in a hundred million years, respectively), they could cause the release of large amounts of radioactivity that would result in a very large dose of radiation to nearby people by drinking of contaminated water, by direct radiation, and by inhalation of radioactive materials. (See Section 4.1 for details.)



* Assumes three transfers for purposes of analysis in this EIS.

** Assumes continued burial in existing NRC-licensed burial ground.

*** Includes the main reprocessing building, the spent fuel pool, the two burial grounds, and the low-level-waste treatment facility.

Figure 2.6. Alternative 4b - No Action (Continued Storage in Tanks).

The long-term (100-year) population risk for alternative 4b (120,000 person-rem, 12-96 health effects; Table 2.2) would be substantially higher than for alternative 1a, primarily because of the potential risk of human intrusion into the liquid wastes. Risks from leaching and migration of radioactivity in groundwater would be comparatively small (see Section 4.1.7). The amount of radioactivity in the tanks would be reduced to about 0.3% of the current levels in about 300 years because of radioactive decay of the wastes (most of the current radioactivity is associated with the relatively short-lived cesium-137 and strontium-90). The dose to a person intruding into the wastes after 300 years (wastes would have evaporated down to salt and solids by then) would be 60 rem. The total risks would be between 12 and 96 health effects in a population that would normally incur 30 million cancer deaths from all causes over the 10,000-year period. (See Section 4.1 for more details.) As noted under alternative 1a, these estimates of long-term impacts must be viewed with caution since rare natural events, technical and social changes, and medical progress cannot be predicted with accuracy so many years into the future.

2.1.6.3 Nonradiological Impacts

The risks of worker injuries (40) and deaths (0.42) would be less than for alternative 1a, primarily because there would be no decontamination/decommissioning of buildings and no offsite transportation (Section 4.2.1). Although there would be no impacts associated with construction of buildings, there would be minor impacts associated with construction of new tanks. Otherwise, the nonradiological impacts for alternative 4b would be about the same as for alternative 1a (Section 4.2.1).

The social impacts at West Valley associated with public perception of risks (such as fear and changes in social and governmental relationships) might be greater than for alternative 1a because the wastes would be left in the liquid form. There would, however, be no social impacts associated with offsite transportation and disposal of radioactive wastes. The geographic distribution of risks is clearly different for this alternative in that people near the West Valley facility would continue to bear all risks (Section 4.2.2).

2.1.6.4 Institutional Issues

Most of the institutional issues previously described would not be applicable to this alternative (Section 4.3). If the Department of Energy took no action, there would be an additional institutional issue in that the State of New York would retain full responsibility for the site. Current legislation and the cooperative agreement between the U.S. Department of Energy and New York State (1980) allow for Department use of the West Valley facilities only for the purpose of a solidification project. Furthermore, by not taking action, the Department would fail to comply with an act of Congress (Section 4.3.1.6 and Appendix C).

2.1.7 Summary Comparison

A summary comparison of the technical aspects of each alternative in relation to alternative 1a is presented in Table 2.3. A comparison of the impacts of each alternative is presented in Table 2.4.

Table 2.3. Summary Comparison of Technical Aspects of the Alternatives

ALTERNATIVE 1a (Preferred) (Onsite Processing to Terminal Waste Form, Separated Salt/Sludge)	ALTERNATIVE 1b (Onsite Processing to Terminal Waste Form, Nonseparated Salt/Sludge)	ALTERNATIVE 2 (Onsite Processing to Interim Waste Form)
	PROCESS	
Separate sludge from supernate, remove radioactivity from supernate with ion exchanger • Process sludge and ion-exchange concentrates into borosilicate glass • Salt cake remains after evaporation	Similar to 1a, except: • No separation--entire volume into borosilicate glass • No salt cake produced • Less technical experience	Appears less complex than 1a at West Valley: • Evaporate to fused salt • Additional processing to terminal form at offsite Federal waste facility by process similar to 1b; no salt cake produced • No experience with HLW fused salt
	FACILITY NEEDS	
• Modified existing process building • New temporary HLW storage facility • New temporary LLW storage facility • Modify existing or construct new LLW treatment facility	Similar to 1a, except: • HLW storage about 4 times larger • LLW storage smaller (no salt cake)	Similar to 1a, except: • Fewer facilities at West Valley (no HLW storage). • Additional facilities offsite (storage, handling, and processing) • Presumes to-be-constructed offsite Federal waste facility
	TRANSPORTATION	
• HLW via train • TRU wastes, LLW, and salt cake via truck	Same as 1a, except: • More shipments of HLW • Fewer shipments of LLW (no salt cake)	Similar to 1a, except: • Ship HLW twice • Fewer shipments of LLW (no salt cake)
	WASTE DISPOSAL	
All offsite: • HLW and TRU wastes in Federal repository (assumed available in 1997) • LLW and salt cake in regional burial ground (assumed available in 1990)	Similar to 1a, except: • More HLW to dispose • No salt cake to dispose • Sulfate sludge to dispose	Similar to 1a, except: • Small additional LLW buried at offsite Federal waste facility • No salt cake to dispose
	DECONTAMINATION AND DECOMMISSIONING (D&D)	
• Entomb empty tanks with cement • Dismantle facilities used in solidification project	Same as 1a	Same as 1a, except: • No HLW storage building at West Valley to dismantle • Added storage/handling facility to dismantle at offsite facility as part of Federal waste facility D&D program
	ENGINEERING AND SCIENTIFIC EFFORT NEEDED	
• Detailed high-level and low-level waste characterization • Procedures to remove wastes from tanks • Facilities modifications and design • Detailed safety analysis • Glass formulation • More development on ion exchange	Same as 1a for first 5 items; add: • Development of high-temperature ceramic melter • Develop materials for higher-temperature, corrosive environment • Off-gas NOx destructor needs development	Same as 1a for first 4 items; add: • Fused salt properties, including chemical and radiological stability
	TIME	
• Solidification, 1987-1990 • 20 years for total project • End about year 2000 • Assumed total 100-yr institutional controls, then abandonment • Several potential delays	Same as 1a for total project, except: • More development time delays start of solidification • More solidification time	Same as 1a, except: • Additional potential delay at offsite facility

Table 2.3. Continued

ALTERNATIVE 3 (In-Tank Solidification)	ALTERNATIVE 4a (No Action, 10-Year Delay)	ALTERNATIVE 4b (No Action, Continued Storage In Tanks)
	PROCESS	
Potentially less complex than 1a: · Mix wastes with cement, pour into spare tank, allow to solidify · No experience with HLW in concrete	· Continued storage in tank for 10 yr, then choose one of the other alternatives or a new alternative	Less complex than 1a: · Continued storage in tank, only maintenance and monitoring · Potential need for 3 transfers to new tanks over 100 yr
	FACILITY NEEDS	
Less than 1a: · Fewer modifications · No HLW storage · No LLW storage · Cooling system	· Appropriate to alternative chosen	Less than 1a: · 3 new tanks, pipes, pumps, etc. · Evaporator and new ventilation system
	TRANSPORTATION	
· None	· Appropriate to alternative chosen	· None
	WASTE DISPOSAL	
All wastes left onsite: · HLW solidified in tanks · LLW and TRU wastes in existing onsite NRC-licensed burial ground	· During 10-yr delay, continued disposal of LLW in onsite NRC-licensed burial ground; then disposal appropriate to alternative chosen	All wastes left onsite: · Liquid HLW in tanks · Continued burial of LLW and TRU wastes in onsite NRC-licensed burial ground
	DECONTAMINATION AND DECOMMISSIONING (D&D)	
Less than 1a: · Tanks containing solidified HLW left onsite · Buildings and emptied tanks entombed with cement	· Appropriate to alternative chosen	· Emptied tanks entombed with cement
	ENGINEERING AND SCIENTIFIC EFFORT NEEDED	
Waste characterization, removal from tanks, and safety analysis similar to 1a: · Less facilities design work · Concrete formulations, including chemical and radiological stability · Tank structural analysis · Cooling systems design	· Appropriate to alternative chosen; Research and development continued during 10-yr delay may allow better decision on waste form	Less than 1a: · Only removal from tanks the same · Add design of new tanks
	TIME	
Similar to 1a, except: · Less time through final D&D (8 yr) · Added time to actively cool wastes (10 yr)	More than 1a: · 10 yr plus time appropriate to alternative chosen	· Activities over entire 100 yr of assumed institutional control

Table 2.4. Summary Comparison of Impacts of the Alternatives

ALTERNATIVE 1a (Preferred) (Onsite Processing to Terminal Waste Form, Separated Salt/Sludge)	ALTERNATIVE 1b (Onsite Processing to Terminal Waste Form, Nonseparated Salt/Sludge)	ALTERNATIVE 2 (Onsite Processing to Interim Waste Form)
	RADIOLOGICAL IMPACTS--OCCUPATIONAL	
Small: • 1800 person-rem which would cause 0.2-1.4 health effects (fatal cancers and genetic defects) • 1 rem/yr for average worker (less than 5 rem/yr regulation) • Mostly associated with activities needed to decontaminate and dismantle facilities (including handing and transportation of D&D wastes)	Slightly greater than 1a: • 2100 person-rem, 0.2-1.7 health effects	Slightly greater than 1a: • 2200 person-rem, 0.2-1.8 health effects
	RADIOLOGICAL IMPACTS--SHORT-TERM POPULATION RISK (100 years)	
Small: • 340 person-rem, which compares to 15 million person-rem from background radiation • Would cause 0.03-0.27 health effects (fatal cancers and genetic defects) in a population that would normally incur 300,000 cancer deaths • Primarily associated with transportation of wastes	Slightly greater than 1a: • 390 person-rem, 0.04-0.31 health effects	Slightly greater than 1a: • 420 person-rem, 0.04-0.34 health effects
	RADIOLOGICAL IMPACTS--LONG-TERM POPULATION RISK (100 to 10,000 years)	
Small: • 210 person-rem, which compares to 1.5 billion person-rem from background radiation • Would cause 0.02-0.17 health effects (fatal cancers and genetic defects) in a population that would normally incur 30 million cancer deaths • Primarily associated with risks of potential human intrusion and groundwater contamination at the burial ground	Smaller than 1a: • 70 person-rem, 0.007-0.06 health effects • Primarily because no salt cake disposal and thus less risks due to potential human intrusion and groundwater contamination at the burial ground	Smaller than 1a: • 70 person-rem, 0.007-0.06 health effects • Same reason as 1b
	NONRADIOLOGICAL IMPACTS--GENERAL	
Small: • Some dust and noise during construction and demolition • Small amounts of gaseous and liquid effluents released to environment • Land already cleared and dedicated to industrial activities; only 4 hectares (10 acres) of grass and gravel disturbed • Estimated risk of 53 worker injuries, 0.8 deaths	Same as 1a, except: • Risk of 56 worker injuries, 1 death	Similar to 1a, except: • Less construction at West Valley • More construction at offsite Federal waste facility (construction of handling/storage building) • Risk of 61 worker injuries, 1.1 deaths
	NONRADIOLOGICAL IMPACTS--SOCIAL	
Major: • Due to public perceptions and inequitable geographic distribution of risks (West Valley, transportation routes, final disposal sites at Federal repository and regional burial ground)	Same as 1a	Similar to 1a, except: • Added incremental social impact at offsite Federal waste facility and uncertain availability of such a facility
	INSTITUTIONAL ISSUES	
• EPA/NRC criteria for HLW may or may not be finalized before wastes are solidified • Transportation regulations and jurisdictions, especially questions of state and local controls • Federal repository not yet available (assumed 1997) • Regional burial ground not yet available (assumed 1990) • Assumed 100 yr of institutional controls (guarding, monitoring, etc.) • Meets intent of West Valley Demonstration Project Act	Same as 1a	Similar to 1a, except: • Added issue of waste storage/processing in another state at Federal waste facility and uncertain availability of such a facility • Doesn't meet intent of West Valley Demonstration Project Act

Table 2.4. Continued

ALTERNATIVE 3 (In-Tank Solidification)	ALTERNATIVE 4a (No Action, 10-year Delay)	ALTERNATIVE 4b (No Action, Continued Storage In Tanks)
	RADIOLOGICAL IMPACTS--OCCUPATIONAL	
Less than 1a: • 1100 person-rem, 0.1-0.9 health effects • Primarily because less handling of wastes, no transportation, and no dismantlement	• 80 person-rem for 10 yr of maintenance and monitoring, 0.008-0.06 health effects, plus amount appropriate to alternative chosen	Less than 1a: • 880 person-rem over 100 yr, 0.09-0.7 health effects • Primarily because less handling of wastes, no transportation, and no D&D
	RADIOLOGICAL IMPACTS--SHORT-TERM POPULATION RISK (100 years)	
Much less than 1a: • 37 person-rem, 0.004-0.03 health effects • Primarily because no transportation, less handling of radioactive wastes	• 120 person-rem for 10 yr delay plus amount appropriate to alternative chosen • Primarily due to 10 more years of risks associated with wastes in liquid form	More than 1a: • 460 person-rem, 0.05-0.37 health effects • Primarily because no transportation (but greater risk at West Valley because of risks associated with wastes in liquid form)
	RADIOLOGICAL IMPACTS--LONG-TERM POPULATION RISK (100 to 10,000 years)	
Greater than 1a: • 5200 person-rem, 0.52-4.2 health effects • Primarily because of higher risk of human intrusion and groundwater contamination	• As appropriate for alternative chosen	Much greater than 1a: • 120,000 person-rem, 12-96 health effects • Primarily because waste in liquid form (potential human intrusion)
	NONRADIOLOGICAL IMPACTS--GENERAL	
Similar to 1a, except: • Less construction/modifications activities • Risk of 35 worker injuries, 0.37 deaths	• As appropriate for alternative chosen	Less than 1a: • Only construction impacts during 3 tank transfers • Risk of 40 worker injuries, 0.42 deaths
	NONRADIOLOGICAL IMPACTS--SOCIAL	
Major, but different than 1a: • All risks remain at West Valley	Major: • Increased public perception of risks at West Valley during 10-yr delay • Delayed public perception of risks along transportation routes and other disposal sites	Major, but different than 1a: • All risks remain at West Valley
	INSTITUTIONAL ISSUES	
Different than 1a: • May not meet EPA/NRC criteria for waste disposal • Transportation not an issue • Federal repository not an issue; West Valley becomes defacto repository • Regional burial ground not an issue • Project legislation needs revision • Same assumption of 100 yr of institutional controls • Doesn't meet intent of West Valley Demonstration Project Act	• More time for institutional issues to be wholly or partially resolved (especially EPA/NRC criteria for waste disposal, and availability of Federal repository and regional burial ground) • Doesn't meet intent of West Valley Demonstration Project Act	Different than 1a: • Probably not meet EPA/NRC criteria for waste disposal • Transportation not an issue • Federal repository not an issue • Regional burial ground not an issue • Added issue of need for new legislation if Department of Energy takes no action • Same assumption of 100 yr of institutional controls • Doesn't meet intent of West Valley Demonstration Project Act

2.2 OPTIONS WITHIN THE ALTERNATIVES

Following is a summary of several options for various steps within the alternatives. Further discussions are given in the appropriate subsections of Appendix B. In the following subsections, the changes in the environmental impacts resulting from substitution of an option in a given alternative are summarized. Also, the effects this would have on the overall comparison of alternatives is discussed.

2.2.1 New Facility

For alternatives la and lb, use of a new solidification facility instead of modifying the existing reprocessing facility is an option for processing the HLW. This option would have three advantages: (1) the new facility would conform to whatever criteria are set, whereas the old facility might require modification to meet these criteria, (2) workers would not be exposed to radiation during construction activities and installation of solidification equipment, and (3) exposure of workers to radioactivity during processing and during final decontamination and decommissioning might be less since the new facility would be designed with greater remote-operation capability than the modified facility.

A safety analysis will consider the ability of the building to withstand natural forces and the consequences of any potential release of radioactivity to the environment. Thus, the specific activities that would be going on inside the building (such as amounts and types of radioactive materials inside the building at any one time and equipment and process design) will be considered. At this point in time, it is thought that modification of the existing reprocessing building would be adequate for use in solidification activities as currently envisioned (see Section 4.1 for radiological risk analysis and also Appendix B, Sections B.2 and B.3). It is possible that further design work and detailed safety analyses may lead to a determination that either: (1) additional physical modifications would have to be made to the existing building, and/or (2) changes would have to be made in the planned solidification activities (e.g. a slower throughput), or (3) construction of a new building would be desirable.

If a new facility were used, it is probable that worker doses would be less during solidification operations. The new building would be designed to minimize doses to workers during processing and during final decontamination and decommissioning. However, the modifications planned for the existing building would also be designed to minimize doses by increasing remote-handling capabilities and by anticipating final decontamination and decommissioning needs. The major difference between the two options is related to the need for eventually decontaminating and decommissioning both the existing facility and the new facility, as compared to presolidification decontamination, modifications, and final decontamination and decommissioning of the existing facility. It may be that decontamination and dismantlement of the old facility plus use and decontamination/dismantlement of a new facility would lead to lower total worker exposures. However, within the current uncertainties of project design and estimating worker doses, it appears that the total doses for implementing alternative la or lb would not be significantly different if this option were implemented.

There would also be some small differences in nonradiological and socioeconomic impacts if a new facility were used. In either case--construction of a new facility or use of a modified existing facility--there would be construction and operation of new facilities (HLW storage and LLW storage). The differences would thus be relative to modifications/operation of the existing building versus construction/operation of a new building. Since conceptual design work has just begun, there is no detailed information on the amount of land disturbance, commitment of resources, or numbers of workers. It is currently estimated that use of the modified existing building would cause disturbance of about 4 hectares (10 acres) of grass and gravel near the existing buildings (Section 4.7.1), there would be no stresses on supplies of resources (Section 4.7), and the peak work force would be about 300 to 500 workers (Section 4.2.2). There would be no significant nonradiological or socioeconomic impacts associated with this land disturbance, commitment of resources, or work force. If a new facility were constructed, it is probable that slightly more land (grass and gravel) would be disturbed within the fence, more resources such as cement would be committed, and the peak work force might be smaller. The nonradiological and socioeconomic impacts would still not be significant.

Considering the above-mentioned advantages, disadvantages, and uncertainties, if the use of a new facility were substituted for modification of the existing facility in alternative 1a, the comparison of the other alternatives with alternative 1a would be about the same.

2.2.2 Interim Waste Forms

Use of the agglomerated-calcine process instead of the fused-salt process for the interim waste form is an option in alternative 2. The agglomerated-calcine process essentially involves the first part of one of the solidification processes (decontamination of the salt cake and calcining) in alternative 1a. In addition, an agglomeration step is introduced to form the calcine powder into clumps to decrease the potential for dispersion of the wastes in the event of an accident. A higher processing temperature (550°C) would be required than for the fused salt (350°C). This mechanically intensive process would have greater potential for producing airborne particulates and contamination problems during processing.

Engineering and scientific effort needed before the agglomerated-calcine process could be implemented would include: (1) studies of the properties of agglomerated calcine made from West Valley wastes, (2) studies on the adaptation of the disc pelletizer (used in agglomeration of the calcine powder) to remote operations, and (3) studies of the drying parameters.

The agglomerated-calcine option would generate a lower volume (85% less) of interim-form HLW to transport to an offsite terminal-form Federal waste facility (not yet constructed). This would decrease the worker doses and short-term population risks associated with transportation. However, the HLW would eventually be made into a terminal form (borosilicate glass) and placed in a repository, thus making the long-term impacts from HLW disposal the same as those for alternative 1a. Since the salt would be separated, there would be salt cake requiring disposal. Thus, the total long-term population risks for alternative 2 with agglomerated calcine would be the same as for alternative 1a.

2.2.3 Temporary Onsite High-Level-Waste Storage

Temporary storage of the solidified terminal-form HLW in the existing spent fuel pool instead of in a new temporary storage building was considered. Although the pool could easily accommodate the HLW from alternative 1a, accommodating the larger volume of HLW from alternative 1b would be difficult. The spent fuel pool would have to be modified to accommodate the HLW canisters. This would expose the workers performing the reracking to an additional small amount of radioactivity. For alternative 1a, it might be possible to leave the existing spent fuel in the pool if enough room is available for both the fuel and the HLW canisters. The spent fuel pool would eventually be dismantled after both the spent fuel and the HLW were shipped offsite,* but there would be no special HLW storage building to decontaminate and dismantle.

Overall, if use of the spent fuel pool was substituted for the use of a new storage facility, the environmental comparisons among the various alternatives would be about the same.

2.2.4 Dismantlement of Empty Tanks

Dismantlement, instead of entombment, of the tanks is an option for alternatives 1a, 1b, and 2. Dismantling the tanks would lead to an increase in the exposure of workers to radioactivity (230 person-rem for dismantlement versus 13 person-rem for entombment). This would also result in higher exposures of workers who would transport and dispose of the tank pieces. Dismantlement would also lead to a higher risk to the population along transportation routes because more wastes would be shipped. Details of dismantlement were discussed previously (U.S. Dep. Energy 1978).

Although the long-term population risk from entombment of the tanks at West Valley would be eliminated, there would be some long-term risk associated with transportation and disposal of the pieces of the tanks elsewhere. The dollar costs would be higher than for entombment, primarily due to the additional costs of packaging, transporting, and disposing of pieces of the tanks. There is uncertainty as to what level of residual activity will remain in the tanks. This cannot be resolved until the wastes are actually removed. (In this EIS, it was assumed that only 0.1% would remain in the tanks.)

The overall comparisons between alternatives 1a, 1b, and 2 would not be greatly altered if dismantlement of the tanks was substituted for entombment of the tanks. The decision on tank disposition will be made by the end of the solidification campaign and will include consideration of the disposition of the rest of the West Valley site.

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*For purposes of analysis in this EIS, the existing spent fuel storage pool is considered to be a part of the main reprocessing building. Before this building could be dismantled, the existing spent fuel would have to be transported offsite to some currently unidentified location. Transport and offsite storage of this spent fuel is covered in the cumulative impacts given in Section 4.4.

2.2.5 Entombment of Buildings

Entombment, instead of dismantlement, of the facilities used in solidification of the West Valley wastes under alternatives 1a, 1b, and 2 is an option. Entombment would involve decontamination followed by filling the buildings with cement. The doses to the workers would be less because they would not have to decontaminate the buildings as thoroughly or dismantle the buildings. Also, the contaminated equipment could be left in the entombed buildings, instead of being cut and removed. The doses to workers during transportation and final disposal would also be less since the volume of LLW and TRU wastes from the decontamination and decommissioning step would be reduced to about one-half. The short-term risks to the population along the transportation routes would be correspondingly reduced. The long-term risks to the population would be increased slightly owing to potential human intrusion into the buildings. If humans did intrude after 100 years when the site was no longer under institutional controls, the consequences would not be very serious because the radioactivity remaining would be small after the extensive decontamination procedures and because the radionuclides would have decayed. The dose to the potential intruder would be about 1 rem, which is twice the annual amount that members of the general population are allowed to receive under current regulations.

Overall, if entombment of the buildings were substituted for dismantlement for alternatives 1a, 1b, and 2, the occupational doses and short-term population risks would be slightly less. The long-term population risks in the vicinity of West Valley would be slightly greater. However, this would not significantly alter the comparisons among the various alternatives. The decision on the disposition of the facility used for solidification will be made by the end of the solidification campaign.

2.2.6 Onsite Disposal of Low-Level Wastes

An option for disposal of the LLW generated as a result of the solidification project is to dispose of a portion or all of the LLW in the existing NRC-licensed burial ground at West Valley rather than transport them to a to-be-established regional burial ground. The NRC-licensed burial ground onsite at West Valley has been used for disposal of plant-generated radioactive wastes since the plant was put into operation. Disposal onsite offers several potential advantages: elimination of transportation risks/impacts/costs, elimination of the need for construction of a new temporary storage facility for LLW (necessitated by the current unavailability of a regional burial ground), reduction of worker exposure to radioactive materials (the LLW would be handled once instead of twice), and elimination of the institutional issue of availability of a regional burial ground. Onsite disposal of LLW would be in accordance with applicable Department of Energy guidelines.

If disposal at the onsite NRC-licensed burial ground were substituted into alternatives 1a, 1b, or 2, the overall short-term impacts would be reduced (primarily because of elimination of the extra handling and transportation), but the long-term impacts would be about the same.

2.2.7 Truck Transport of High-Level Wastes

The HLW are assumed in this EIS to be transported exclusively by rail for alternatives 1a, 1b, and 2. If the HLW were transported by truck rather than by rail, the radiological impacts associated with these alternatives would increase because more shipments would be required. The population dose for normal transport would increase in proportion to the increase in number of shipments required. The population doses associated with truck transport of HLW are estimated to be 460 person-rem for alternative 1a, 960 person-rem for alternative 1b, and 1200 person-rem for alternative 2. This compares with 66 person-rem for alternative 1a, 120 person-rem for alternative 1b, and 153 person-rem for alternative 2 for rail transport of the HLW. The occupational doses would also increase for these alternatives. The occupational doses for truck transport of the HLW are estimated to be 60 person-rem for alternative 1a, 260 person-rem for alternative 1b, and 330 person-rem for alternative 2. This compares with an occupational dose of less than 1 person-rem for HLW transported by rail for these alternatives.

The radiological impacts associated with HLW transport accidents would not vary significantly because the increase in the likelihood of an accident (due to more shipments) is offset by the lower accident severity (due to less HLW per shipment).

2.3 ALTERNATIVE REJECTED FROM DETAILED CONSIDERATION

The shale fracture alternative was rejected from detailed consideration in this EIS. This alternative is based on techniques developed by the oil and gas industry to enhance oil and gas recovery. Shale fracture has also been used by Oak Ridge National Laboratory in Tennessee to dispose of intermediate-level radioactive wastes and had been considered in a previous study of West Valley (U.S. Dep. Energy 1978). The alternative would entail: (1) drilling holes and forcing water under high pressure down into a shale rock formation, deep underground at West Valley (this would fracture the rock and open up spaces); (2) mixing the liquid HLW with cement and other additives to form a grout; and (3) injecting this grout mixture under pressure down the drill holes and into the fractures in the shale, where the grout would solidify in a few hours, and, thus, the waste would be permanently left as a solid grout mixture in the shale rock.

The chief advantages of this process are that it would not require the modifications and elaborate equipment needed for other alternatives, it could be carried out quickly and would not depend on availability of a Federal repository for final disposal of wastes, and it would cost the least amount of money.

However, shale fracture has some critical disadvantages: there are prospects for future drilling in the West Valley area for natural gas, and extensive drilling in the area near the shale beds could lead to eventual leakage of radioactivity from the shale beds; some question remains about the type of fractures that would be produced in the shale at West Valley (possibly extending beyond the impermeable shale into other types of water-bearing rocks); and if the disposal technique were judged to be inadequate for West Valley wastes at some future date, the wastes would be in an irretrievable form that would not allow corrective measures to be taken. Because of these serious shortcomings, it was decided that shale fracture would not be given further consideration as a viable option for management of the West Valley liquid HLW.

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U.S. Department of Energy. 1978. "Western New York Nuclear Service Center Study: Companion Report." TID-28905-2.

U.S. Department of Energy. 1980. "Final Environmental Impact Statement, Management of Commercially Generated Radioactive Wastes." DOE/EIS-0046F. Office of Nuclear Waste Management, Washington, DC. October 1980.

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U.S. Department of Energy/New York State. 1980. "Cooperative Agreement Between United States Department of Energy and New York State Energy Research and Development Authority on the Western New York Nuclear Service Center at West Valley, New York." Effective October 1, 1980. Amended 1981.

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3. AFFECTED ENVIRONMENT*

3.1 SITE AND REGION

3.1.1 General Site Location and Characteristics

The West Valley plant is located in Cattaraugus County, New York, about 50 km (30 mi) southwest of Buffalo (Figure 3.1). The locations of communities, transportation routes, and waterways within 16 km (10 mi) of the site are shown in Figure 3.2. The site occupies a fairly level plateau at an elevation ranging from 420 m (1380 ft) to 433 m (1420 ft) mean sea level (MSL). The complex containing the reprocessing plant and other facilities (Figure 3.3) is near the center of the plateau.

The West Valley site is irregularly shaped and is bounded on the east, west, and south by hills that approach 650 m (2130 ft) MSL. The hills are covered with second growth evergreen and deciduous trees. The valleys between the hills have a deep overburden of glacial soil in which watercourses have cut deep gorges. In the site vicinity, the largest of these watercourses is Cattaraugus Creek to the north. It flows generally to the west and empties into Lake Erie. Buttermilk Creek, a tributary of Cattaraugus Creek, extends through the West Valley site across the central part of the plateau in a valley cut about 30 m (100 ft) below the surrounding surface of the ground. Tributaries of the creek have further dissected the surface of the plateau (Nucl. Fuel Serv. 1973, 1975a).

3.1.2 Geology and Seismicity

The West Valley site is in the Glaciated Allegheny section of the Appalachian Plateau Physiographic Province (Nucl. Fuel Serv. 1973, 1975a; U.S. Dep. Energy 1978). The region is overlain by glacial deposits of variable thickness and is underlain by shales, siltstones, and sandstones of the Upper Devonian Canadaway and Conneaut Groups. Bedrock exposures are restricted to the steep stream valleys and gorges cut by former glacial meltwater streams and by modern Cattaraugus Creek and its tributaries, and to sparsely distributed small outcrops in upper reaches of tributaries to Buttermilk Creek. Repeated glaciations by Wisconsinan and older ice sheets have covered the region with a complex of tills, lacustrine sediments, moraines, and outwash deposits (Figure 3.4). Depths to bedrock may exceed 160 m (530 ft) in the bottoms of buried bedrock valleys (Figure 3.5), but drift is much thinner on hillsides and as thin as 1.5 m (5 ft) or less on summits.

*Information presented in this section is based on the references cited and on the more detailed site description presented in "Western New York Nuclear Service Center: Companion Report" (U.S. Dep. Energy 1978).

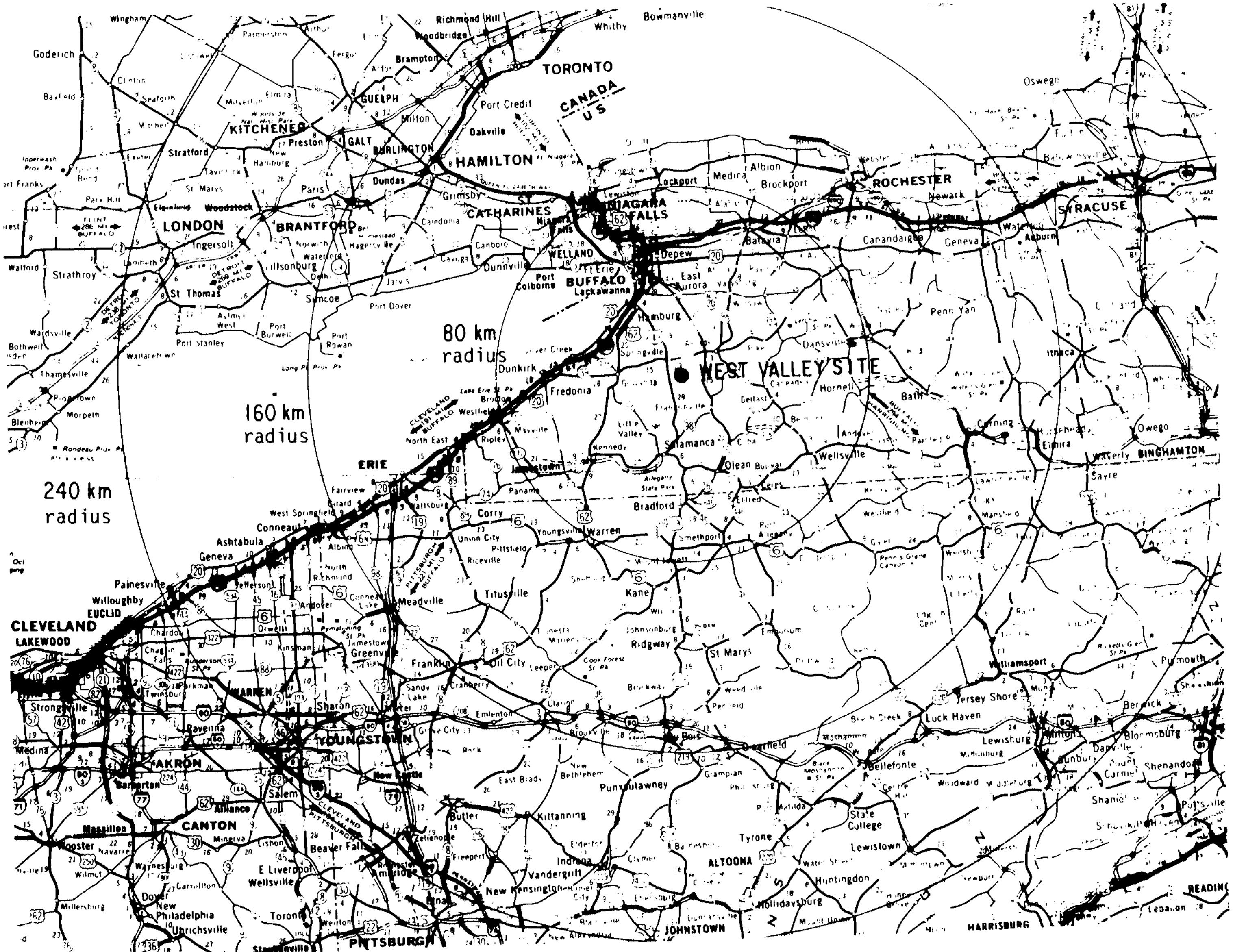


Figure 3.1. Location of the Western New York Nuclear Service Center.
Source: Nuclear Fuel Services (1975a).

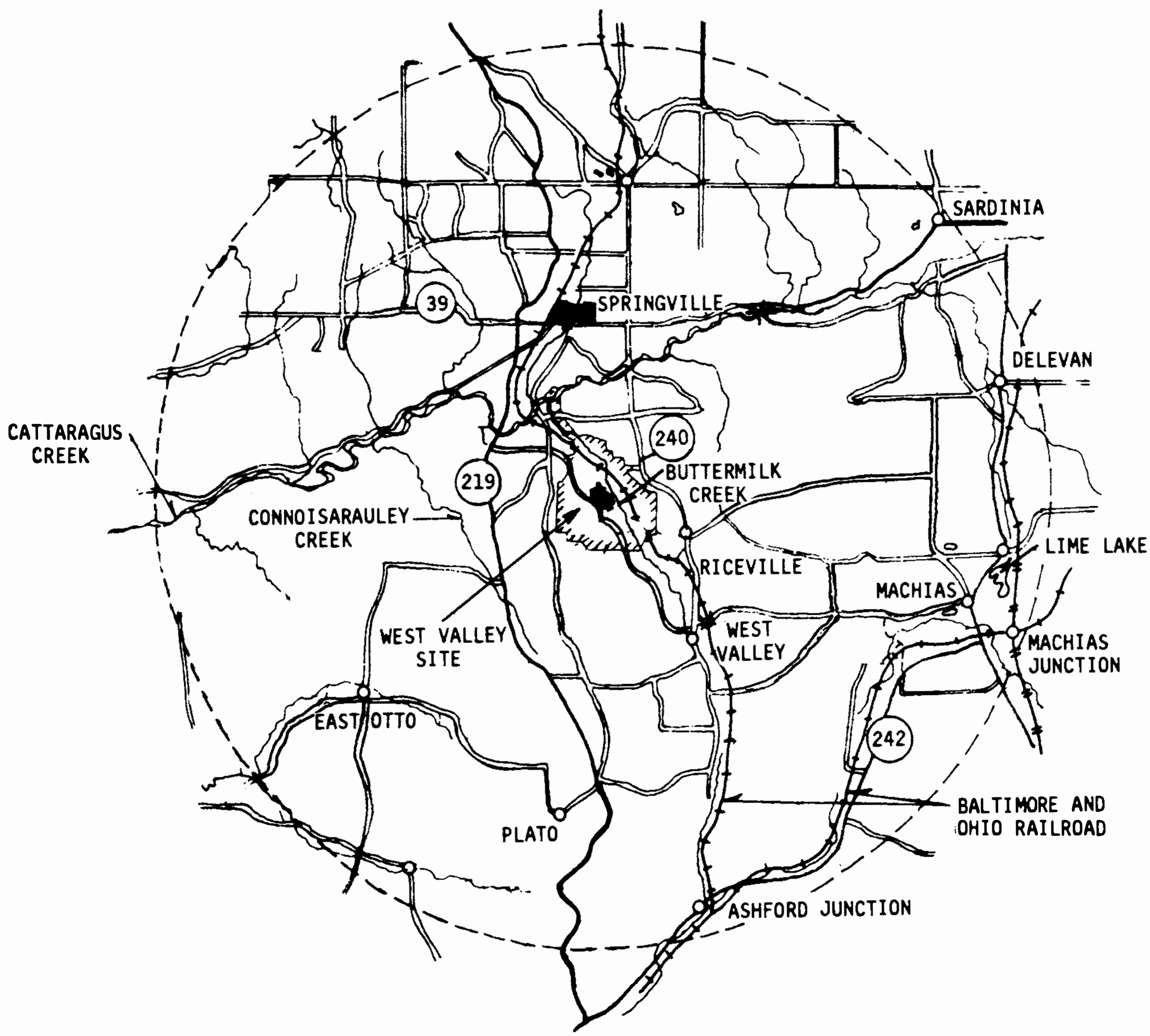


Figure 3.2. Principal Features of the Area Within 16 km (10 mi) of the West Valley Plant. Adapted from U.S. Department of Energy (1978).

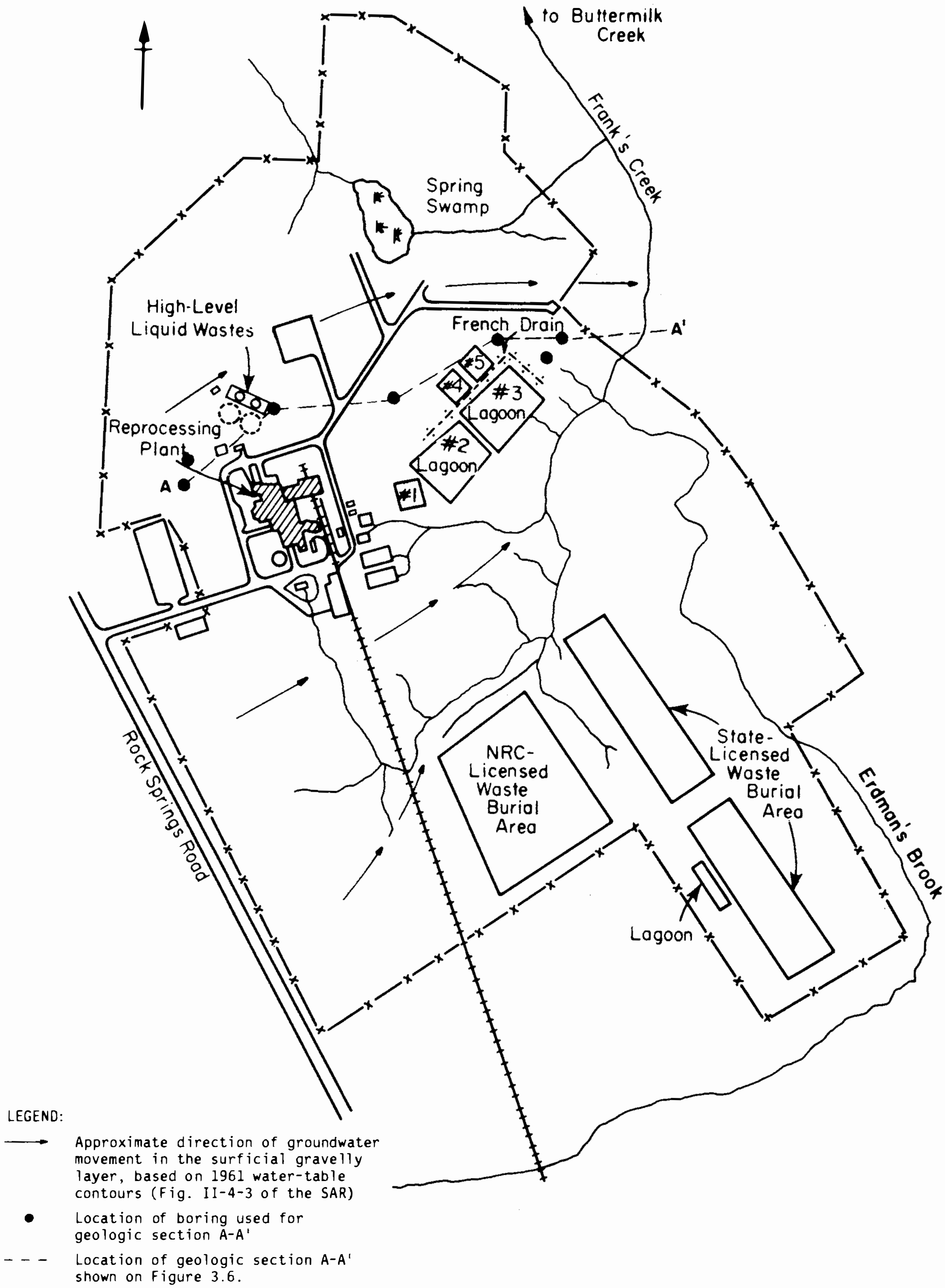
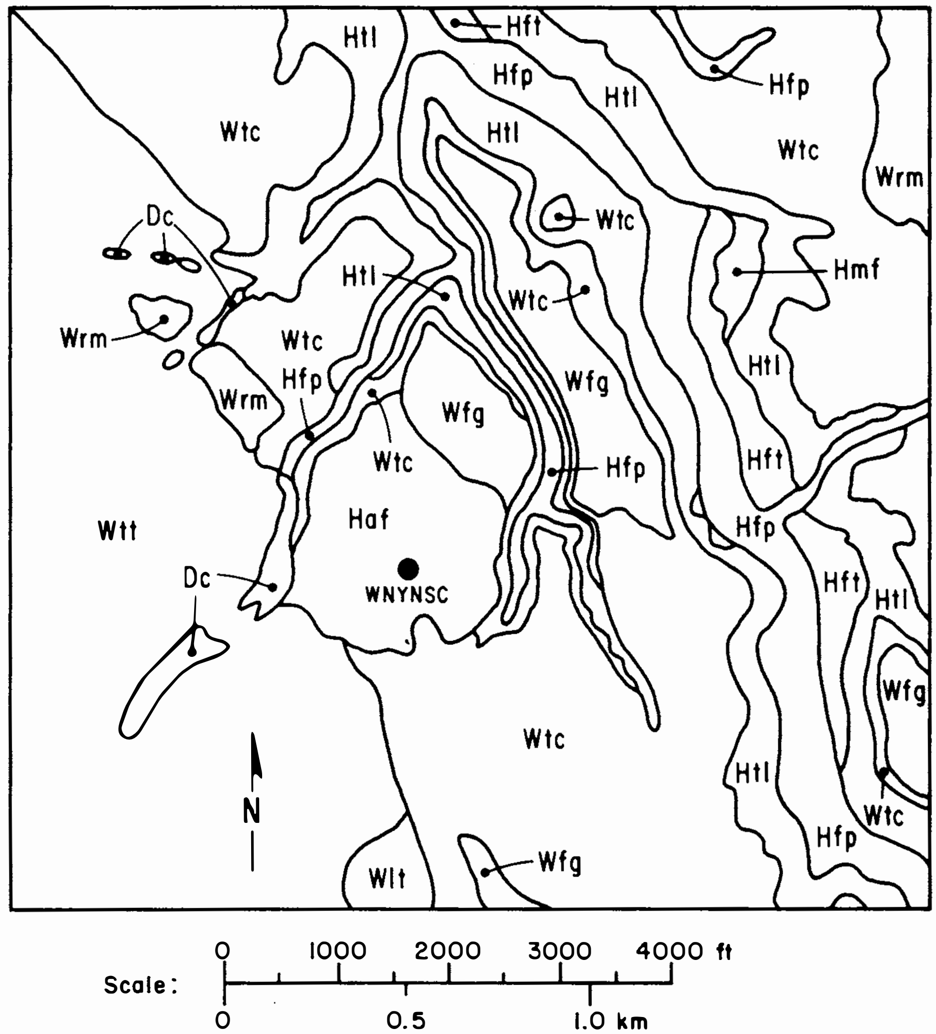


Figure 3.3. Map of West Valley Site Showing Plant Location and Burial Areas. Adapted from U.S. Department of Energy (1978).



LEGEND:

Hfp - Floodplain; gravel, silt alluvium

Hmf - Mudflows; pebbly silt, marginal to floodplains, derived from clayey till (Wtc)

Htl - Landslides, slumps; developed on exposures of clayey till (Wtc)

Hft - Low terraces of Cattaraugus Creek and tributaries; ferruginous gravel and silt, wood-bearing

Haf - Alluvial fans; channery gravel, sand

Wfg - Fluvial gravel, sand, derived from upland drainage, hummocky where laid over thin ice; overlies clayey till (Wtc)

Wtc - Till, clayey with pebbles and cobbles; deformed silt stringers, minor overridden pebble gravel, sand; mainly reworked lacustrines. May include Hiram equivalent till in upper few feet

Wrm - Ground moraine; mixed stony till, stratified drift; ice marginal

Wlt - Lodgment till, >5-ft thick; stony, silty, variously bright and drab

Wtt - Lodgment till, <5-ft thick; occasional rock outcrop

Dc - Bedrock outcrop; shales of the Canadaway Group

Figure 3.4. Surficial Geologic Map in the Vicinity of the Western New York Nuclear Service Center. Adapted from LaFleur (1979).

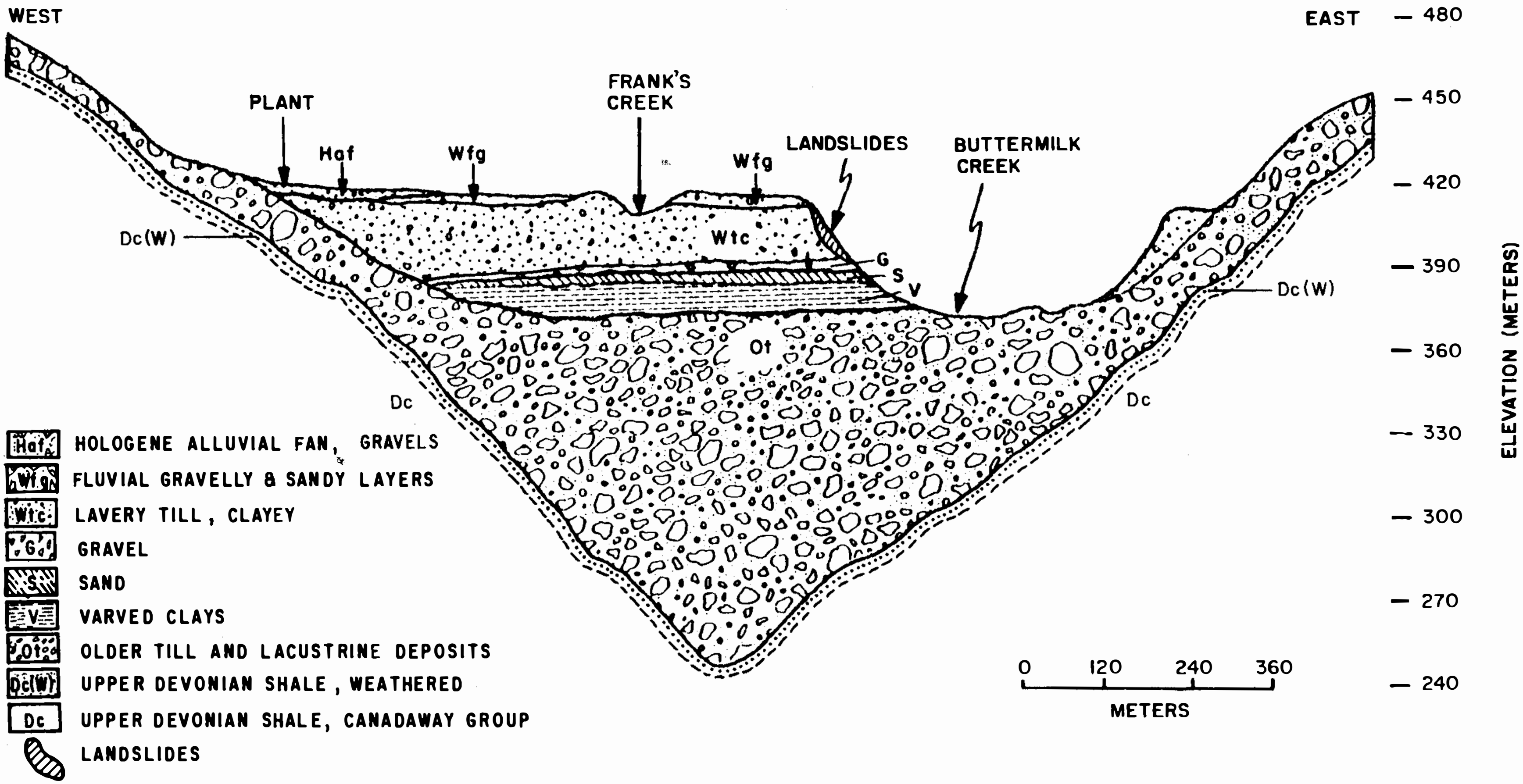


Figure 3.5. Generalized East-West Geologic Cross Section at the Western New York Nuclear Service Center. NOTE: Vertical scale = 1/4 horizontal scale. Adapted from Dana et al. (1979a).

3.1.2.1 Site Geology

A generalized stratigraphic column for the vicinity of the site is given in Table 3.1. The Paleozoic sequence of consolidated rocks that underlie the unconsolidated Holocene and Pleistocene deposits at the site comprises a thickness of approximately 2300 m (7500 ft) and ranges in age from Cambrian to Devonian. The sequence includes shales, siltstones, sandstones, and carbonates (limestone and dolomite); the Saliva Group of the Upper Silurian includes some evaporite beds as well (in the depth range of approximately 800 to 1000 m). The bedrock underlying the area is nearly flat and quite undeformed, the average dip being 6-8 m/km (about 30-40 ft/mi) to the south. The Paleozoic sequence is underlain by Precambrian crystalline rock.

In the immediate vicinity of the site, the bedrock underlying the Pleistocene glacial deposits in the Upper Devonian shale belong to the Caneadea-Machias Formation of the Canadaway Group. This unit is a thin-bedded, black and grey, moderately hard shale and siltstone that may attain a thickness of 120 m (400 ft) or more beneath the site. In a test well drilled by the U.S. Geological Survey about 1200 m southeast of the plant, 24 vertical or near-vertical fractures were observed in the cores over the total depth of 460 m (1500 ft). Moreover, a zone of decomposed shale and rubble was noted at the contact between the overlying till and the bedrock, suggesting the possiblity of groundwater movement through this zone (U.S. Environ. Prot. Agency 1977).

The distribution of glacial deposits in the site vicinity is shown in Figure 3.4. A generalized east-west geologic cross section through the plant and extending east of Buttermilk Creek is shown in Figure 3.5. The section illustrates the presence of an old preglacial valley that had been eroded in the bedrock and was subsequently filled with glacial deposits. This buried valley trends approximately north 25° west, slopes northward, and has an average depth of about 168 m (550 ft) (Nucl. Fuel Serv. 1973). The current valley of Buttermilk Creek was eroded in the unconsolidated glacial materials during the 10,000 to 15,000 years since the disappearance of the last glacier.

Possibly five or more glacial ice sheets advanced over the West Valley region, depositing a thick sequence of tills and lacustrine sediments. Part of these are now buried below the level of Buttermilk Creek. The lowest exposed till section has been assigned to Olean glaciation. Lying in channels cut on Olean till are gravels deposited during the Plum Point interstadial. Overlying the Olean till is a thick sequence of Kent till and associated proglacial lacustrine sediments. These till and lacustrine units are capped by Kent recessional kame deltas and associated intervening clastic sediments that form a sand blanket of varying thickness across Buttermilk Valley. The sand blanket is covered in part by channel gravels and gravel blankets that may have been deposited in other fluvial environments. The Kent sequence was subsequently overridden by Lavery-age ice, which deposited a thick sequence of tills and included overridden proglacial sands and gravels. Partly capping the Lavery till are late Wisconsinan proglacial outwash and fluvial gravels and Holocene alluvial fan deposits (Dana et al. 1979a).

A map of surficial deposits is illustrated in Figure 3.4. Holocene deposits in the site vicinity consist primarily of alluvial fan deposits (Haf), floodplain alluvium and gravel (Hfp), low alluvial terraces consisting of gravel and silt (Hft), and recent landslides and slumps (Htl).

Table 3.1. Generalized Stratigraphic Column for the Vicinity of Western New York Nuclear Service Center

System	Series	Unit	Thickness (m)	Approx. Depth (m)
Quaternary	Holocene	Alluvial fans; floodplain alluvium	0-6	3
	Pleistocene	Glacial till; fluvial sands & gravels	0-160	30
Devonian	Upper	Canadaway Group Java & West Falls Group (shales) Sonyea Group Genesee Group	580	610
	Middle	Tully Formation	5	615
		Hamilton Group (shale & limestone)	110	725
		Onondaga Limestone	50	775
Silurian	Upper	Akron-Bertie Salina Group	230	1005
	Middle	Lockport Group	70	1075
		Clinton Group	45	1120
	Lower	Medina (sandstone)	30	1150
Ordovician	Upper	Queenston Formation (red shales)	300	1450
		Oswego Formation (sandstone)	35	1485
	Middle	Lorraine Group Utica Formation	250	1735
		Trenton-Black River Group	255	1990
Cambrian	Upper	Tribes Hill-Beekmantown	30	2020
		Little Falls Dolomite	60	2080
		Theresa Formation	215	2295
		Potsdam Formation	30	2325
Precambrian				

As indicated in Figure 3.4, the plant area and high-level-waste tank complex are located in the area of an alluvial fan comprising about 28 hectares (68 acres). The eastern border of the fan deposits overlaps a surficial fluvial gravel deposit of Wisconsinan age (Wfg), which extends eastward essentially all the way to Frank's Creek. The alluvial fan material is comprised of gravels and silty sands, with little to some silty clay. South and east of the plant area in the vicinity of the burial grounds, the natural surficial deposit consists of Lavery till of Wisconsinan age (Wtc), which is comprised of silty clay with pebbles and silt stringers (see Figure 3.4).

A geologic cross section (A-A') extending from west of the HLW tank complex eastward to Frank's Creek is shown in Figure 3.6. The subsurface information shown in this figure is based upon the seven relatively shallow borings indicated. The locations of this cross section and of the borings used are shown in Figure 3.3. The surficial gravelly layer ranges in thickness from about 1.5 m (5 ft) in the vicinity of Boring 80 USGS-6, near Frank's Creek, to 6 m (20 ft) in Boring 12, about 200 m (670 ft) west of Boring 80 USGS-6. Over the western two-thirds of the section, the surficial gravelly layer consists of the alluvial fan deposit (Haf) discussed in the preceding paragraph; whereas in the eastern portion of the cross section, the layer is made up of a fluvial gravelly and sandy deposit of Wisconsinan age (Wfg). Based on the boring log data, the surficial unit across this section can be said to consist of gravel and silt with varying amounts of sand and clay.

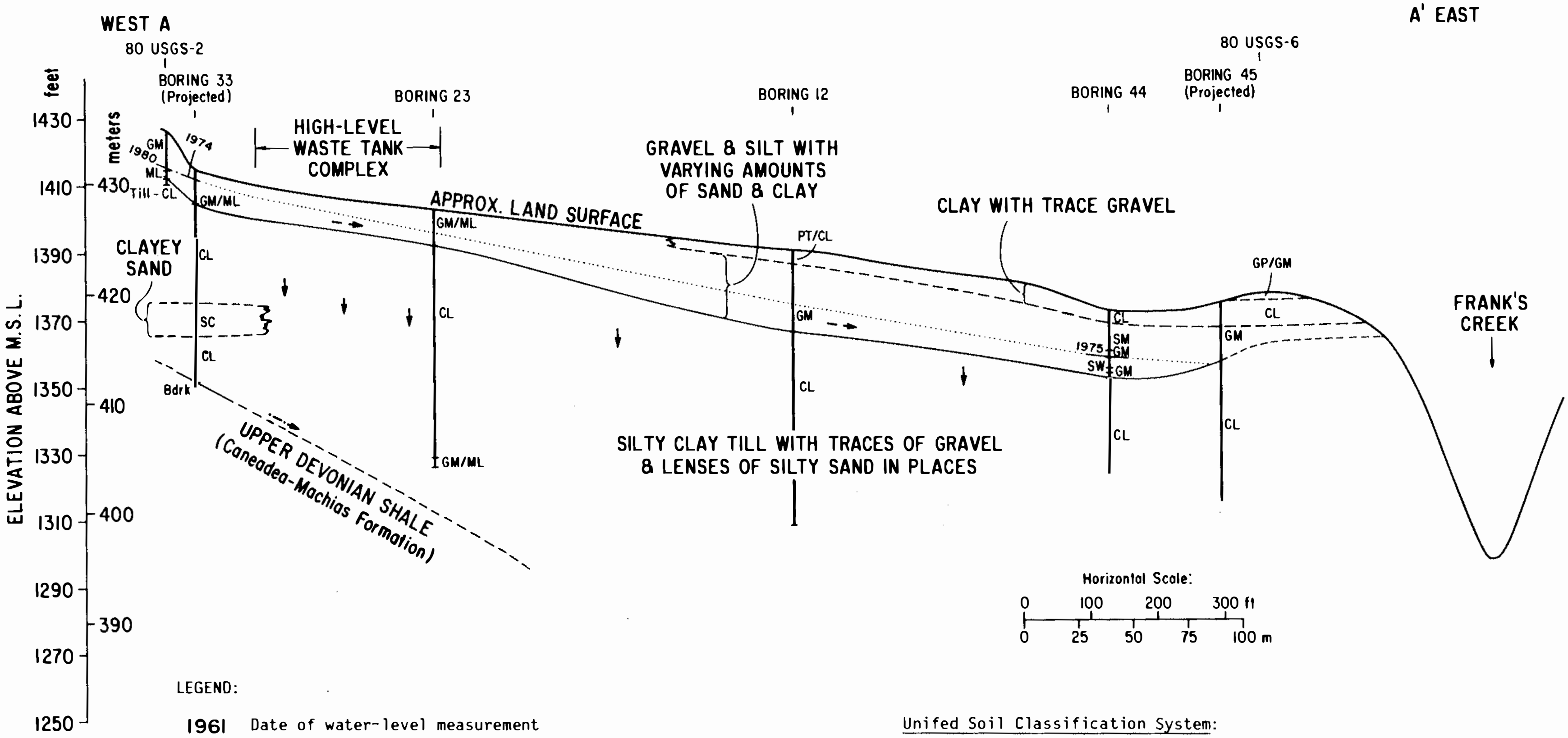
Silty clay till (Lavery till) underlies the gravelly surficial layer (see Figure 3.6). The thickness of the till is dependent on the depth to the underlying shale bedrock (Caneadea-Machias Formation). At Boring 33 on the west side of the section, the till is only about 16-m thick, but the thickness increases significantly eastward as the bedrock surface inclines steeply to the east.

Sandy and silty lenses, stringers, and pods have been observed to occur within the Lavery till in several places across the site. Such a zone is seen at Boring 33 (Section A-A'); it consists of a clayey sand layer found at a depth of 12 to 15 m (39 to 49 ft). The results of field investigations indicate that most of these lenses, stringers, or pods included within the silty-clay till do not appear to be continuous over long distances (30-100 m). The evidence also indicates that few, if any, of these coarse-grained inclusions consist of "clean" sand or gravel. In most cases, the silt content of the included bodies is too high to result in a high permeability for the lens or included layer as a whole. As an illustration of the type of coarse-grained layers and stringers found within the Lavery till and older tills, Table 3.2 provides a generalized lithologic log for the till soils underlying the site.

3.1.2.2 Seismic Considerations

The West Valley site is situated in a region that has experienced a moderate amount of relatively minor seismic activity. The record of earthquake activity in western New York and the surrounding area dates back over 100 years.

The general seismotectonic relationships in New York State, including those historical earthquakes of Modified Mercalli Intensity (MMI) V or greater, are shown in Figure 3.7. The only significant (MMI $\geq$ VII) earthquake activity in western New York has occurred in the vicinity of the Clarendon-Linden Fault.



LEGEND:

1961 Date of water-level measurement

——— Measured position of water table

········ Estimated position of water table

— → Probable direction of groundwater flow in surficial gravel and silt layer

↓ Probable direction of vertical groundwater flow through till

·—·→ Probable direction of groundwater flow through the upper weathered bedrock at till-bedrock contact

Note: This subsurface section (see Figure 3.3 for location) represents our evaluation of the most probable conditions based on interpretation of currently available data. Some variations from these conditions must be expected.

Unifed Soil Classification System:

GP - Poorly-graded gravels, gravel-sand mixtures, little or no fines

GM - Silty gravels, gravel-sand-silt mixtures

SW - Well-graded sands, gravelly sands, little or no fines

SM - Silty sands, sand-silt mixtures

SC - Clayey sands, sand-clay mixtures

ML - Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity

CL - Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays

PT - Peat, humus, swamp soils with high organic contents

Figure 3.6. Geologic Cross Section A-A'.

Table 3.2. Generalized Lithological Log for Till Soils Underlying the Western New York Nuclear Service Center

Unit	Thickness of Unit (m)
Till, dark blue-gray silt and clay, small pebbles; dense, compact, moist	6.0
Sand, coarse, some fine sand and silt, water-bearing	1.5
Till, as before	15.0
Gravel, coarse, and sand; silty, compact, permeable but apparently not water-bearing	1.0
Sand, coarse, some silt and fine gravel	2.5
Till, as before, abundant fine pebbles	8.0
Sand, some silt and fine gravel, compact	0.5
Till, as before	2.5
Gravel, coarse, sparse fine material	0.5
Till, as before	2.5
Gravel, coarse to fine, sparse fine material	2.0
Till, as before	11.0
Sand, some fine gravel and silt	2.0
Till, as before, plus 20% ± very fine sand	17.0

Source: Adapted from Table II-4-1 of the NFS Safety Analysis Report (Nucl. Fuel. Serv. 1973).

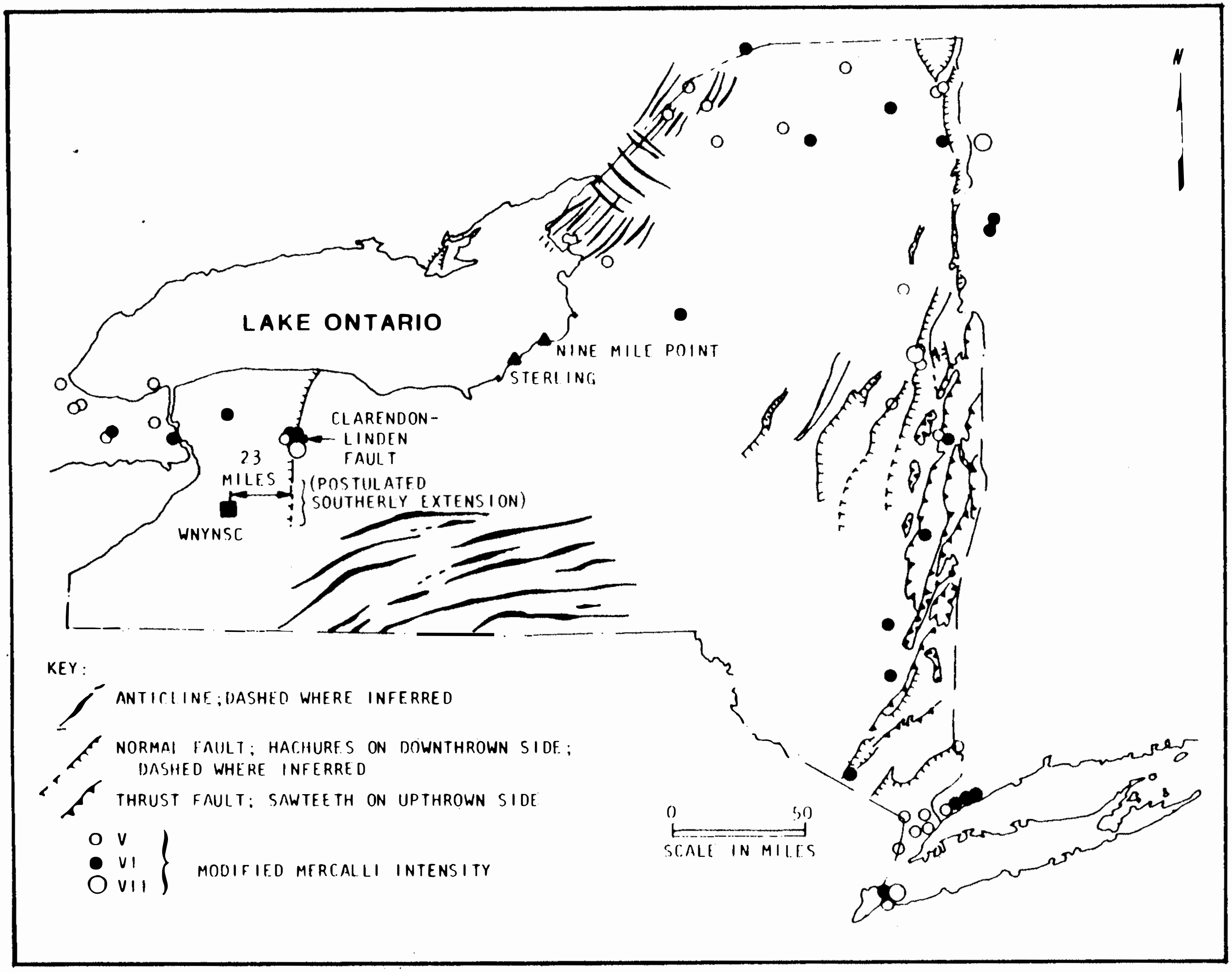


Figure 3.7. Generalized Seismotectonic Map of New York Showing Historical Seismicity.
Source: Dames and Moore (unpublished data).

Several small shocks in the Buffalo-Hamilton area are probably due to glacial rebound effects, i.e., local stress concentrations as a triggering mechanism for earthquakes by causing minor crustal readjustmends.

Outside of the area covered by Figure 3.7, there is a zone of major seismic activity near LaMalbaie, Quebec, in the lower St. Lawrence River Valley. Major earthquakes (MMI IX or X) have occurred in this area several times, the most recent being 1925. The earthquakes were felt over the entire eastern section of Canada and the northeastern United States. The West Valley site probably experienced no more than MMI IV from any of these events. This would be the greatest level of ground motion experienced at the site in historical time.

3.1.3 Hydrology

Several studies have been made of the hydrology on portions of the West Valley site, particularly of the low-level burial grounds. In addition to studies made before the plant was built (Nucl. Fuel Serv. 1973, 1975a), there are studies by the U.S. Geological Survey (Prudic and Randall 1977; Prudic 1980) and by the New York State Geological Survey/State Museum, New York State Education Department [(Dana et al. 1979b, 1980) under the auspices of the U.S. Environmental Protection Agency (USEPA) and the U.S. Nuclear Regulatory Commission (NRC)].

3.1.3.1 Groundwater

The West Valley site is underlain by at two aquifer zones, neither of which can be considered highly permeable. The upper aquifer consists of the saturated portion of the surficial, gravelly deposits discussed in Section 3.1.2 and shown in cross section A-A' in Figure 3.6. On the west side of the site, they consist of alluvial fan deposits (Haf); on the eastern side, they represent fluvial, gravelley or sandy deposits (Wfg). The areal distribution of these two units is shown on the surficial-glacial geology map of the site (Figure 3.4).

The thickness of these surficial deposits ranges from about 1.5 to 6.0 m (see Figure 3.6). In this portion of the site, the gravels appear to be mixed with silts and varying amounts of sand and clay, clearly a situation not likely to result in a highly transmissive aquifer. Field permeability tests performed in 1974 near the high-level-waste tank complex resulted in a computed horizontal permeability for these surficial materials of no higher than 5×10^{-5} cm/s (0.14 ft/d) (Nucl. Fuel Serv. 1975b). The surficial layer tends to thin significantly on the east side, adjoining Frank's Creek (see Figure 3.6). Such thinning would also tend to reduce the net discharge through the aquifer.

The second aquifer zone consists of a zone of decomposed shale and rubble at the contact between the overlying till and the bedrock, as noted in Section 3.1.2. This zone will rarely be thicker than about 0.5 m [Dc(w) in Figure 3.5]. Groundwater could enter this zone in the upland areas and in steep stream valleys where the weathered bedrock is exposed at the surface. Slow recharge could also occur from the overlying gravelly deposits through the low-permeability till sequence. It is believed that the weathered bedrock zone would rarely have an overall permeability exceeding 1×10^{-3} cm/s (about 3 ft/d).

As discussed in the preceding paragraph, groundwater movement can occur (at a very low rate) downward through the till sequence. Conservatively, one can select a coefficient of vertical permeability of 1×10^{-7} cm/s for the material (Dana et al. 1979c), based on laboratory and field measurements by several investigators. Water might also be expected to move laterally within the till through the sandy, gravelly and silty lenses or stringers. However, as noted in Section 3.1.2, because of the silt content and lack of extensive continuity of these included bodies, the effective horizontal permeability of any one of these lenses is highly unlikely to exceed that determined for the surficial gravelly deposits--about 5×10^{-5} cm/s.

The groundwater flow patterns pertinent to the site relate to the recharge and downgradient movement for the two aquifer zones identified above. Directions of groundwater movement are indicated on cross section A-A' in Figure 3.6. Short arrows are used in the figure to indicate downward movement through the till; as reported, such movement is believed to be extremely slow. The approximate direction of groundwater flow in the surficial unit, as indicated on the map of the West Valley site (Figure 3.3), is based on water-level measurements performed in 1961. Groundwater in the surficial unit tends to move in an easterly or northeasterly direction from the western boundary of the site, close to Rock Springs Road. It is believed that most, if not all, of the groundwater in this unit discharges into Frank's Creek or into small tributaries of that creek.

Groundwater recharging the weathered shale and rubble zone will tend to move eastward toward the thalweg (locus of the lowest points in the cross section of the buried valley) of the buried valley, located about 300 to 350 m to the west of Buttermilk Creek (Figure 3.5). Once attaining the thalweg, the direction of groundwater movement would shift to the direction of the thalweg, about north 25° west, and proceed toward the northwest.

Groundwater flow rates and travel times have been computed for the site surficial unit and for the underlying till sequence (Nucl. Fuel Serv. 1975b). The cross section A-A' (Figure 3.6) is aligned approximately along a groundwater flow path for the surficial gravelly unit. Based on the water-table level indicated in the cross section, an average gradient (i) of 0.033 was computed. The average horizontal permeability (K_h) for the unit was assumed to be 1×10^{-4} cm/s, and the assumption was made that, for this material, the effective porosity (n_e) was 0.15. Based on these, the seepage or pore velocity (u) was computed from:

$$u = \frac{K_h i}{n_e}$$

The resulting value for u calculates to be 0.019 m/d. The distance from the HLW tank complex to Frank's Creek, the presumed point of discharge, is 430 m. Hence, the computed average travel time from the waste tank complex to the creek is about 62 years.

The travel time for groundwater to move from the waste tank complex, downward through the till, to the second aquifer zone was also computed. The average vertical permeability of the till was assumed to be 1.0×10^{-7} cm/s, the average downward gradient was assumed to be unity, and an effective porosity of 0.10 was adopted. Based on these estimates, the computed time for water to travel vertically from the bottom of the overlying surficial gravelly unit to the till-shale contact--when this unit has a thickness of about 17 m--is 54 years.

Estimates of travel time to the nearest surface stream (62 years) and to the nearest aquifer (54 years) are for water alone. These estimates are conservative because radionuclides dissolved in water are subject to ion-specific physical and chemical interactions (sorption and ion exchange) with the soil material, which usually retard migration.

It would appear, therefore, that the movement of possible contaminants through the upper aquifer zone would be the most critical of the two pathways. Surface streams would be reached most quickly in this manner. However, should any contaminants be spilled on the ground surface during the winter when the surface soil is completely frozen, the material would probably not enter the upper aquifer zone. Since the liquid would tend to move laterally over the ground surface as runoff, its rate of movement would be dependent on surface slope and temperature, the latter influencing its tendency to freeze on the surface.

3.1.3.2 Surface Water

Major surface-water drainage features of the site area are Cattaraugus Creek and Buttermilk Creek, principally the latter. Buttermilk Creek originates south of the site, but its lower portions--including its confluence with Cattaraugus Creek--are wholly within the boundaries of the site. Buttermilk Creek drains approximately 76 km^2, about 14 km^2 of which are within the site boundaries. The average flow rate of the creek is 1.3 m^3/s (Nucl. Fuel Serv. 1975a).

The total drainage area of Cattaraugus Creek is about 1400 km^2, including 560 km^2 above its confluence with Buttermilk Creek to the north of the site. Peak flow rates in Cattaraugus Creek occur in November-December and in March. In the vicinity of the site, the typical maximum flow rate is 20 m^3/s; a typical minimum rate is about 1 to 2 m^3/s, and the average is about 10 m^3/s. Cattaraugus Creek enters Lake Erie near the eastern end of the lake, about 45 km (27 mi) southwest of Buffalo.

The circulation patterns of Lake Erie have been studied by Buechi and Rumer (1969). A physical model of Lake Erie was constructed and studied in a rotating apparatus designed to simulate the effect of the earth's rotation. The observed current pattern with zero wind stress showed a relatively well-mixed western basin, a strong eastward south shore current, a relatively slow westward flow in the central basin that sustained an eastward current along the north shore, and an eastern basin dominated by a converging flow towards the Niagara River.

The studies of the lake model indicated that a westerly wind alters the circulation pattern from the case of no wind stress. The lake develops somewhat separate surface and subsurface circulation patterns under the action of a westerly wind. These patterns are coupled with vertical and transverse motions. The south shore current observed in the zero wind stress studies is even more predominant at the surface for the wind-driven pattern.

Preliminary residence-time studies indicate that a tracer entering through the Detroit River and remaining in the surface flow will move very rapidly through Lake Erie along the south shore under the action of a westerly wind. The subsurface pattern is more complex and marked by stable gyre formation and transverse flows north and south across the lake. Figure 3.8 illustrates the general circulation patterns for Lake Erie, both with and without wind stress (Buechi and Rumer 1969). Cattaraugus Creek water is assumed to follow the generally eastward current of the surface circulation as the water enters the lake. Thus, the water would ultimately be carried toward the mouth of the Niagara River.

Both Cattaraugus and Buttermilk creeks lie in deep valleys; historical data for these two creeks indicate a maximum gage height of 4.3 m (14 ft) and 2.6 m (8.5 ft), respectively. The surface drainage pattern and depth of these valleys are such that they could contain a 100-year flood stage in the site vicinity (Dames & Moore 1974).

3.1.4 Climate and Meteorology

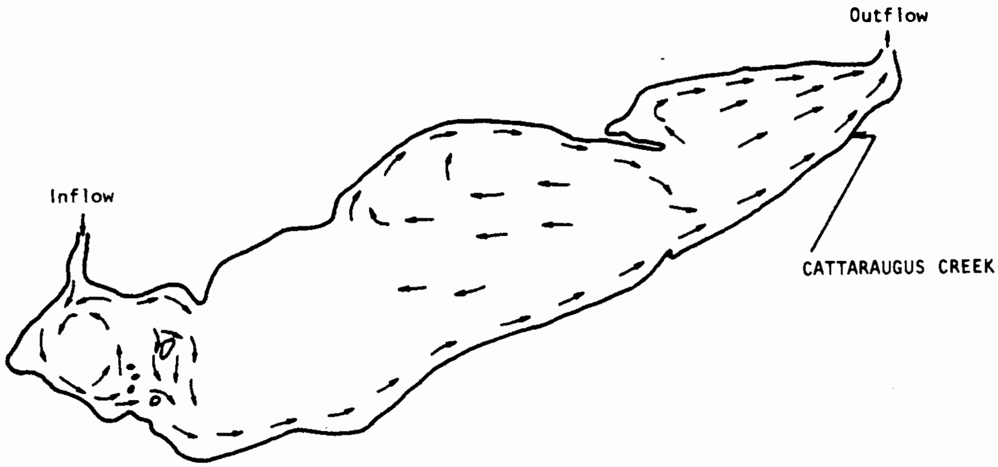
Western New York has a typically humid, continental climate modified by the presence of Lakes Erie and Ontario and the upslope terrain from the lakes toward the south and southeast. The region lies near the typical track of many major low-pressure systems that cross the continent.

Wide seasonal variations in temperature are tempered appreciably by the lakes; summer temperatures above 32°C (90°F) are rare, and cold air masses can be warmed by as much as 15°C (27°F) in crossing over the lakes. Temperatures for the local area are reported for Franklinville [20 km (12 mi) southeast, elevation 485 m (1590 ft) MSL], the nearest station reporting to the National Climatic Center. The average annual temperature is 7.2°C (45°F); the warmest month is July [mean temperature of 19.6°C (67°F)]; and the coldest month is February [mean temperature of -5.7°C (22°F)] (U.S. Dep. Commer. 1977a).

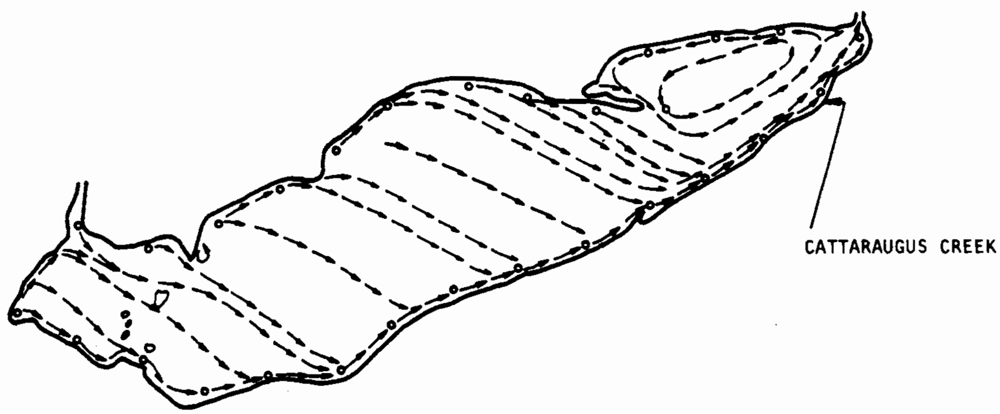
Precipitation is high [averaging about 104 cm (41 in.) per year] and fairly evenly distributed throughout the year (U.S. Dep. Commer. 1977a). Heavy snowfall is associated with outbreaks of arctic air as cold air becomes saturated by passage over Lake Erie. Counties downwind of the lake experience average annual snowfalls of more than 380 cm (150 in.) (U.S. Dep. Energy 1978).

Winds at the site are generally from the west and south; speeds greater than 1.3 m/s occur 92% of the time, and speeds of 4 to 8 m/s occur 59% of the time (Nucl. Fuel Serv. 1975). Winds from the south-southeast, blowing toward Buffalo, occur only 6.5% of the time (above 8 m/s only 0.6% of the time).

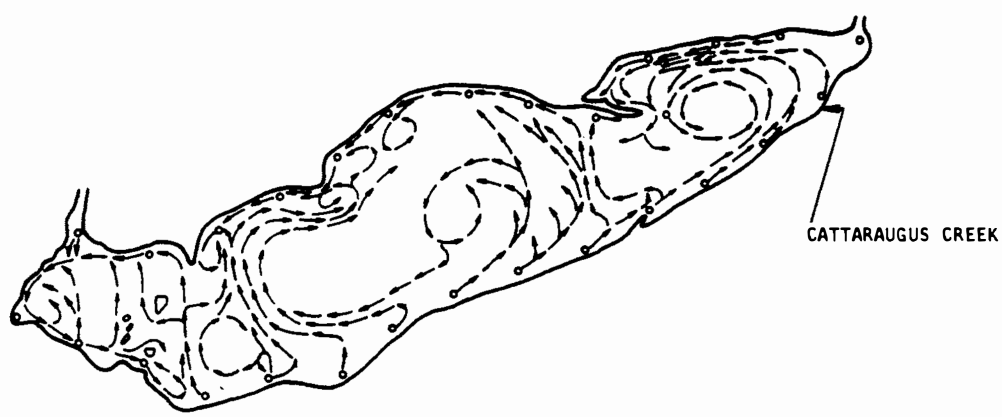
Thunderstorms are infrequent because of the stabilizing influence of the lake. The frequency and intensity of tornadoes also is low in comparison to other parts of the United States; for the period 1950 through 1970, only 16 tornadoes were reported within 80 km of site (Nucl. Fuel Serv. 1973). The probable frequency of ice storms is about two to three per year.



General Circulation Pattern in Model Lake Without Wind Stress



General Surface Circulation Pattern with Westerly Wind



General Subsurface Circulation Pattern with Westerly Wind

Figure 3.8. Lake Erie Circulation Patterns. Adapted from Buechi and Rumer (1969).

3.1.5 Ecology and Land Use

The area surrounding the West Valley site is within the deciduous-forest biome, but the vegetation of the area has been greatly influenced by past agricultural and forestry practices.

The original vegetation of the area was that of the Great Lakes Forest Association (Nucl. Fuel Serv. 1975). Dominant trees were sugar maple, beech, and hemlocks on the north-facing slopes and in the cool valleys; and oaks, chestnut, and hickory on south-facing slopes. However, within the past several generations, most of the area has been cleared for agriculture and the forests that were allowed to remain have been repeatedly harvested.

Much of the cleared land remains in agricultural production today, but many hundreds of acres were cleared, used temporarily, and then abandoned when found to be submarginal for agriculture. Natural succession has proceeded on these lands, but because of soil depletion and other factors, the return to forests has been slow. Many of these abandoned farms are covered with shrubs and other low vegetation. However, during the 1930s and 1940s, a good deal of reforestation was undertaken, so in some areas there are now large, even-aged stands of larch, red pine, Scotch pine, and other introduced species.

The rolling and irregular topography and somewhat impermeable soils of the area also are factors in the area ecology (Nucl. Fuel Serv. 1975a; U.S. Dep. Energy 1978). Wetlands on the site are mostly spring-fed swamps such as the one just north of the process plant lagoons (Figure 3.3) and the marshes south of the plant. There are no extensive floodplains associated with the onsite streams (Section 3.1.3). The last glaciation also left a number of depressions that developed into bog lakes and eventually into peat bogs. Some of these are now entirely filled and can be recognized only by the underlying peat, whereas others are in earlier stages of succession.

Except for the central portion of the site where the facilities are located, the site is mostly forested. All along Buttermilk Creek and in the southwestern part of the site there is a climax or near-climax, mixed-deciduous forest. Common species include maple, oak, ash, beech, birch, hemlock, fir, pine, basswood, elm, hickory, cherry, cottonwood, and aspen.

Fauna found on the site are typical of those of the northeastern United States (Nucl. Fuel Serv. 1975a). White-tailed deer, the largest indigenous mammals in the area, are common and represent an important recreational resource. Other mammals present include the woodchuck, porcupine, raccoon, cottontail, and red fox. Several recreationally important bird species occur in the site area--wild turkey, ruffed grouse, and ring-necked pheasant, which are permanent residents, and the woodcock, which commonly breeds in the area but migrates in spring and fall. Many species of waterfowl migrate through the area, but no major concentrations occur nearer than the Iroquois National Wildlife Refuge, 65 km to the north. Thirteen species of amphibians and reptiles were identified within a 16-km radius of the site during a survey made in the summer of 1966; in September 1974, fish species were collected by seining at three locations near the site (Nucl. Fuel Serv. 1974).

"Except for occasional transient individuals," no endangered or threatened species are known to exist on the site or in the adjacent area (Larsen 1980).

Lists of plants and vertebrate animal species on the site are given in Appendix B of the U.S. Department of Energy (1978) report.

3.1.6 Socioeconomics

The West Valley site is located in the Cattaraugus County town* of Ashford, slightly less than 2 km (1.2 mi) south of Erie County. For purposes of this section, the project impact area has been defined as consisting of the five surrounding counties of Allegany, Cattaraugus, Chautauqua, Erie, and Wyoming. The most distinct demographic and socioeconomic feature within this five-county area is the contrast between the urban development in the vicinity of Buffalo and its suburbs and the largely rural, sparsely populated nature of the rest of the surrounding area.

3.1.6.1 Demography and Settlement Pattern

As shown in Table 3.3, the estimated 1980 population of the five counties in the impact area totals 1,410,803 people. Nearly 80% reside in Erie County, which contains the Buffalo metropolitan area. In recent years, the city of

Table 3.3. Population in the Five-County Study Area

County/Town	1960	1970	1980	1960-1970 Total Change	1960-1970 % Change	1970-1980 Total Change	1970-1980 % Change
Allegany County	43,978†[1]	46,458†[1]	53,000†[2]	2,480	5.6	6,542	14.1
Cattaraugus County	80,187†[1]	81,666†[1]	87,130†[2]	1,479	1.8	5,464	6.7
Chautauqua County	145,377†[1]	147,305†[2]	149,673†[6]	1,928	1.3	2,368	1.6
Erie County	1,064,688†[2]	1,113,491†[3]	1,082,000†[2]	48,803	4.6	-31,491	-2.8
Wyoming County	34,793†[3]	37,688†[3]	39,000†[2]	2,895	8.3	1,312	3.5
Town of Concord	6,452†[4]	7,573†[4]	8,134†[7]	1,121	17.4	561	7.4
Town of Ashcord	1,490†[5]	1,577†[5]	1,882†[7]	87	5.8	305	19.3

†[1] Southern Tier Regional Planning and Development Board (1978).

†[2] New York State Department of Commerce data provided by Erie County Department of Environment and Planning.

†[3] U.S. Bureau of the Census (1973).

†[4] Erie and Niagara Counties Regional Planning Board (1975).

†[5] Danziger (1978).

†[6] Chautauqua County Planning Board & Department of Planning (1973).

†[7] U.S. Bureau of the Census (1980).

Buffalo has experienced a decrease in population, but the population of its suburbs has grown. Among the five counties, Erie is the only one that experienced an overall loss of population between 1970 and 1980; the other, more rural counties experienced moderate to slight increases in population.

*In New York, the "town" is a government unit intermediate between the county and the municipality. In some states, similar units are called "townships".

In the immediate vicinity of the site, the populations of both the towns of Ashford (in which the site is located) and nearby Concord increased during the past decade. The largest community in the two towns is Springville, with an estimated 1980 population of 4220 (U.S. Bur. Census 1980). The closest community to the site, the unincorporated hamlet of West Valley about 5 km from the site, had an estimated 1978 population of 713.*

3.1.6.2 Economics

The economic center of the region is the Buffalo metropolitian area, which is located north of the West Valley site. Buffalo is connected to the east and west by the New York State Thruway. The major economic links for the southern counties (Allegany, Cattaraugus, and Chautauqua) are Highway 219 and the nearly completed Southern Tier Expressway.

Although generally rural in character, Cattaraugus County has a diversified business composition (U.S. Dep. Commer. 1966, 1977b). The total nonagricultural labor force of the county was 25,800 people in 1970, 27,300 in 1975, and 27,500 in 1976 (N.Y. State Dep. Labor 1977). About one-third (32%) of the nonagricultural employees were in manufacturing in 1976; almost as many (25.1%) were employed in government. Other major nonagricultural employment fields were wholesale and retail trade (16.7%) and service and miscellaneous (17.5%) (N.Y. State Off. Plan. Serv. 1970; N.Y. State Dep. Commer. 1963, 1974). In the immediate site area, four small industries manufacturing tools and machine parts and a surveying firm (all in nearby Springville) employ about 400 skilled craftsmen and technicians. The Kissing Bridge ski area employs more than 400 persons during the winter. A hospital and two medical research laboratories also provide employment in Springville.

The West Valley operation is the only industrial activity in the vicinity of West Valley. In 1964, Nuclear Fuel Services (NFS) employed 264 operating personnel at the center, supplemented at times by temporary workers. However, in recent years when the plant has not been operating, employment has dropped to 50 people (in 1978, 26 of these employees lived in Cattaraugus County and 24 lived in Erie County, including 14 in Springville).

As shown in Table 3.4, all counties in the five surrounding counties have average household incomes under $15,000 except Erie County ($18,546) and Wyoming ($16,288). Erie County leads the area in income because of its metropolitan setting.

The unemployment rate in the project impact area is generally higher than the overall state rate (8.3% for the first four months of 1980) and the nationwide rate (6.4%). The local rates ranged from 7.6% unemployment in Chautauqua County to 10.5% in Erie County (N.Y. State Dep. Labor 1980).

The largest economic impact of the West Valley plant on the local area in recent years has been its contribution to the property tax base of Cattaraugus County, the town of Ashford, and the West Valley Central School District. The property orginally taken for the site constitued only 4% of the assessed valuation for the town and county, and 4% for the school district. By 1966, when

*Based on 310 dwellings with water hookups and an estimated average of 2.3 residents per dwelling.

Table 3.4. Average Household Incomes: 1970 and 1980

County	Income ($) 1970	Income ($) 1980	Percentage Change 1970-1980
Allegany	8,258	13,591	65
Cattaraugus	8,296	14,214	71
Chautauqua	8,472	14,663	73
Erie	10,833	18,546	71
Wyoming	9,420	16,288	73

Source: 1970 census data and projections by Urban Decision Systems, Los Angeles.

the plant became operational, NFS was paying almost 20% of the tax revenues of both the West Valley School District and the town of Ashford (Table 3.5). Since then, at least 16% of those local tax revenues have been paid by NFS, and loss of those revenues would necessitate a 22% increase in the tax rate. The State of New York has recently passed legislation to offset these losses (Section 4.3.9).

The economic impact of the West Valley plant on Erie County (primarily Springville) has been different from that on Cattaraugus County. Although more plant employees have resided in Springville than in any other area community, neither Springville nor Erie County has received any direct economic benefits from the plant operation in the form of tax payments. However, the Erie County communities in which the plant employees have lived have received indirect economic benefits. Springville has been the recipient of many of these indirect economic benefits, including expenditures by individual employees who live there.

3.1.6.3 Housing and Real Estate

In general, throughout the region the housing situation is characterized by low vacancy rates, a need for new units, and an apparent need for repairs or replacement of many existing units. In Cattaraugus County, for example, more than 65% of the residential units were built before the end of World War II, and nearly 25% needed at least moderate repairs in 1973. Occupancy rates in the county exceed 90%, but nearly 11% of all rural residences in the county are seasonal or vacation homes occupied only part of the year. The Cattaraugus County Planning Board estimates a need to build 5519 additional units during the current decade (Cattaraugus Co. Plan. Board 1976). Also, regional planners have identified housing for senior citizens as a priority county need (Southern Tier Regional Plan. Dev. Board 1978).

Table 3.5. Taxes Paid by Nuclear Fuel Services, Inc. (NFS), to the Town of Ashford (Cattaraugus County) and West Valley Central School District in Selected Years

Year	Assessed Valuation of West Valley Plant ($)	Total Taxes ($)	Taxes Revenues from NFS ($)	Percentage of Total by NFS
Town of Ashford				
1965	152,000		6,156	
1966	700,000	127,351	25,004	20
1970	790,000	155,335	29,846	19
1974	900,000	179,255	36,441	20
1978	900,000	176,248	31,953	18
1979	900,000	192,930	34,714	18
1980	900,000	224,972	39,655	18
West Valley Central School District				
1965	700,000	125,000	22,797	18
1968	700,000	139,000	31,045	16
1970	790,000	248,847	44,854	18
1974	900,000	337,204	60,324	18
1977	900,000	416,830	70,125	17
1978	900,000	454,795	75,440	17
1979	900,000	484,295	79,484	16
1980	900,000	539,763	87,932	16
1981†[1]	-	447,977	87,932	20

†[1] NFS no longer paid taxes. State of New York made payments in-lieu-of taxes.

Sources: Robert Conrad, Business Manager, West Valley Central School District; Barbara Edwards, Cattaraugus County Treasurer.

3.1.6.4 Recreation

Although there are few developed recreational facilties near the West Valley site, outdoor recreation is one of the fastest growing industries in Cattaraugus County, and this trend is expected to continue throughout the region for the next 10 to 20 years as the Buffalo/Rochester metropolis expands (N.Y. State Parks Recr. 1972, 1978; Cattaraugus Co. Plan. Board 1977).

Vacant farm and forest lands in Cattaraugus County are being acquired for seasonal homes and camps (Cattaraugus Co. Plan. Board, 1977; Ashford Town Board et al. 1964). Among the more popular outdoor recreational activities are camping, nature study, skiing, golfing, bird watching, and water-oriented sports. Allegany State Park, New York's largest state park, is 40 km south of the site. Other recreational resources include the Allegany Reservoir, several ski resort centers, and camping and museum facilities owned by the Seneca Nation. In northeast Cattaraugus County, there is potential for recreational development at Case Lake in the town of Franklinville (Ashford Town Board et al. 1964).

Southern Erie County has numerous sport fishing areas in the Cattaraugus Creek watershed, including several creeks in the town of Concord. Regional planners describe Cattaraugus Creek as "New York's best stream for Lake Erie-run salmonoids...." (Erie and Niagara Co. Regional Plan. Board 1978). Area planners view enhancement of recreational activities as an important means of strengthening Erie County's economy by increasing tourist expenditures (Erie and Niagara Co. Regional Plan. Board 1975).

3.1.7 Cultural Resources

3.1.7.1 Regional

A literature review of the local and regional culture history for the southern Erie and northern Cattaraugus counties in western New York State has recently been made (Henderson et al. 1980). This review profiled the regional cultural and material characteristics of recognized prehistoric societies, historic European settlers, and ethnohistoric and contemporary Native American peoples. Kinds and distributions of sites that are anticipated in the general area were assessed as they relate to particular topographic settings.

In general, the two-county study area was found to have had a long and complex occupational sequence that began sometime around 10,000 BC. Numerous cultural resource sites have been reported for the area, particularly those of the prehistoric periods. Moreover, experts on this area such as White (1974) have stated the Cattaraugus Creek Valleys and bluffs have "a very high archeological potential" (Henderson et al. 1980).

3.1.7.2 Plant Site

A possible earthwork that is reported in the literature may be located on the plant site. Archaic sites are also to be expected along the floodplains of Buttermilk Creek, which cross cut the plant property. Moreover, historic standing structures and foundation structures may also be present on this property (Henderson et al. 1980).

3.1.8 Radiological

Routine radiation monitoring of the environment, both within and outside the West Valley site boundaries, has been conducted by NFS, the former U.S. Atomic Energy Commission (through 1972), and the New York State Department of Environmental Conservation. A summary of the current programs and the locations of the sampling stations are given in Appendix F. Additional, nonroutine radiological studies have also been conducted or sponsored by the above agencies and other groups, such as the U.S. Geological Survey, New York State Geological Survey, U.S. Public Health Service, New York State Department of Health, U.S. Department of Energy, and U.S. Environmental Protection Agency. The major emphasis of all these programs has been on surface and subsurface migration of radionuclides from the New York State-licensed waste-burial area.

The results of this monitoring have shown that the only measurable, above-background external radioactivity [15.0-20.0 (1968-1972), 11.0-13.5 (1979) vs. 4.0-14.0 μrem/h background] occurring outside the site boundaries results from radionuclides deposited in Cattaraugus Creek downstream from the plant. Within the site boundaries, excluding the known quantities of radionuclides in the plant and waste burial areas, there is some slight contamination of the soil within the exclusion (fenced) area northeast of the plant [17.5-22.0 μrem/h (1979)]. There also are some slightly above-background levels in the onsite streams northwest of the plant [13.5-17.5 μrem/h (1979)], resulting from sediments deposited during early plant operations before installation of the LLW treatment facility (Nucl. Fuel Serv. 1975a; N.Y. State Dep. Environ. Conserv. 1966-1979).

Repeated streambed samples and aerial surveys have shown that the extent of the area of above-background radiation is decreasing with time. Excluding the small amount of radionuclides (400-114,000 pCi/kg) in the deep sediments in Cattaraugus Creek behind Springville Dam and the slightly contaminated areas described above, the current radiation levels for the offsite and exclusion areas now approximate preoperational levels (N.Y. State Dep. Environ. Conserv. 1966-1979; West Valley Tank Decontam. Decomm. Task Group 1978; Mott 1980).

Routine radiological monitoring of the environment would also be performed during the operations. This environmental surveillance program would be designed in accordance with Department requirements (e.g., DOE Orders, 5400 Series) and in consideration of past environmental surveillance programs and information as well as the routine and potential accidental release points from the operations.

In assessing the radiological impact, an area within an 80-km radius of the West Valley site was used. This area included parts of Canada.

3.2 TRANSPORTATION ROUTES AND DISPOSAL SITES

Several offsite areas would be affected in alternatives 1a, 1b, and 2, including disposal sites (Federal repository and regional burial ground), an offsite processing site (alternative 2 only), and areas along transportation routes. None of these offsite areas have yet been specifically identified. As discussed in Section 4.3, the State of New York would have to identify the regional burial ground and the Department of Energy would have to identify the other offsite areas before implementation of an alternative.

Since no real sites have been identified, no site-specific environmental details were used in assessment of environmental impacts. Where assumptions were made in order to analyze environmental impacts, these assumptions are given along with the analyses in Section 4 and Appendix B.

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4. ENVIRONMENTAL CONSEQUENCES AND RISKS OF THE ALTERNATIVES FOR THE WEST VALLEY HIGH-LEVEL WASTE SOLIDIFICATION PROJECT

4.1 RADIOLOGICAL IMPACTS

4.1.1 Introduction

Four alternatives were considered for the long-term containment of the West Valley liquid high-level wastes (HLW); three of these alternatives require solidification of the wastes and the fourth is a "no-action" alternative (see Section 2). The radiological impacts of each alternative must be evaluated to aid the decision-maker in selecting the course of action for the West Valley project. The methods used and results obtained from these evaluations of radiological consequences, the risks associated with the various alternatives, and the potential impacts of the four alternatives are discussed in this section. Potential effects for the preferred alternative la are used as the base for discussion and comparison.

These evaluations involved the calculation of doses of radiation to workers and to the population that might be expected to occur during processing, transportation, and storage of the West Valley HLW under normal and abnormal conditions. The people considered in these calculations are the workers who would process and handle the wastes, the people living near the plant (within 80 km or 50 mi, which includes a portion of Canada), the people in proximity of the wastes as they were being transported offsite to a Federal repository or regional burial ground, and the people assumed to live within an 80-km radius of the disposal sites. In addition, population doses for the continental United States from releases of gaseous radioactivity to the atmosphere are also considered.

The principal pathways for transmitting radioactivity to humans are identified in this section and the relationship between the resulting radiation dose and health effects is given. The events leading to the release of radioactivity include both normal events and accidental events such as equipment failure during the waste solidification process, natural disasters (earthquake, tornado), an airplane crash into the wastes during processing and storage, or a sabotage attempt. For each event, the main mechanism of transport (atmospheric or hydrologic) is identified.

Two major time periods are considered in the evaluations. The first is a short-term period (100 years) during which institutional surveillance and control are assumed to be in effect. During this period, any processing, transport, or waste disposal would take place. The second is a long-term period that lasts for 10,000 years (following the end of the first 100 years), during which time institutional control would no longer exist and radiological impacts could be produced primarily by migrational and intrusional events.

The principal migrational event considered is leaching of the solid wastes by groundwater, with subsequent release of activity to the biosphere. The intrusional events considered are occurrences such as natural disasters, an airplane crash, or human intrusion, with the subsequent release of radioactivity. After 10,000 years, radiological impacts due to these events could still occur. The yearly radiological impacts for the last year of the 10,000-year long-term period are calculated to give an estimate of the upper limit of the risks that could be expected beyond the 10,000-year period.

The main source of radioactivity at West Valley is the liquid HLW wastes stored in two underground tanks. Currently, the dominant activity is due to fission products such as strontium-90 and cesium-137, which have half-lives of about 30 years (shorter-lived isotopes originally present have decayed to insignificant levels). The activity of strontium-90 and cesium-137 will decrease over a millionfold after several hundred years, at which time the dominant activity will be that of the transuranic elements that have much longer half-lives. After a much longer period of time (10^3 to 10^6 years), radium-226--through its daughter, radon-222--may become a dominant source of radiation exposure under certain conditions that are identified later (see Section 4.1.5).

In assessing radiological impacts, the time-dependent decay characteristics of the radionuclides were considered. The detailed radionuclide inventories used for dose calculations are listed in Table B.2. The activity of some of the more important isotopes in both HLW tanks is shown in Figure 4.1 as a function of time over a period of 10,000 years after 1987. On the average, the fission product radioactivity in the waste will decay to about 0.3% of the 1987 level in 300 years. In contrast, plutonium-239 will require about 200,000 years to decay to 0.3% of its 1987 activity. Because of these differences in decay rates, assumptions had to be made concerning the time of occurrence of a given event. The estimates of released quantities of material and the likely events or scenarios leading to such releases depend on many factors, some of which are not precisely known at this time--such as the exact makeup of the HLW and facility and process design. Therefore, assumptions were required when the data were lacking. These assumptions were based on engineering judgment and are considered to be conservative--that is, the values overstate rather than understate the quantities of a radiological release. However, because of the assumptions that had to be made, the quantities of radiological release given in this section must be regarded as estimated maxima rather than confident predictions of expected values.

The risks associated with the various disposition locations and waste forms are evaluated, based on the process information and time schedule described in Section 2. The risk to the public is defined as the probability of an event occurring times the consequences of the event in terms of radiation dose received. Some individuals, such as workers who handle waste shipping casks and packages, would be exposed directly to radiation that is able to penetrate the thick lead or water shields covering the radioactive wastes. Some members of the population would also be exposed to radiation from waste shipments.

Very small quantities of radioactive material may escape from the wastes during normal storage, processing, or shipment, and larger amounts may be released in the event of an accident. A portion of the released radioactive material may be dispersed in gaseous or fine particulate form through the

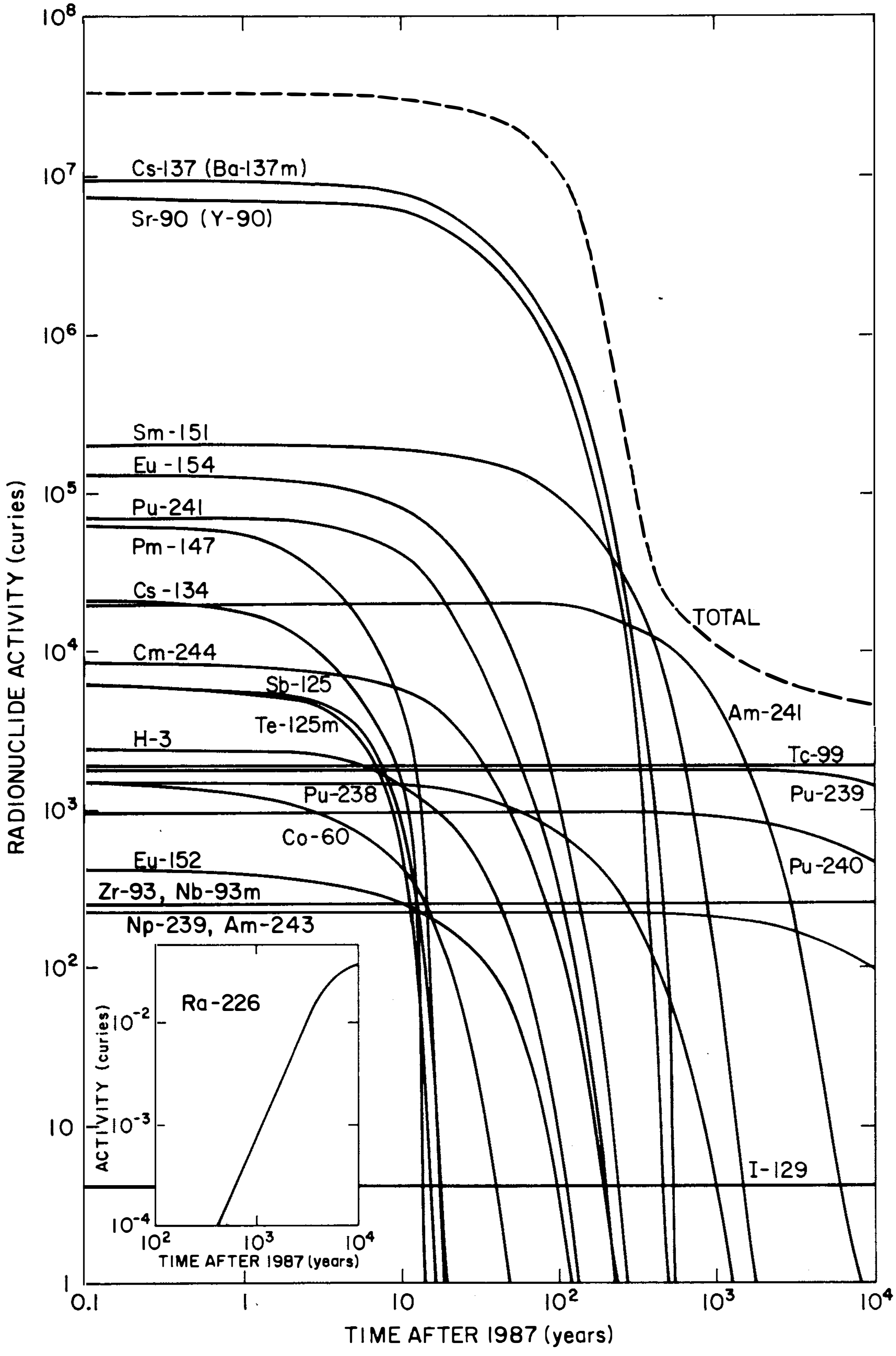

Figure 4.1. Principal Radionuclide Composition of Wastes in Tanks 8D2 and 8D4.

atmosphere or in dissolved or suspended form in water. After it has been distributed through the environment, this radioactive material may irradiate people externally or it may enter their bodies by inhalation or by ingestion of contaminated foodstuffs or water and thereafter cause internal irradiation.

All of these possible pathways in estimating the radiological impacts have been considered by the methods described in Section 4.1.3. The results of the radiological impact analysis are summarized briefly in the following section.

4.1.2 Brief Summary of Results

The results of the radiological impact analyses for the population over the short and long terms, and for the workers over the short term, are briefly summarized in Table 4.1. The estimated risks are discussed more fully in the sections that follow.

Table 4.1. Summary of Radiological Impacts

		Population Dose Risk		
Alternative	Occupational Dose (person-rem)	100-Year Short Term (person-rem)	10,000-Year Long Term (person-rem)	Annual Maximum After Long-Term Period†1 (person-rem/yr)
1a	1,800	340	210	0.01
1b	2,100	390	70	0.002
2	2,200	420	70	0.002
3	1,100	37	5,200	0.2
4a†2	80	120	NA†3	NA
4b	880†4	460	120,000	2.0
Natural background radiation to 1.5 million population in West Valley region		15 million	1.5 billion	150,000

†1 Predicted risks for the first year after the end of the 10,000-year long-term period.

†2 Only includes the impacts for the 10-year storage period. It is necessary to add the impacts associated with any one of the action alternatives when a decision on solidification is made.

†3 NA = not applicable.

†4 Represents a 100-year dose assuming three tank transfers.

As seen in Table 4.1, the dose risk to the population from implementation of any of the four waste-disposal alternatives represents an extremely small increase in the normal population dose due to background radiation sources. The highest population dose risk would be for the no-action alternative 4b over the long term; in this case, the greatest contributions would come from the dose risks associated with a few individuals engaged in intrusional events such as digging into the HLW. Based on the probable ranges of dose/health effect estimators described in Section 4.1.8, this highest population dose risk over the long term of 10,000 years (120,000 person-rem) would result in 12 to 96 health effects (fatal cancers and genetic defects) in addition to roughly 30 million expected cancer deaths and 9 million genetic abnormalities from causes other than exposure to radiation originated by implementation of a waste-solidification alternative at West Valley. The alternative with the highest population dose risk for the short term (460 person-rem) would result in 0.05-0.4 health effects over the 100-year period, in addition to 300,000 total cancer deaths from other causes over the same time period. The highest occupational exposure (2200 person-rem) is estimated to result in about 0.1 to 1 additional cancer fatalities. After the 10,000-year period, the highest population risk over a 1-year period is estimated to be 2 person-rem. This population dose risk would result in less than 0.002 health effects as compared with about 3000 cancer deaths and 900 genetic abnormalities normally expected per year in the assumed 1.5 million people living in the vicinity of West Valley.

4.1.3 Radiological Impact Assessment

As indicated earlier, the principal source of radioactivity at West Valley is the wastes contained in the underground storage tanks, 8D2 and 8D4. On the basis of information in the U.S. Department of Energy (1978a) report, the inventory of each radioisotope was calculated for the year 1987, the projected starting date of the West Valley solidification project. These data are given in Appendix B, Tables B.2 and B.3, for the neutralized Purex wastes and acidic Thorex wastes, respectively.

For the purposes of this EIS, the quantities of radionuclides released to the environment during both normal and abnormal (e.g., earthquakes and tornadoes) events were based on the calculated inventory of radioactivity present at the time of release and the fraction expected to become mobile under the assumed conditions of release. In calculating the releases, each alternative was divided into component steps (see Section 4.1.4). Dose and risk estimates for the short term were developed independently for each step, based on the best available process and design information. As noted earlier, however, broad use of engineering judgment was necessary where needed data were lacking. The judgments made were conservative and the estimated releases are believed to overstate rather than understate the released activity.

The principal pathways whereby released radioactive material may reach people are (1) direct external exposure to radionuclides in air and water or on the ground; (2) inhalation of radionuclides into the lungs, followed by redistribution to other organs of the body; and (3) ingestion of radioactive nuclides through drinking water and foodstuffs. These principal pathways are shown diagrammatically in Figure 4.2. Other pathways such as irrigation, rain wash, and runoff were included in the analysis but were found to contribute less than 5% of the calculated doses.

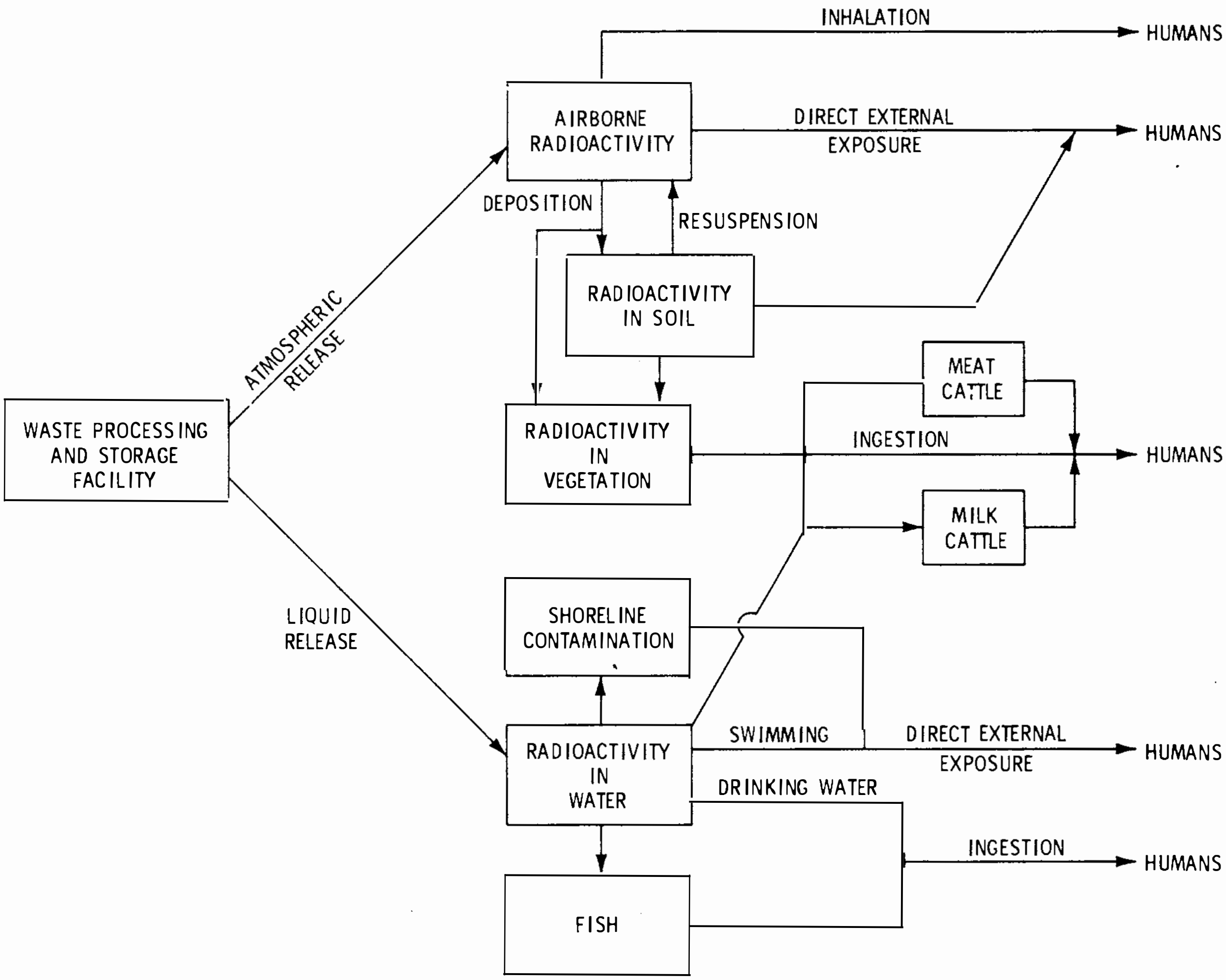

Figure 4.2. Radioactivity Exposure Pathways to Humans.

Three classes of human exposure were considered: (1) a hypothetical individual receiving the maximum possible dose, (2) the general population exposed to the radiation (assumed to be the population within 80 km [50 mi] of the source or near the transport routes at the time the wastes were being taken to a Federal repository or a regional burial ground) and (3) workers engaged in processing, handling, transport, etc., for whom occupational doses are calculated separately. The principal mechanisms by which the radioactive material would enter the exposure pathways mentioned above are either atmospheric or hydrologic transport. Atmospheric and hydrologic releases for the short-term period from the various routine activities at West Valley were evaluated based on the preliminary process design developed for this project. Hydrologic transport through migration of groundwater was considered for the long-term period during which the HLW and TRU wastes would be onsite or in a Federal repository and the LLW would be in a regional burial ground or in the onsite NRC-licensed burial ground.

Calculation of the consequences of radionuclide releases required consideration of movement from the point of release through the various pathways to the points where members of the population could be exposed. For each alternative, the radionuclides released to the atmosphere during operation were assumed to be carried and diluted by the wind to population centers, agricultural areas, and grazing lands near the facility. Annual average relative air and ground deposition concentrations, i.e., χ/Q and D/Q, for each of 160 segments (16 wind-direction sectors at 10 distances) within the 80-km radius around each site were computed using methodology provided in Regulatory Guide 1.111 (U.S. Nucl. Reg. Comm. 1977b) and the computer program χOQDOQ (Goll 1976). These values were then used as input to a computer program which implements the radiological exposure models of Regulatory Guide 1.109 (U.S. Nucl. Reg Comm. 1977a) to estimate dose commitments from atmospheric exposure pathways. Radiation dose commitments from release of radioactive liquid effluen s at various waste-processing and storage sites were estimated using a computer model based on the methodology described in Regulatory Guide 1.109. Migrational release through the groundwater pathway was calculated using the model described by Nuclear Safety Associates (1980). The assumptions concerning meteorological parameters, population distribution, and agricultural productivity for West Valley were based on information in a recent report prepared by Bechtel Corporation (1979). The 1990 population within an 80-km radius of the West Valley site (including a portion of Canada) was estimated to be 1.5 million. This projected population and its distribution was used for all radiological impact calculations involving releases from the West Valley site. Detailed information on the parameters used and assumptions made in calculating radiological impacts is given by Nuclear Safety Associates (1980).

Population doses for the continental United States from releases of tritium and iodine-129 were calculated according to the method presented by the U.S. Department of Energy (1978c). This method is based on the 1970 U.S. population and was developed by the National Oceanic and Atmospheric Administration (NOAA). The NOAA calculation assumes that 1-Ci/yr of material released from a Midwest site travels eastward and exposes 80% of the U.S. population. The population-weighted concentration was found to be 3×10^{-10} person-Ci/m^3 after adjusted for the population growth through the year 1990. Combining the population-weighted concentrations with the dose-model factors developed by the Department results in 5.5×10^{-4} and 56 person-rem per curies of tritium and iodine-129 released, respectively. The dose factors developed include consideration of global environmental cycles of the nuclides.

In assessing dose commitments outside the West Valley region, the same calculational methodology was used; however, the projected populations were different from that of the West Valley site, except in the area around the regional burial ground, which was assumed to have demographic characteristics similar to West Valley. The population in the region of a Federal waste facility where the West Valley wastes in interim form would be converted into the terminal form was assumed to be 700,000 over the short term, and the population in the region of a Federal repository was assumed to be two million over the long term.

As depicted in Figure 4.2, each of the exposure pathways leading to humans results in a dose that is dependent not only on the quantity of radioactivity released into the environment but also on individual behavior patterns. These patterns or habits include such factors as residence time in various locations, breathing rate, and the quantities of food and water consumed. The values assumed for these parameters are those given in the Regulatory Guides cited above (U.S. Nucl. Reg. Comm. 1977a, 1977b). In estimating the maximum individual dose, these factors were chosen so as to maximize the dose. For population groups, values representative of the average members were selected. The internal dosimetry model used in deriving the dose-conversion factors included in the current Regulatory Guide 1.109 (U.S. Nucl. Reg. Comm. 1977a) is primarily based on the 1959 recommendations of the International Commission on Radiological Protection. More recent information on the effects of radiation on the body, on the uptake and retention of radioactive materials in body tissues, and on radioactive decay schemes has since become available. For this assessment, the revised internal dose conversion factors from Killough et al. (1978) and Dunning et al. (1979) were adopted.

For each radionuclide of concern, the inhalation dose conversion factors used were for an activity median aerodynamic diameter (AMAD) of one micrometer. For the ingestion pathway, the dose conversion factors are those derived using the highest f_1 value, where f_1 is the fraction of ingested radionuclide that reaches the bloodstream from the intestinal tract. In the case of alpha emitters, the dose conversion factors are those which were calculated using a quality factor of 20 as recommended by the International Commission on Radiological Protection (1979). All doses from internal exposure are 50-year committed dose equivalents (or dose commitments) and were calculated for the 50-year period following inhalation or ingestion. In other words, they are the time integral of the dose equivalent rate over 50 years following intake of the radioactivity. Because age-dependent dose conversion factors are not listed in the reports of Killough et al. (1978) and Dunning et al. (1979), specific age-dependent groups have not been considered in the calculation of dose. However, data derived from a recent study (Miller et al. 1979) on the dosimetry of radionuclides indicate that, if the source of radioactivity consists primarily of fission products such as strontium-90 and cesium-137, there would be little variation in calculated dose commitment to a population when specific age-dependent groups were considered. Moreover, these differences contributed by age-dependent parameters would not likely be as large as the overall uncertainty in the calculation of dose (Hoffman et al. 1978).

Following the recommendation of the International Commission on Radiological Protection (1977b), an effective dose equivalent (H_E) was calculated:

$$H_E = \frac{1}{R_T} \sum_i R_i H_i \qquad (4.1)$$

where R_i and R_T are health-effect factors representing, respectively, the stochastic risk resulting from the irradiation of tissue i and the total risk when the whole body is irradiated uniformly (uniform irradiation is assumed for external exposure from radionuclides in the air, water, or on the ground). Hi is the committed dose equivalent in tissue i. The values of R_i and R_T recommended by the International Commission on Radiological Protection (1977a, 1977b, 1979) were derived on the basis of the average risk levels over both sexes and all ages for the various organs or tissues. These values are given in Table 4.2.

In addition to the doses calculated for the individual and the population as a result of releases of radioactive material from the various activities, the occupational doses received by the work force while carrying out the various tasks were calculated. The occupational doses are given separately from the

Table 4.2. Dose-Effect Factors Used to Calculate Effective Dose Equivalents from Ionizing Radiation

Effect and Tissue at Risk†[1]	Incidence per Million Person-rem (R_i)
Genetic Defect	
Gonads	40†[2]
Fatal Cancer	
Breast†[3]	25
Red marrow	20
Lungs	20
Thyroid	5
Bone surface	5
Remainder†[4]	50
TOTAL	165 (R_T)

†[1] Except for irradiation of the gonads, the health risk is that of fatal cancer induction.

†[2] Genetic risk within the first two generations following irradiation of either parent.

†[3] Average of females and males.

†[4] A risk conversion factor of 10 fatal cancers per million person-rem is applicable to each of five remaining organs or tissues receiving the highest dose equivalents.

Source: Reports of the International Commission on Radiological Protection (1977a, 1977b).

population doses in this EIS since the occupational doses are basically voluntary doses received by the work force in execution of their work responsibilities, and the exposure criteria are different from those of the general population. In this document, estimates are presented of the occupational exposure to operating personnel (radiation workers) under routine circumstances, including those from small incidents.

The maximum exposure for radiation workers allowed by the regulations given in Department of Energy Order 5480.1, Chapter XI, is 5 rem to the whole body each year and not more than 3 rem each calendar quarter (U.S. Dep. Energy 1981e). The whole-body dose is calculated as the sum of internal and external doses. Extensive efforts are made by the Department of Energy to reduce worker exposure levels that are as low as reasonably achievable (ALARA) under these limits. These efforts include detailed planning of all work that involves radiation exposure potential to reduce exposure time, provision of adequate shielding, and preclusion of radionuclide uptake. Such work is carried out under written procedures that must be approved by health physicists. These procedures specify time limits for the work and the protective clothing and equipment required. Depending on the radiation and contamination potential, the work may be continuously monitored by health physicists.

Experience with operation of Department facilities such as the Savannah River Plant, the Idaho National Engineering Laboratory, and the Hanford Reservation indicate that actual personnel exposures can be expected to be considerably less than these standards. The annual average dose to an individual worker at these facilities is less than 1 rem. Work in conjunction with the alternatives involving waste solidification is expected to be similar in many respects to work done in irradiated fuel reprocessing areas at Department facilities. Whenever possible, use was made of the extensive experience at Department facilities to estimate the occupational doses for various activities.

Because calculation of the occupational dose varies greatly with the specific task, the occupational dose calculations are given in the appropriate subsections of Appendix B. Maximum occupational doses would most likely occur during initial decontamination of the existing reprocessing plant and during modification of the plant to perform the HLW solidification. The individual doses associated with these activities may be as high as 2 to 3 rem per year.

In making radiological assessments of hypothetical events, some of which have extremely small probabilities of occurrence and all of which could occur in the future, a considerable number of assumptions must be made. For each hypothesized event, a scenario must be developed which not only describes the nature of the event and its relationship to the steps that comprise each of the four alternative strategies, but also gives an estimate of the probability of occurrence of the event and an estimate of the quantity of radioactive material released. Such scenarios have been developed for the solidification project and are summarized below in Section 4.1.4 for the short term and in Section 4.1.5 for the long term. The radiological impacts corresponding to these release scenarios are described in Section 4.1.6 for the short term and in Section 4.1.7 for the long term.

4.1.4 Short-Term Releases of Radionuclides

A summary of the principal release scenarios and assumptions used for calculating short-term radiological impacts is given in Table 4.3. The summary is organized according to the seven principal components of the solidification project: (1) decontamination of the process cells before solidification processing begins, (2) removal of the liquid HLW from the underground tanks, (3) processing to solidify the wastes, (4) temporary onsite storage, (5) offsite transportation of the solid wastes, (6) offsite disposal at a regional burial ground, and (7) final decontamination and decommissioning of the facilities. Items 2 and 3 are further divided into releases due to normal or routine operations, releases from process incidents (such as inadvertent spills), and releases resulting from natural disasters (tornadoes and earthquakes). The release scenarios for each type of event are described, along with the applicable alternatives, per annum frequency of any event, source of radioactivity being considered, and fraction of the source released offsite in the specified event. These values are based a study by Nuclear Safety Associates (1980).

Table 4.3. Summary of Principal Release Scenarios and Assumptions Used for Calculating Short-Term Radiological Impacts to the General Population

Event	Release Description	Applicable Alternatives	Expected Frequency per Year	Length of Campaign (years)	Source of Radioactivity	Release Fraction†[1]
Initial Decontamination						
Replace equipment	During decontamination, 0.1% of the activity in the reprocessing plant becomes airborne and is released through the stack with double filtration (DF†[2] = 10^4); the decontamination solution is run through the LLW treatment facility†[3] with total DF of 10^5.	1a, 1b, 2, 3	Continuous	3	Reprocessing plant	1×10^{-7} (G) 1×10^{-5} (L) 1 (H-3) (L)
Removal from Tanks						
Routine releases	10% of the liquid becomes airborne annually via evaporation processes (DF = 50,000) and is assumed to be released from tank farm ventilation systems. The combined DF for tank farm and stack filtration systems is taken to be 10,000.	All	Continuous	Variable†[4]	Tanks 8D2 and 8D4	2×10^{-10}/yr (G) 1×10^{-1}/yr (H-3) (G)
Process incidents	250 gallons of HLW are spilled at the pump within the structure; a fraction of 2×10^{-9} is reentrained and released through the stack.	All	0.33	Variable†[4]	Tanks 8D2 and 8D4	7×10^{-13} (G) 4×10^{-4} (H-3) (G)
Earthquake/tornado	Filtration systems become inoperative; 0.1% of liquid becomes airborne by evaporation process.	All	7×10^{-5} (earthquake) 8×10^{-6} (tornado)	Variable†[4]	Tanks 8D2 and 8D4	2×10^{-8} (G) 1×10^{-3} (H-3) (G)
Processing						
Routine releases	Separate and decontaminate salt from HLW slurry 10% of the liquid becomes airborne annually by evaporation into ventilating air stream with overall DF of 5×10^8 before release through the stack.	1a	Continuous	3	Tank 8D2	2×10^{-10}/yr (G) 0.1/yr (H-3) (G)
	Solidify salt from evaporation Liquid is run through ion exchangers, evaporators, and condensers before being sent to LLW treatment facility for release. Total DF is 1×10^{10}.	1a	Continuous	3	Tank 8D2 (Decontam. supernate)	5×10^{-11} (G) 1×10^{-11} (L) 1 (H-3) (L)

Table 4.3. Continued

Event	Release Description	Applicable Alternatives	Expected Frequency per Year	Length of Campaign (years)	Source of Radioactivity	Release Fraction†[1]
Processing (contd.)						
Routine releases (contd.)	Calcination Overall facility DF for offsite airborne release is 1×10^{11}.	1a, 1b, 2	Continuous	3	Tanks 8D2 and 8D4	1×10^{-11} (G)
	Fraction of total activity released from LLW treatment facility is 1×10^{-9}.	1a, 1b, 2	Continuous	3	Tanks 8D2 and 8D4	1×10^{-9} (L) 1 (H-3) (L)
	Vitrification Release from vitrification is taken to be 10% of that from calcination because of its less dispersable form.	1a, 1b, 2	Continuous	3	Tanks 8D2 and 8D4	1×10^{-12} (G) 1×10^{-10} (L)
	In-tank cement solidification Liquid is run through evaporators, condensers, and LLW treatment facility before release to the environment.	3	Continuous	2	Tanks 8D2 and 8D4	5×10^{-11} (G) 1×10^{-9} (L) 1 (H-3) (L)
	Conversion of HLW to interim waste form Liquid is run through evaporators, melters, and condensers before being sent to LLW treatment facility.	2	Continuous	3	Tanks 8D2 and 8D4	5×10^{-11} (G) 1×10^{-9} (L) 1 (H-3) (L)
Process incidents	100 gallons of HLW spilled onto the floor during separation and decontamination of salt from the HLW slurry; 2×10^{-9} of the spill is released through the ventilation system before recovery.	1a	0.3	3	Tank 8D2	3×10^{-13} (G)
	100 gallons of decontaminated supernate spilled inside the cell; 2×10^{-9} of the spill becomes airborne release before recovery.	1a	0.33	3	Tank 8D2 (Decontam. supernate)	3×10^{-13} (G)
	100 kg of calcine spilled; 10^{-8} of it becomes airborne and is released through the stack.	1a, 1b, 2	0.33	3	Tanks 8D2 and 8D4	5×10^{-13} (G)

Table 4.3. Continued

Event	Release Description	Applicable Alternatives	Expected Frequency per Year	Length of Campaign (years)	Source of Radioactivity	Release Fraction†[1]
Processing (contd.)						
Process incidents (contd.)	500 gallons of HLW spilled within the structure due to pumpline rupture; 2×10^{-9} of the spill becomes airborne release before recovery.	3	0.5	2	Tanks 8D2 and 8D4	1.5×10^{-12} (G)
	Evaporator efficiency reduced from 10^4 to 10^3 for a 6-hour period.	3	0.5	2	Tanks 8D2 and 8D4	3×10^{-11} (G)
Earthquake/tornado	Filtration systems incapacitated during:		7×10^{-5} (earthquake) 8×10^{-6} (tornado)			
	Separation and decontamination of salt	1a	(as above)	3	Tank 8D2	2×10^{-8} (G)
	Solidification of salt	1a	(as above)	3	Tank 8D2 (Decontam. supernate)	5×10^{-10} (G)
	Calcination or fused-salt conversion	1b, 2	(as above)	3	Tanks 8D2 and 8D4	1×10^{-10} (G)
	Vitrification	1a, 1b, 2	(as above)	3	Tanks 8D2 and 8D4	1×10^{-12} (G)
	In-tank cement solidification	3	(as above)	2	Tanks 8D2 and 8D4	6×10^{-10} (G)
Onsite Storage of HLW						
Routine releases	1% of the liquid becomes airborne annually by evaporation into ventilating air stream with overall DF of 5×10^8 before release to the atmosphere.	All	Continuous	Variable†[5]	Tanks 8D2 and 8D4	2×10^{-9}/yr (G) 1×10^{-2}/yr (H-3) (G)
Airplane crash	Airplane crashes onto tank, impact disrupts the structure, breaches the tank, and vaporizes portions of the HLW:	All	1×10^{-8}	Variable†[5]	Tanks 8D2 and 8D4	
	1200 gallons of HLW become airborne and released at ground level.					2×10^{-3} (G)
	1500 gallons of HLW reach Cattaraugus Creek.					2.5×10^{-3} (L)

Table 4.3. Continued

Event	Release Description	Applicable Alternatives	Expected Frequency per Year	Length of Campaign (years)	Source of Radioactivity	Release Fraction†[1]
Onsite Storage of HLW (contd.)						
Sabotage	A sabotage attempt by a terrorist group results in the release of HLW to the environment; 10% of the total activity in the tanks reaches Cattaraugus Creek.	All	1×10^{-5}	Variable†[5]	Tanks 8D2 and 8D4	0.1 (L)
Transportation						
Normal	Direct irradiation of surrounding population from penetrating radiation (based on the regulatory limit of 10 mrem/h at 6 feet).	1a, 1b, 2	Routine	3	Canister or Package	Not applicable
Accidents	Loss of shielding A severe accident occurs that compromises the HLW cask or LLW package. No material is actually released, but the integrity of the shielding is compromised:	All				
	HLW (rail)†[6]	1a, 1b, 2	Depends upon severity of accident†[7]	3	Canister	Not applicable
	LLW (truck)†[6]	1a, 1b, 2		3	Package	Not applicable
	Loss of contents A severe accident occurs that breaches the HLW cask or LLW package. Material is assumed to be released and aerosolized:					
	HLW (rail)†[6]	1a, 1b, 2	Depends upon severity of accident†[7]	3	Canister	Depends upon severity of accident
	LLW (truck)†[6]	1a, 1b, 2		3	Package	
Onsite Management of LLW						
Airplane crash	Airplane crashes onto temporary onsite storage area where LLW are stored.	1a, 1b, 2	1×10^{-8}	15	Total LLW	1×10^{-2} (G)
Airplane crash	Airplane crashes onto onsite NRC burial ground where LLW are stored.	3	1×10^{-8}	100	Total LLW	1×10^{-2} (G)

Table 4.3. Continued

Event	Release Description	Applicable Alternatives	Expected Frequency per Year	Length of Campaign (years)	Source of Radioactivity	Release Fraction†[1]
Offsite Disposal at Regional Burial Ground						
Airplane crash	Airplane crashes onto regional burial ground where LLW are stored.	1a, 1b, 2	1×10^{-8}	100	Total LLW	1×10^{-2} (G)
Final Decontamination and Decommissioning	1% of the activity in the tanks is assumed to remain after completion of an alternative. During decontamination, 0.1% of the remaining activity becomes airborne and is released through the ventilation systems with facility DF of 10^4 before offsite release. The decontamination solution is run through the LLW treatment facility with total DF of 10^5.	1a, 1b, 2, 3	Continuous	2	Tanks 8D2 and 8D4	1×10^{-9} (G) 1×10^{-7} (L)

†[1] Release fraction = the fraction of radionuclide inventory from the source of radioactivity that is released to the environment offsite. For ruthenium, the release fraction is 100 times greater than those indicated. G = gaseous; L = liquid.

†[2] DF, decontamination factor = the ratio of the initial amount of radioactivity in a stream to the final amount of that radioactivity in a stream following treatment by a given process.

†[3] The upgraded LLW treatment facility is assumed to consist of evaporators, condensers, and the current LLW treatment systems.

†[4] Varies according to alternative: 3 years for alternatives 1a, 1b, and 2; 2 years for alternatives 3 and 4.

†[5] Varies according to alternative: 3 years for alternatives 1a, 1b, and 2; 2 years for alternative 3; 10 years for alternative 4a; indefinite for alternative 4b.

†[6] Expressed as accident probability per kilometer of travel (not frequency per year).

†[7] A series of accidents were analyzed in this EIS, and the risks were summed to obtain the total risk from transporting radioactive wastes. The probability of a very severe accident is low whereas less severe accidents would be expected to occur more frequently.

Source: Report of Nuclear Safety Associates (1980) with minor modifications.

The primary emphasis of accident analysis was to identify accidents with potential for offsite releases. A wide range of postulated accidents that might occur during the operating phases of the waste management facilities were analyzed. However, no attempt was made to exhaustively analyze all conceivable accidents. Before construction of facilities such as those described in this EIS would be undertaken, more exhaustive safety analyses based on actual design would be carried out under Federal regulations.

For each type of event, one or more specific scenarios were developed. These scenarios were based on a consequence viewpoint and are believed to bound the impacts of radiological consequences from each alternative. The scenarios describe the release event, give the quantity of material released, and, where applicable, the decontamination factor (DF), which is a measure of the degree to which the released radioactivity was reduced by filtration or some other means before escaping from the plant. Although the time period being considered is 100 years, it should be noted that for the action alternatives 1a, 1b, 2, and 3, the physical and chemical properties of the HLW would change in three years after the initiation of processing. After the HLW were solidified, the potential for release of radioactivity from the HLW would be greatly reduced. Only in the case of alternative 4b would the same scenarios for release of radioactivity remain in effect throughout the 100-year period. In alternative 4a, the solidification option would be reconsidered after 10 years of no action. Two types of hypothetical transportation accidents--loss of shielding and loss of contents--are evaluated for HLW, LLW, and TRU wastes.

Some of the scenarios, such as those related to the removal of the liquid HLW from the underground tanks, would apply to all alternatives. In the action alternatives 1a, 1b, 2, and 3, removal would be necessary before immobilizing the HLW as glass, fused salt, and concrete, respectively. In the no-action alternative, the HLW would be removed from the existing tanks in order to transfer the wastes to new tanks. In other cases, the scenarios would apply to fewer alternatives, and in some instances to only one, as in the case of the separation of the supernate from the sludge followed by the decontamination of the supernate, which is applicable only to alternative 1a.

With respect to the expected frequency per year of an event, the fractional frequencies for accidents represent less than one event per year; for example, the frequency of 0.5 for the process incident in which 1900 liters (500 gallons) of HLW are spilled represents an event that is predicted to occur once in two years, and a frequency of 1×10^{-6} represents an event that would be expected to occur once in one million years. Since routine releases are continuously occurring, no frequency is assigned for these releases.

The length of campaign represents the number of years that would be needed to complete the task (e.g., replace equipment, removal from tanks).

Three different sources from which the releases could originate are identified in Table 4.3. The first and most important source is the liquid HLW in the two underground tanks, 8D2 and 8D4. The neutralized HLW in Tank 8D2 is considered alone in the scenarios involving the salt/sludge separation in alternative 1a. The second source is the decontaminated supernate after ion-exchange treatment. The third source is the LLW generated from solidification processes.

The release fraction is based on information given in the scenario, process information, design of the atmospheric protection system, and operation of the liquid LLW-treatment system. In each case, the release fraction refers to the source of radioactivity. The tritium release fractions are also listed where applicable. Most of the decontamination factors used for deriving these release fractions were obtained from U.S. Nuclear Regulatory Commission (1979) published values for licensing of nuclear power reactors.

4.1.5 Long-Term Releases of Radionuclides

The scenarios for long-term radiological impacts are summarized in Tables 4.4 and 4.5. These tables are organized along the same lines as Table 4.3 for the short term, except that the length of campaign is not included. Table 4.4 deals with the onsite wastes and Table 4.5 deals with the offsite wastes.

The long term refers to the 10,000-year period that follows the end of the short-term period of 100 years. At the time the long term begins, it is assumed that in alternatives 1a, 1b, and 2, the West Valley HLW would have been immobilized as borosilicate glass and that these wastes, along with the TRU wastes, would have been disposed in a Federal repository. The LLW generated in these alternatives would have been buried, and the tanks (after removal of the wastes for processing) would have been entombed in concrete.

In alternatives 3 and 4b, the HLW would remain at West Valley. In alternative 3, the HLW would be immobilized as a large concrete monolith in an underground tank. The TRU wastes and LLW in this alternative would also have been buried in the onsite NRC-licensed burial ground. In alternative 4b, the HLW would remain as liquids, contained in underground tanks. As indicated earlier, it is assumed that during the long-term period a Federal repository, the regional burial ground, and the West Valley site would not be under institutional control.

The mechanisms of release for most of the events described in Tables 4.4 and 4.5 would be intrusional, migrational, or a combination of these two. The intrusional events would include drilling, digging, and farming on contaminated soil following human intrusions; an airplane crash; and a meteorite strike at the Federal repository. Radon emanation is a migrational event which occurs when radon-222, a radioactive gas formed as the decay product of radium-226, migrates through the soil and enters a house built over the location of the migrating gas. The groundwater is partly intrusional and partly migrational in that the groundwater is assumed to breach the container and then leach the wastes through a migrational mechanism. The earthquake and tornado are intrusional events, but do not themselves release the contained waste; however, by fracturing the waste container and its contents these events allow the contents to be leached by groundwater. The same mechanisms operate in the faulting and groundwater transport event, except that in this case the causal agent is assumed to be aging over the long-term. Solution mining assumes that the Federal repository is a salt mine and that at some future date solution mining will begin, which could lead to canister corrosion and leaching of the wastes.

The long-term radiological impacts from storage or disposal of waste in a Federal repository are based on analyses prepared for the "Final Environmental

Table 4.4. Summary of Principal Release Scenarios and Assumptions Used for Calculating Long-Term Radiological Impacts to the General Population: Onsite Disposal

Event	Release Description	Applicable Alternatives	Expected Frequency per Year	Source of Radioactivity	Release Fraction†[1]
Storage of Liquid HLW in Tank (No Action)					
Groundwater	After abandonment, tanks leak and vaults crack, releasing the tank contents into the silty till. The fractions of activity leached from the tanks are 0.2 and 0.01 per year for supernate and sludge, respectively.	4b	Continuous	Total waste inventory	0.2/yr (Supernate) 0.01/yr (Sludge)
Human digging	Human intruders dig into the HLW storage. The individuals receive exposures from direct irradiation and inhalation.	4b	1×10^{-2}	Total waste inventory	Not applicable
Farming	Following the digging by intruders, some of the waste is brought to the surface and becomes a source of radiation exposure to the residents via food chain pathways and direct irradiation.	4b	1×10^{-4}	Total waste inventory	Not applicable
Earthquake	Leach rate increases from 0.01 to 0.1 per year for sludge as a result of this natural event.	4b	7×10^{-5}	Total waste inventory	0.1/yr
Airplane crash	The crash impact disrupts the structure, breaches the tank, and vaporizes portions of HLW:	4b	1×10^{-8}	Total waste inventory	
	1200 gallons of HLW becomes airborne and released at ground level.				2×10^{-3}
	1500 gallons of HLW reach Cattaraugus Creek.				2.5×10^{-3}
Storage of Solidified HLW in Tank (In-Tank Solidification)					
Groundwater	Water enters the solidified HLW tank, leaches out the waste with a release fraction of 10^{-3} per year.	3	Continuous	Total waste inventory	1×10^{-3}/yr

Table 4.4. Continued

Event	Release Description	Applicable Alternatives	Expected Frequency per Year	Source of Radioactivity	Release Fraction†[1]
Storage of Solidified HLW in Tank (In-Tank Solidification) (contd.)					
Radon emanation	Buildup of Ra-226 in the solidified HLW tank, resulting in radon emanation into a house on top of the waste.	3	Continuous	Total waste inventory	Not applicable
Human digging	Human intruders dig into the HLW storage. The individuals receive exposures from direct irradiation and inhalation.	3	1×10^{-2}	Total waste inventory	Not applicable
Earthquake	Leach rate increases from 10^{-3} to 10^{-2} per year.	3	7×10^{-5}	Total waste inventory	1×10^{-2}/yr
Entombment of Tanks					
Groundwater	Water enters the entombed waste tanks and leaches out the waste at a rate of 10^{-2} per year.	1a, 1b, 2	Continuous	0.1% of total waste inventory	1×10^{-2}/yr
Radon emanation	As a result of Ra-226 build up in the remaining waste, radon emanates into a house built on top of the burial ground.	1a, 1b, 2	Continuous	0.1% of total waste inventory	Not applicable
Human digging	Human intruders digging into the entombed burial. The individuals receive radiation exposures from direct irradiation and inhalation.	1a, 1b, 2	1×10^{-2}	0.1% of total waste inventory	Not applicable
Farming	Following digging by intruders, some of the waste is brought to the surface and becomes a source of radiation exposure to the residents via food chain pathways and direct irradiation.	1a, 1b, 2	1×10^{-4}	0.1% of total waste inventory	Not applicable
Earthquake	Leach rate increases from 0.01 to 0.1 per year as a result of this natural event.	1a, 1b, 2	7×10^{-5}	0.1% of total waste inventory	0.1/yr

Table 4.4. Continued

Event	Release Description	Applicable Alternatives	Expected Frequency per Year	Source of Radioactivity	Release Fraction†[1]
<u>Onsite Disposal of LLW</u>					
Groundwater	After abandonment, containers leak and contents released into the silty till with a leach rate of 0.01 per year.	3	Continuous	Total LLW inventory	1×10^{-2}/yr
Radon emanation	Buildup of Ra-226 in LLW causing radon emanation into a house built on top of the burial ground.	3	Continuous	Total LLW inventory	Not applicable
Human digging	Human intruders dig into the burial ground. The individuals receive exposures from direct irradiation and via inhalation.	3	1×10^{-2}	Total LLW inventory	Not applicable
Farming	Following digging by intruders, some of the waste is brought to the surface and becomes a source of radiation exposure to the local residents via food chains and direct irradiation.	3	1×10^{-4}	Total LLW inventory	Not applicable
Earthquake	Leach rate of water increases from 0.01 to 0.1 per year as a result of earthquake.	3	7×10^{-5}	Total LLW inventory	0.1/yr
Airplane crash	1% of LLW, 10% becomes airborne and released at ground level.	3	1×10^{-8}	Total LLW inventory	1×10^{-2}

†[1] Release fraction = the ratio of the radioactivity released to the total radioactivity from the source.

Table 4.5. Summary of Principal Release Scenarios and Assumptions Used for Calculating Long-Term Radiological Impacts to the General Population: Offsite Disposal

Event	Release Description	Applicable Alternatives	Expected Frequency per Year	Source of Radioactivity	Release Fraction†[1]
Federal Repository					
Meteorite strike	A large meteorite strikes the repository site. The impact breaches the repository and releases 1% of the total waste to the atmosphere, of which 10% becomes respirable.	1a, 1b, 2	2×10^{-13}	Total waste inventory	1×10^{-3}
Faulting and groundwater transport	Fault intersects repository. Access is created by pressure between aquifer, wastes, and surface. Aquifer carries wastes to surface.	1a, 1b, 2	2×10^{-13}	Total waste inventory	2×10^{-3}
Drilling	A small group of individuals drill into the waste repository for exploratory activities. One-fourth of the waste in one canister is circulated to the surface. Exposures are received by individuals via direct irradiation, inhalation, and food chains.	1a, 1b, 2	5×10^{-7}	1/4 of the waste of a canister	Not applicable
Solution mining of salt	A geologic repository in domed salt is breached by solution mining activities. 3% of salt recovered is consumed by a population of 40 million.	1a, 1b, 2	1×10^{-6}	Total waste inventory	3×10^{-2}
Events at Offsite Regional Burial Ground					
Groundwater	After abandonment, containers leak and contents released into the silty till with a leach rate of 0.01 per year.	1a, 1b, 2	Continuous	Total LLW inventory	1×10^{-2}/yr

Table 4.5. Continued

Event	Release Description	Applicable Alternatives	Expected Frequency per Year	Source of Radioactivity	Release Fraction†[1]
<u>Events at Offsite Regional Burial Ground</u> (contd.)					
Radon emanation	Buildup of Ra-226 in LLW causing radon emanation into the house on top of the burial ground.	1a, 1b, 2	Continuous	Total LLW inventory	Not applicable
Human digging	Human intruders dig into the regional burial ground. The individuals receive exposures from direct irradiation and via inhalation.	1a, 1b, 2	1×10^{-2}	Total LLW inventory	Not applicable
Farming	Following the digging by intruders, some of the waste is brought to the surface and becomes a source of radiation exposure to the local residents via food chains and direct irradiation.	1a, 1b; 2	1×10^{-4}	Total LLW inventory	Not applicable
Earthquake	Leach rate of water increases from 0.01 to 0.1 per year as a result of earthquake.	1a, 1b, 2	7×10^{-5}	Total LLW inventory	0.1/yr
Airplane crash	1% of LLW becomes airborne and released at ground level.	1a, 1b, 2	1×10^{-8}	Total LLW inventory	1×10^{-2}

†[1] Release fraction = the ratio of the radioactivity released to the total radioactivity from the source.

Impact Statement, Management of Commercially Generated Radioactive Wastes" (U.S. Dep. Energy 1980c), but modified to account for the differences in volume and radioactivity content between West Valley wastes and assumed commercially generated waste used in that study.

It should be stressed that the assessment of long-term radiological effects is more difficult and much less certain than the assessment of short-term risks. The potential releases of radionuclides or their transport pathways for nuclides over long-term periods are uncertain. Probabilities and times of occurrence for rare geologic events and for natural processes in the distant future cannot be accurately predicted.

4.1.6 Short-Term Radiological Impacts

The results of the dose and risk calculations for the short-term release scenarios described in Table 4.3 are given in Tables 4.6 through 4.10 for each of the four major alternatives. The doses and risks are given for the offsite individual receiving the maximum dose and for the offsite population within an 80-km radius. The per annum probability of occurrence of each major event used in calculating radiation risk is also given. The cumulative dose risk over the short-term period to the population of 1.5 million assumed to reside in the vicinity of West Valley is presented and compared with the dose to the same population from natural background radiation. This cumulative dose risk was obtained by integrating the annual doses and risks over the appropriate time intervals for all operational steps or components making up each alternative. It is important to note that an individual in the West Valley region receives approximately 100 mrem/yr from normal background sources and that a commensurate total population background dose for a 100-year period is 15 million person-rem.

Most of the doses from normal events and risks from accidents associated with implementing the action alternatives (1a, 1b, 2, and 3) would occur in the first three years of operation, between 1987 and 1990. For the no-action alternative, the potential radiation dose from routine operations would decrease approximately at the same rate as the decay of the fission products of primary concern, cesium-137 and strontium-90, which have half-lives of about 30 years. The release scenario of greatest importance in terms of radiation dose to the public would be a large airplane crash onto Tank 8D2 at West Valley. Such a crash could lead to the airborne release of a fraction of the radionuclides present, resulting in a very large dose of 3×10^4 rem to the maximally exposed hypothetical individual through the inhalation pathway and a large dose of 5×10^8 person-rem to the population through external exposure to radionuclides deposited on the ground and through inhalation. However, the probability of the occurrence of this accident is so low (1×10^{-8} per year) that, in spite of the magnitude of the potential release, the overall risk is minor.

The largest maximum individual dose risk from any of the alternatives would occur at the site boundary of West Valley and is conservatively estimated to be about 5 mrem/yr. This dose was calculated based on an individual who consumes 21 kg/yr of fish in Cattaraugus Creek. By comparison, an individual receives about 100 mrem/yr from background sources at this location. Thus, this risk is equal to the dose that this hypothetical individual would receive from natural background radiation in roughly 20 days of every year.

Table 4.6. Summary of Short-Term Radiological Doses and Risks to the General Population for Alternative 1a: Terminal Waste Form with Separated Salt/Sludge

Event	Maximum Individual Dose (rem)	Population Dose (person-rem)	Fraction or Probability (1/year)	Maximum Individual Risk (rem/year)	Population Risk (person-rem/year)	Length of Campaign (years)	100-Year Cumulative Risk (person-rem)
Initial Decontamination	5×10^{-4}	6×10^{-2}	0.33	2×10^{-4}	2×10^{-2}	3	6×10^{-2}
Removal from Tanks							
Routine releases	3×10^{-5}	2	0.33	1×10^{-5}	6×10^{-1}	3	2
Process incidents	8×10^{-8}	9×10^{-4}	0.33	2×10^{-8}	3×10^{-4}	3	9×10^{-4}
Earthquake	3	4×10^{3}	7×10^{-5}	2×10^{-4}	0.3	3	0.9
Tornado	3	4×10^{3}	8×10^{-6}	2×10^{-5}	3×10^{-2}	3	6×10^{-2}
Airplane crash	3×10^{4}	5×10^{8}	1×10^{-8}	3×10^{-4}	5	3	15
Sabotage	2	1×10^{6}	1×10^{-5}	2×10^{-5}	10	3	30
Processing							
Routine releases	2×10^{-4}	3	0.33	7×10^{-5}	1	3	3
Process incidents	5×10^{-8}	6×10^{-4}	0.33	2×10^{-8}	2×10^{-4}	3	6×10^{-4}
Earthquake	2	4×10^{3}	7×10^{-5}	2×10^{-4}	0.3	3	0.9
Tornado	2	4×10^{3}	8×10^{-6}	2×10^{-5}	3×10^{-2}	3	9×10^{-2}
Transportation							
Normal	2×10^{-3}	290	0.33	7×10^{-4}	96	3	290
Accidents							
HLW (land)	0.6	6	6×10^{-5}	4×10^{-5}	4×10^{-4}	3	1×10^{-3}
HLW (water)	0.6	6	1×10^{-10}	2×10^{-11}	2×10^{-10}	3	6×10^{-10}
TRU and LLW	2×10^{-2}	0.2	4×10^{-2}	8×10^{-4}	8×10^{-3}	3	2×10^{-2}
Temporary Onsite Storage							
Airplane crash onto LLW	20	3×10^{5}	1×10^{-8}	2×10^{-7}	3×10^{-3}	15	4×10^{-2}
Offsite Disposal at Regional Burial Ground							
Airplane crash onto LLW	20	3×10^{5}	1×10^{-8}	2×10^{-7}	3×10^{-3}	100	9×10^{-2}
Final Decontamination and Decommissioning							
Tanks and facilities	1×10^{-2}	2	0.5	5×10^{-3}	1	2	2

Time-Integrated Dose Risk, 100-Year, Due to the Solidification Project†[1] (person-rem)	Time-Integrated Dose, 100-Year, Due to Natural Background Radiation in the West Valley Region†[2] (person-rem)
340	15 million

†[1] This collective risk was obtained by integrating the annual risks over the appropriate time intervals for all operational steps or components making up each alternative.

†[2] Based on 1.5 million population and average individual annual dose of 100 mrem/yr from exposure to natural radiation.

Table 4.7. Summary of Short-Term Radiological Doses and Risks to the General Population for Alternative 1b: Terminal Waste Form with Nonseparated Salt/Sludge

Event	Maximum Individual Dose (rem)	Population Dose (person-rem)	Fraction or Probability (1/year)	Maximum Individual Risk (rem/year)	Population Risk (person-rem/year)	Length of Campaign (years)	100-Year Cumulative Risk (person-rem)
Initial Decontamination	5×10^{-4}	6×10^{-2}	0.33	2×10^{-4}	2×10^{-2}	3	6×10^{-2}
Removal from Tanks							
Routine releases	3×10^{-5}	2	0.33	1×10^{-5}	6×10^{-1}	3	2
Process incidents	8×10^{-8}	9×10^{-4}	0.33	2×10^{-8}	3×10^{-4}	3	9×10^{-4}
Earthquake	3	4×10^{3}	7×10^{-5}	2×10^{-4}	0.3	3	0.9
Tornado	3	4×10^{3}	8×10^{-6}	2×10^{-5}	3×10^{-2}	3	6×10^{-2}
Airplane crash	3×10^{4}	5×10^{8}	1×10^{-8}	3×10^{-4}	5	3	15
Sabotage	2	1×10^{6}	1×10^{-5}	2×10^{-5}	10	3	30
Processing							
Routine releases	2×10^{-4}	3	0.33	7×10^{-5}	1	3	3
Process incidents	5×10^{-8}	6×10^{-4}	0.33	2×10^{-8}	2×10^{-4}	3	6×10^{-4}
Earthquake	1×10^{-2}	20	7×10^{-5}	7×10^{-7}	2×10^{-3}	3	6×10^{-3}
Tornado	1×10^{-2}	20	8×10^{-6}	8×10^{-8}	2×10^{-4}	3	6×10^{-4}
Transportation							
Normal	2×10^{-3}	340	0.33	7×10^{-4}	113	3	340
Accidents							
HLW (land)	0.2	2	2×10^{-4}	4×10^{-5}	4×10^{-4}	3	1×10^{-3}
HLW (water)	0.2	2	5×10^{-10}	2×10^{-11}	2×10^{-10}	3	6×10^{-10}
TRU and LLW	1×10^{-2}	0.1	4×10^{-2}	4×10^{-4}	4×10^{-3}	3	1×10^{-2}
Temporary Onsite Storage							
Airplane crash onto LLW	20	3×10^{5}	1×10^{-8}	2×10^{-7}	3×10^{-3}	15	4×10^{-2}
Offsite Disposal at Regional Burial Ground							
Airplane crash onto LLW	20	3×10^{5}	1×10^{-8}	2×10^{-7}	3×10^{-3}	100	9×10^{-2}
Final Decontamination and Decommissioning							
Tanks and facilities	1×10^{-2}	2	0.5	5×10^{-3}	1	2	2

Time-Integrated Dose Risk, 100-Year, Due to the Solidification Project†[1] (person-rem)	Time-Integrated Dose, 100-Year, Due to Natural Background Radiation in the West Valley Region†[2] (person-rem)
390	15 million

†[1] This collective risk was obtained by integrating the annual risks over the appropriate time intervals for all operational steps or components making up each alternative.

†[2] Based on 1.5 million population and average individual annual dose of 100 mrem/yr from exposure to natural radiation.

Table 4.8. Summary of Short-Term Radiological Doses and Risks to the General Population for Alternative 2: Interim Waste Form

Event	Maximum Individual Dose (rem)	Population Dose (person-rem)	Fraction or Probability (1/year)	Maximum Individual Risk (rem/year)	Population Risk (person-rem/year)	Length of Campaign (years)	100-Year Cumulative Risk (person-rem)
Initial Decontamination	5×10^{-4}	6×10^{-2}	0.33	2×10^{-4}	2×10^{-2}	3	6×10^{-2}
Removal from Tanks							
Routine releases	3×10^{-5}	2	0.33	1×10^{-5}	6×10^{-1}	3	2
Process incidents	8×10^{-8}	9×10^{-4}	0.33	2×10^{-8}	3×10^{-4}	3	9×10^{-4}
Earthquake	3	4×10^{3}	7×10^{-5}	2×10^{-4}	0.3	3	0.9
Tornado	3	4×10^{3}	8×10^{-6}	2×10^{-5}	3×10^{-2}	3	6×10^{-2}
Airplane crash	3×10^{4}	5×10^{8}	1×10^{-8}	3×10^{-4}	5	3	15
Sabotage	2	1×10^{6}	1×10^{-5}	2×10^{-5}	10	3	30
Processing							
Routine releases	2×10^{-4}	3	0.33	7×10^{-5}	1	3	3
Process incidents	5×10^{-8}	6×10^{-4}	0.33	2×10^{-8}	2×10^{-4}	3	6×10^{-4}
Earthquake	1×10^{-2}	20	7×10^{-5}	7×10^{-7}	2×10^{-3}	3	6×10^{-3}
Tornado	1×10^{-2}	20	8×10^{-6}	8×10^{-8}	2×10^{-4}	3	6×10^{-4}
Transportation							
Normal	2×10^{-3}	370	0.33	7×10^{-4}	123	3	370
Accidents							
HLW (land)	0.2	2	2×10^{-4}	4×10^{-5}	4×10^{-4}	3	1×10^{-3}
HLW (water)	0.2	40	1×10^{-10}	4×10^{-10}	4×10^{-9}	3	1×10^{-8}
TRU and LLW	1×10^{-2}	0.1	4×10^{-2}	4×10^{-4}	4×10^{-3}	3	1×10^{-2}
Temporary Onsite Storage							
Airplane crash onto LLW	20	3×10^{5}	1×10^{-8}	2×10^{-7}	3×10^{-3}	15	4×10^{-2}
Offsite Disposal at Regional Burial Ground							
Airplane crash onto LLW	20	3×10^{5}	1×10^{-8}	2×10^{-7}	3×10^{-3}	100	9×10^{-2}
Final Decontamination and Decommissioning							
Tanks and facilities	1×10^{-2}	2	0.5	5×10^{-3}	1	2	2

Time-Integrated Dose Risk, 100-Year, Due to the Solidification Project†[1] (person-rem)	Time-Integrated Dose, 100-Year, Due to Natural Background Radiation in the West Valley Region†[2] (person-rem)
420	15 million

†[1] This collective risk was obtained by integrating the annual risks over the appropriate time intervals for all operational steps or components making up each alternative.

†[2] Based on 1.5 million population and average individual annual dose of 100 mrem/yr from exposure to natural radiation.

Table 4.9. Summary of Short-Term Radiological Doses and Risks to the General Population for Alternative 3: In-Tank Solidification of Waste

Event	Maximum Individual Dose (rem)	Population Dose (person-rem)	Fraction or Probability (1/year)	Maximum Individual Risk (rem/year)	Population Risk (person-rem/year)	Length of Campaign (years)	100-Year Cumulative Risk (person-rem)
Initial Decontamination	5×10^{-4}	6×10^{-2}	0.33	2×10^{-4}	2×10^{-2}	3	6×10^{-2}
Removal from Tanks							
Routine releases	2×10^{-5}	1	0.5	1×10^{-5}	6×10^{-1}	2	1
Process incidents	8×10^{-8}	9×10^{-4}	0.5	4×10^{-8}	5×10^{-4}	2	9×10^{-4}
Earthquake	3	4×10^{3}	7×10^{-5}	2×10^{-4}	0.3	2	0.6
Tornado	3	4×10^{3}	8×10^{-6}	2×10^{-5}	3×10^{-2}	2	6×10^{-2}
Airplane crash	3×10^{4}	5×10^{8}	1×10^{-8}	3×10^{-4}	5	2	10
Sabotage	2	1×10^{6}	1×10^{-5}	2×10^{-5}	10	2	20
Processing							
Routine releases	2×10^{-4}	3	0.5	1×10^{-4}	1.5	2	3
Process incidents	4×10^{-7}	1×10^{-2}	0.5	2×10^{-7}	5×10^{-3}	2	1×10^{-2}
Earthquake	6×10^{-2}	1×10^{2}	7×10^{-5}	4×10^{-6}	7×10^{-3}	2	2×10^{-2}
Tornado	6×10^{-2}	1×10^{2}	8×10^{-6}	5×10^{-7}	8×10^{-4}	2	2×10^{-3}
Onsite Disposal in NRC Burial Ground							
Airplane crash onto LLW	20	3×10^{5}	1×10^{-8}	2×10^{-7}	3×10^{-3}	100	9×10^{-2}
Final Decontamination and Decommissioning							
Tanks and facilities	1×10^{-2}	2	0.5	5×10^{-3}	1	2	2

Time-Integrated Dose Risk, 100-Year, Due to the Solidification Project†[1] (person-rem)	Time-Integrated Dose, 100-Year, Due to Natural Background Radiation in the West Valley Region†[2] (person-rem)
37	15 million

†[1] This collective risk was obtained by integrating the annual risks over the appropriate time intervals for all operational steps or components making up each alternative.

†[2] Based on 1.5 million population and average individual annual dose of 100 mrem/yr from exposure to natural radiation.

Table 4.10. Summary of Short-Term Radiological Doses and Risks to the General Population for Alternative 4: Delayed Action or No Action

Event	Maximum Individual Dose (rem)	Population Dose (person-rem)	Fraction or Probability (1/year)	Maximum Individual Risk (rem/year)	Population Risk (person-rem/year)	Length of Campaign (years)	100-Year Cumulative Risk (person-rem)
Storage in Tanks							
Routine releases	2×10^{-5}	1	1×10^{-2}	1×10^{-6}	6×10^{-2}	100	1
Removal from Tanks							
Routine releases	2×10^{-5}	1	0.5	1×10^{-5}	6×10^{-1}	2	1
Process incidents	8×10^{-8}	9×10^{-4}	0.5	2×10^{-8}	5×10^{-4}	2	9×10^{-4}
Earthquake	3	4×10^{3}	7×10^{-5}	2×10^{-4}	0.3	100	9
Tornado	3	4×10^{3}	8×10^{-6}	2×10^{-5}	3×10^{-2}	100	0.9
Airplane crash	3×10^{4}	5×10^{8}	1×10^{-8}	3×10^{-4}	5	100	150
Sabotage	2	1×10^{6}	1×10^{-5}	2×10^{-5}	10	100	300

Time-Integrated Dose Risk Due to the Solidification Project†[1] (person-rem)		Time-Integrated Dose Due to Natural Background Radiation in the West Valley Region†[2] (person-rem)	
10-year (delayed action):	120	10-year (delayed action):	1.5 million
100-year (no action):	460	100-year (no action):	15 million

†[1] This collective risk was obtained by integrating the annual risks over the appropriate time intervals for all operational steps or components making up each alternative.

†[2] Based on 1.5 million population and average individual annual dose of 100 mrem/yr from exposure to natural radiation.

The maximum dose to an individual member of the population resulting from normal transportation of the wastes from West Valley was calculated for a hypothetical person residing 15 m away from the truck and rail routes used to transport the wastes. The cumulative dose predicted for this individual is about 2 mrem. This is less than a 1% increase in the total dose from natural background over the same three-year period.

The maximum dose to a member of the general public resulting from a transportation accident is predicted to be 0.6 rem for alternative 1a and 0.2 rem for alternatives 1b and 2. This dose results from a very severe accident involving the transport of solidified HLW. The corresponding population doses from this accident are 6 person-rem for alternative 1a, 2 person-rem for alternative 1b, and 40 person-rem for alternative 2 (see Appendix B, Section B.5).

For all alternatives, the projected cumulative risk to the population within 80 km of each waste storage and disposal facility and within 0.8 km from the transportation routes is a very small fraction of the dose from natural background radiation. Cumulative risks to the population would range from 37 person-rem for alternative 3 to about 460 person-rem for alternative 4b, as compared with 1.5×10^7 person-rem from natural background over the 100-year period to the 1.5×10^6 people within an 80-km radius of West Valley. As indicated in Tables 4.6 through 4.8, the projected population doses from radioactive waste transportation are more than fifty times greater than the airborne doses predicted to result from normal facility operations for alternatives 1 and 2, which involve shipping radioactive waste offsite. The population dose from transportation would result primarily from the radiation penetrating the waste packages and irradiating the population residing along the transport route (1.7 million people). For alternatives 3 and 4 (neither of which requires offsite transportation of waste), 80% or more of the cumulative risk is estimated to result from the hypothetical sabotage event and the very unlikely airplane crash. These potential accidents would be common to all alternatives as long as the HLW remained as liquids in the tanks. For the action alternatives, this risk would be greatly reduced after the HLW were solidified. For the no-action alternative, the potential risk of these events would decrease as time passed and the radioactive nuclides decayed. At the end of the 100-year short-term period, the annual risks from these events would be reduced by a factor of about three.

The occupational doses calculated for the various activities associated with the four basic waste management alternatives are summarized in Table 4.11. The procedures used to estimate these doses are given in detail in Appendix B. The occupational doses do not differ greatly between alternatives 1a, 1b, and 2 because the activities contributing the major amounts to these doses are common to these three alternatives. These doses would be 1800, 2100, and 2200 person-rem for alternatives 1a, 1b, and 2, respectively. Alternative 3 would have the lowest dose (1100 person-rem) of the action alternatives. The occupational dose for the no-action alternatives 4b would be 880 person-rem, primarily from routine maintenance activities over the 100-year period during which institutional control is assumed to be in effect.

All the very-low-probability events that have some potential for releasing radioactive materials offsite also have the potential for exposing working personnel to high radiation levels. These events include major process

Table 4.11. Summary of Occupational Doses for Various Waste Management Activities

Activity	Dose (person-rem) 1a	1b	2	3	4
Decontamination of existing facility	740	740	740	740	-
Installation of solidification equipment	50	40	40	20	-
Retrieval of HLW	35	35	35	28	-
Processing of HLW:					
Terminal form	270	270	-	-	-
Interim form	-	-	350	-	-
In-tank solidification	-	-	-	170	-
Handling and disposal:					
HLW	260	620	560	-	-
LLW	83	80	79	38	-
Transportation	210	200	200	-	-
Final decontamination and decommissioning:					
Solidification facilities	140	140	140	100	-
HLW tanks	13	13	13	-	-
Continued monitoring	-	-	-	-	8/year
Tank transfer†[1]	-	-	-	-	28/transfer
	1800	2100	2200	1100	80 or 880†[2]

†[1] Three tank transfers are assumed in this EIS. If the HLW were solidified prior to the year 2000, it would not be necessary to transfer to new tanks.

†[2] Total would be 80 for 10-year period and 880 for 100-year period, assuming three tank transfers during the 100 years.

incidents, tornadoes and earthquakes, sabotage, and airplane crashes. The distribution of radiation effects among the personnel at the site is very difficult to predict because it would depend on precise details of location of the personnel and corrective actions relative to the chain of events. However, the radiation would probably be a relatively small contributor to worker injuries in these unlikely events; most of the injuries would be from such sources as explosive forces, falling buildings, tornado-driven missiles, fire, and saboteur gunfire. The worst-case credible radiological accident that could occur would be the spill of liquid HLW in the immediate vicinity of a worker. This type of accident could result in a maximum individual occupational dose of from 100 to 1000 rem or more depending upon the corrective actions taken. The processing facilities would be designed to prevent such accidents.

From the above discussion, it is apparent that the overall short-term radiological risks from normal facility operation and waste transportation would be much greater for the action alternatives than the predicted risks from accidents. The greater radiological effects for the work force would result from occupational exposures in routine operations and shipping, and, for members of the population, from irradiation due to radioactive waste shipments.

4.1.7 Long-Term Radiological Impacts

The results of projected effects from the long-term release scenarios for each alternative are presented in Tables 4.12 through 4.16. The radiological doses and risks associated with long-term storage and disposal of the HLW, as well as the TRU and low-level wastes produced during processing of the HLW, are given for each alternative. The radiological effects are given as consequences to individuals receiving the maximum dose and to the population within 80 km of the waste-disposal sites. The population at each storage site is assumed not to change for the 10,000-year period. The time-integrated collective risks for the 10,000-year period were calculated by accounting for the decay and ingrowth of radionuclide activity and the probability of occurrence of each release event. (It should be noted that it makes very little difference what time frame is chosen to calculate the population dose since most of it would occur during the first few centuries following the 100-year short-term period.) To demonstrate the insignificance of the risk beyond the 10,000-year period, the last yearly risk for the 10,000-year period is also given in Tables 4.12 through 4.16 for each alternative; this risk is estimated to range from 0.002 to 2 person-rem/yr.

The highly unlikely airplane accident, which has the potential for producing very high radiation consequences to individuals for the short-term period, would continue to be one of the dominating risk events throughout the 10,000 years for the no-action alternative. For the other alternatives over the long term, an airplane crash into the LLW burial ground would only result in negligible consequences to the population.

Based on the maximum dose to an individual, the dominant long-term events are various scenarios wherein individuals and small groups intrude into the waste disposal sites. The maximum dose estimated for these human intrusional events ranges from 0.5 rem per individual for intrusions into the tanks from which the wastes had been removed (alternatives 1 and 2) to a very high radiation dose of about 10,000 rem per individual for intrusions into the tank containing the HLW (alternative 4) after the 100-year institutional control period

Table 4.12. Summary of Long-Term Radiological Doses and Risks to the General Population for Alternative 1a: Terminal Waste Form with Separated Salt/Sludge

Event	Maximum Individual Dose (rem)	Population Dose (person-rem)	Fraction or Probability (1/year)	Maximum Individual Risk (rem/year)	Population Risk (person-rem/year)	10,000-Year Cumulative Risk (person-rem)
Onsite Decommissioned Facilities						
Groundwater	1×10^{-8}	7×10^{-5}	1	1×10^{-8}	7×10^{-5}	6×10^{-2}
Radon	5×10^{-6}	3×10^{-5}	1×10^{-2}	5×10^{-8}	3×10^{-7}	2×10^{-3}
Intrusion (digging)	0.4	4	1×10^{-2}	4×10^{-3}	4×10^{-2}	5
Intrusion (farming)	1	5	1×10^{-4}	1×10^{-4}	5×10^{-4}	7×10^{-2}
Earthquake	1×10^{-7}	7×10^{-4}	7×10^{-5}	7×10^{-12}	5×10^{-8}	5×10^{-5}
Offsite Disposal at Regional Burial Ground						
Groundwater	1×10^{-4}	0.7	1	1×10^{-4}	0.7	70
Radon	3×10^{-3}	2×10^{-2}	1×10^{-2}	3×10^{-5}	2×10^{-4}	1
Intrusion (digging)	0.3	3	1×10^{-2}	3×10^{-3}	3×10^{-2}	20
Intrusion (farming)	10	50	1×10^{-4}	1×10^{-3}	5×10^{-3}	50
Earthquake	1×10^{-3}	7	7×10^{-5}	7×10^{-8}	5×10^{-4}	5×10^{-2}
Airplane crash	10	7×10^{4}	1×10^{-8}	1×10^{-7}	7×10^{-4}	0.3
Federal Repository						
Meteorite strike	5×10^{4}	6×10^{5}	2×10^{-13}	1×10^{-8}	1×10^{-7}	4×10^{-5}
Faulting and groundwater transport	0.2	2×10^{3}	2×10^{-13}	4×10^{-14}	4×10^{-10}	2×10^{-6}
Solution mining of salt	1×10^{-3}	6×10^{4}	1×10^{-6}	1×10^{-9}	6×10^{-2}	60

Time-Integrated Risk Due to the Solidification Project†[1] (person-rem)	Maximum Annual Risk After 10,000 Years (person-rem/yr)	Time-Integrated Dose Due to Natural Background Radiation in the West Valley Region†[2] (person-rem)
10,000 years: 210	0.01	1 year: 150,000 10,000 years: 1.5 billion

†[1] This collective risk was obtained by integrating the annual risks over the appropriate time intervals for all operational steps or components making up each alternative.

†[2] Based on 1.5 million population and average individual annual dose of 100 mrem/yr from exposure to natural radiation.

Table 4.13. Summary of Long-Term Radiological Doses and Risks to the General Population for Alternative 1b: Terminal Waste Form with Nonseparated Salt/Sludge

Event	Maximum Individual Dose (rem)	Population Dose (person-rem)	Fraction or Probability (1/year)	Maximum Individual Risk (rem/year)	Population Risk (person-rem/year)	10,000-Year Cumulative Risk (person-rem)
Onsite Decommissioned Facilities						
Groundwater	1×10^{-8}	7×10^{-5}	1	1×10^{-8}	7×10^{-5}	6×10^{-2}
Radon	5×10^{-6}	3×10^{-5}	1×10^{-2}	5×10^{-8}	3×10^{-7}	2×10^{-3}
Intrusion (digging)	0.4	4	1×10^{-2}	4×10^{-3}	4×10^{-2}	5
Intrusion (farming)	1	5	1×10^{-4}	1×10^{-4}	5×10^{-4}	7×10^{-2}
Earthquake	1×10^{-7}	7×10^{-4}	7×10^{-5}	7×10^{-12}	5×10^{-8}	5×10^{-5}
Offsite Disposal at Regional Burial Ground						
Groundwater	1×10^{-8}	6×10^{-5}	1	1×10^{-8}	6×10^{-5}	7×10^{-3}
Radon	2×10^{-3}	8×10^{-3}	1×10^{-2}	2×10^{-5}	8×10^{-5}	0.6
Intrusion (digging)	0.2	2	1×10^{-2}	2×10^{-3}	2×10^{-2}	3
Intrusion (farming)	0.3	2	1×10^{-4}	3×10^{-5}	2×10^{-4}	2×10^{-2}
Earthquake	1×10^{-7}	6×10^{-4}	7×10^{-5}	7×10^{-12}	4×10^{-8}	4×10^{-6}
Airplane crash	10	7×10^{4}	1×10^{-8}	1×10^{-7}	7×10^{-4}	0.1
Federal Repository						
Meteorite strike	5×10^{4}	6×10^{5}	2×10^{-13}	1×10^{-8}	1×10^{-7}	4×10^{-5}
Faulting and groundwater transport	0.2	2×10^{3}	2×10^{-13}	4×10^{-14}	4×10^{-10}	2×10^{-6}
Solution mining of salt	1×10^{-3}	6×10^{4}	1×10^{-6}	1×10^{-9}	6×10^{-2}	60

Time-Integrated Risk Due to the Solidification Project†[1] (person-rem)	Maximum Annual Risk After 10,000 Years (person-rem/yr)	Time-Integrated Dose Due to Natural Background Radiation in the West Valley Region†[2] (person-rem)
10,000 years: 70	0.002	1 year: 150,000 10,000 years: 1.5 billion

†[1] This collective risk was obtained by integrating the annual risks over the appropriate time intervals for all operational steps or components making up each alternative.

†[2] Based on 1.5 million population and average individual annual dose of 100 mrem/yr from exposure to natural radiation.

Table 4.14. Summary of Long-Term Radiological Doses and Risks to the General Population for Alternative 2: Interim Waste Form

Event	Maximum Individual Dose (rem)	Population Dose (person-rem)	Fraction or Probability (1/year)	Maximum Individual Risk (rem/year)	Population Risk (person-rem/year)	10,000-Year Cumulative Risk (person-rem)
Onsite Decommissioned Facilities						
Groundwater	1×10^{-8}	7×10^{-5}	1	1×10^{-8}	7×10^{-5}	6×10^{-2}
Radon	5×10^{-6}	3×10^{-5}	1×10^{-2}	5×10^{-8}	3×10^{-7}	2×10^{-3}
Intrusion (digging)	0.4	4	1×10^{-2}	4×10^{-3}	4×10^{-2}	5
Intrusion (farming)	1	5	1×10^{-4}	1×10^{-4}	5×10^{-4}	7×10^{-2}
Earthquake	1×10^{-7}	7×10^{-4}	7×10^{-5}	7×10^{-12}	5×10^{-8}	5×10^{-5}
Offsite Disposal at Regional Burial Ground						
Groundwater	1×10^{-8}	6×10^{-5}	1	1×10^{-8}	6×10^{-5}	7×10^{-3}
Radon	2×10^{-3}	8×10^{-3}	1×10^{-2}	2×10^{-5}	8×10^{-5}	0.6
Intrusion (digging)	0.2	2	1×10^{-2}	2×10^{-3}	2×10^{-2}	3
Intrusion (farming)	0.3	2	1×10^{-4}	3×10^{-5}	2×10^{-4}	2×10^{-2}
Earthquake	1×10^{-7}	6×10^{-4}	7×10^{-5}	7×10^{-12}	4×10^{-8}	4×10^{-6}
Airplane crash	10	7×10^{4}	1×10^{-8}	1×10^{-7}	7×10^{-4}	0.1
Federal Repository						
Meteorite strike	5×10^{4}	6×10^{5}	2×10^{-13}	1×10^{-8}	1×10^{-7}	4×10^{-5}
Faulting and groundwater transport	0.2	2×10^{3}	2×10^{-13}	4×10^{-14}	4×10^{-10}	2×10^{-6}
Solution mining of salt	1×10^{-3}	6×10^{4}	1×10^{-6}	1×10^{-9}	6×10^{-2}	50

Time-Integrated Risk Due to the Solidification Project†1 (person-rem)	Maximum Annual Risk After 10,000 Years (person-rem/yr)	Time-Integrated Dose Due to Natural Background Radiation in the West Valley Region†2 (person-rem)
10,000 years: 70	0.002	1 year: 150,000 10,000 years: 1.5 billion

†1 This collective risk was obtained by integrating the annual risks over the appropriate time intervals for all operational steps or components making up each alternative.

†2 Based on 1.5 million population and average individual annual dose of 100 mrem/yr from exposure to natural radiation.

Table 4.15. Summary of Long-Term Radiological Doses and Risks to the General Population for Alternative 3: In-Tank Solidification of Waste

Event	Maximum Individual Dose (rem)	Population Dose (person-rem)	Fraction or Probability (1/year)	Maximum Individual Risk (rem/year)	Population Risk (person-rem/year)	10,000-Year Cumulative Risk (person-rem)
Onsite Disposal of Solidified HLW						
Groundwater	1×10^{-5}	7×10^{-2}	1	1×10^{-5}	7×10^{-2}	60
Radon	5×10^{-3}	3×10^{-2}	1×10^{-2}	5×10^{-5}	3×10^{-4}	2
Intrusion (digging)	4×10^{2}	4×10^{3}	1×10^{-2}	4	40	5100
Intrusion (farming)	1×10^{3}	5×10^{3}	1×10^{-4}	0.1	0.5	70
Earthquake	1×10^{-4}	0.7	7×10^{-5}	7×10^{-9}	5×10^{-5}	5×10^{-2}
Onsite Disposal in NRC Burial Ground						
Groundwater	3×10^{-9}	2×10^{-5}	1	3×10^{-9}	2×10^{-5}	7×10^{-3}
Radon	1×10^{-3}	7×10^{-3}	1×10^{-2}	1×10^{-5}	7×10^{-5}	0.6
Intrusion (digging)	0.2	2	1×10^{-2}	2×10^{-3}	2×10^{-2}	3
Intrusion (farming)	0.3	2	1×10^{-4}	3×10^{-5}	2×10^{-4}	2×10^{-2}
Earthquake	3×10^{-8}	2×10^{-4}	7×10^{-5}	2×10^{-13}	2×10^{-8}	4×10^{-6}
Airplane crash	10	7×10^{4}	1×10^{-8}	1×10^{-7}	7×10^{-4}	0.1

Time-Integrated Risk Due to the Solidification Project†[1] (person-rem)	Maximum Annual Risk After 10,000 Years (person-rem/yr)	Time-Integrated Dose Due to Natural Background Radiation in the West Valley Region†[2] (person-rem)
10,000 years: 5200	0.2	1 year: 150,000 10,000 years: 1.5 billion

†[1] This collective risk was obtained by integrating the annual risks over the appropriate time intervals for all operational steps or components making up each alternative.

†[2] Based on 1.5 million population and average individual annual dose of 100 mrem/yr from exposure to natural radiation.

Table 4.16. Summary of Long-Term Radiological Doses and Risks to the General Population for Alternative 4b: No Action

Event	Maximum Individual Dose (rem)	Population Dose (person-rem)	Fraction or Probability (1/year)	Maximum Individual Risk (rem/year)	Population Risk (person-rem/year)	10,000-Year Cumulative Risk (person-rem)
Onsite Storage of HLW						
Groundwater	2×10^{-3}	10	1	2×10^{-3}	10	70
Intrusion (digging)	1×10^{4}	1×10^{5}	1×10^{-2}	1×10^{2}	1×10^{3}	120,000
Intrusion (farming)	2×10^{3}	1×10^{4}	1×10^{-4}	0.2	1	150
Earthquake	2×10^{-2}	1×10^{2}	7×10^{-5}	2×10^{-6}	7×10^{-3}	700
Airplane crash	2×10^{4}	1×10^{8}	1×10^{-8}	2×10^{-4}	1	780

Time-Integrated Risk Due to the Solidification Project†[1] (person-rem)	Maximum Annual Risk After 10,000 Years (person-rem/yr)	Time-Integrated Dose Due to Natural Background Radiation in the West Valley Region†[2] (person-rem)
10,000 years: 120,000	2.0	1 year: 150,000 10,000 years: 1.5 billion

†[1] This collective risk was obtained by integrating the annual risks over the appropriate time intervals for all operational steps or components making up each alternative.

†[2] Based on 1.5 million population and average individual annual dose of 100 mrem/yr from exposure to natural radiation.

has ended. These unacceptably high doses would fall off significantly with time, owing to the decay of the fission products. For an intruder who would dig into the liquid waste tank beyond the 10,000-year period, the dose consequence would decrease to less than 5 rem.

With the exception of the very high risk to intruders in the no-action alternative, the calculation shows that the long-term risks to the public from implementation of any of the other alternatives would be relatively small compared to those attributable to natural background radiation. For alternatives in which the HLW would be left at West Valley either as concrete (alternative 3) or as liquid (alternative 4), the radiological risks to the population integrated over 10,000 years would be much higher than those for alternatives in which the solidified HLW were shipped to a Federal repository. The no-action alternative would result in the highest 10,000-year integrated population risk of about 120,000 person-rem. In alternatives 3 and 4, these risks would arise from the collective risks estimated for a limited number of individuals due to intrusion by digging and farming. Based on the 10,000-year time frame of this study, the integrated risk in alternative 4 would be equivalent to increasing the collective background radiation dose by less than 0.01%. Alternative 3, in-tank solidification, would result in an integrated population risk of about 5200 person-rem, which is equivalent to increasing the 10,000-year radiation background dose to the population by about 0.0005%.

Among the alternatives in which the waste would be removed to a Federal repository after processing, alternative 1a would produce the highest dose risk of 210 person-rem over 10,000 years, as compared with 70 person-rem for alternatives 1b and 2. The higher radiological dose for alternative 1a would be primarily attributable to the leaching and eventual migration of radionuclides from the salt cake at the LLW burial ground. It was assumed that technetium-99, which has a half-life of 2.1×10^5 years, would be transported freely by groundwater after it was leached out from the salt cake. In this EIS, it was assumed that technetium-99 was not removed from the salt cake.

4.1.8 Health Effects

The significance of the committed dose equivalents resulting from implementation of the waste management alternatives at West Valley may be placed in perspective by estimating their effects on human health. In this section, the methodology and health-effect conversion factors employed to calculate health risk are addressed and the health risks to a hypothetical maximally exposed individual and to the affected population are estimated.

The relationship between radiation doses and health effects has been studied for many years, with the effects of low doses being of special concern. A great deal of data on health (biological) effects of radiation has been accumulated on a worldwide basis over the past several decades. These data have been analyzed by international and national organizations responsible for radiation protection. The up-to-date findings of these organizations are the basis for estimating radiation-related human health effects in this document. The radiological doses to the general population from waste management alternatives may result in somatic and genetic effects. The somatic effect of greatest concern is the possibility of inducing a fatal cancer; the genetic effects include a variety of hereditary changes that might affect future generations. In this document, use of the term "health effects" specifically refers to the induction of fatal cancer and genetic defects.

Until the recent publication of the BEIR III report (Comm. Biol. Effects Ionizing Radiat. 1980), a linear relationship was conventionally used to estimate the risks of somatic and genetic effects from low-level radiation doses. The BEIR III report, authored by a committee representing a broad cross section of disciplines, is one of the most up-to-date summations of all available data on the effects of radiation and represents the current scientific knowledge about the health risks of low-level ionizing radiation exposure. This committee used a linear-quadratic dose-response model, whenever possible, to estimate the cancer risk from low doses of low-LET (linear energy transfer) radiation. This radiation--which includes gamma rays, X-rays, and electrons--is responsible for most of the absorbed doses received by the general population and by radiation workers, but high-LET radiation also contributes. The most important directly ionizing high-LET radiation is alpha radiation emitted by internally deposited radionuclides. The relative biological effectiveness of high-LET radiation relative to low-LET radiation is considered by using a quality factor in calculating the dose equivalent. A quality factor of 20 has been used for calculating dose equivalents from alpha radiation emitted by internally deposited radionuclides.

Because there is great uncertainty in predicting the risk of cancer from low-level radiation doses, the BEIR III report suggested that the linear model may be used to define the upper limits of risk. Because of this conservatism, the linear dose-response relationship with no threshold was used in this EIS. Table 4.17 compares the risk estimators of the total deaths from cancer per million person-rem of collective total body dose equivalents derived from reports published by national and international radiation-protection organizations.

The basis for the health-effect estimates used in this EIS may be found in a recent report of the U.S. Department of Energy (1980c). The risk estimators from this report were prepared with the intent of providing probable ranges of predictors of the effects of irradiation. The risk estimators that have been applied are listed in Table 4.18. The range of these estimators includes the values recommended by the International Commission on Radiological Protection (ICRP) and those suggested by the committee of the BEIR III report. They are given in terms of predicted fatal cancers and predicted genetic defects per million person-rem of population dose. In this EIS, it was assumed that 100 to 800 health effects would be incurred per million person-rem.

The dose risks for the maximally exposed individual and for the population that could result from implementing each of the four alternatives are given in Tables 4.6 through 4.10 and in Tables 4.12 through 4.16. Using these values and the health risk estimators given in Table 4.18, the additional risks of health effects were calculated (Table 4.19 for the maximally exposed individual; Table 4.20 for the affected population). It should be stressed that these risks, or probabilities, are increments above (or additions to) those risks to which the entire population currently is exposed. Current public health statistics show that, for the entire U.S. population, there is a one-in-five chance that death will be due to some form of cancer. The normal occurrence of hereditary disease in the offspring of the current U.S. population is about one in seventeen.

The risks to the maximally exposed individual of suffering a health effect from radiation attributable to the short-term (100-year) period of operation

Table 4.17. Comparison of Dose-Effect Conversion Factors

Report†[1]	Deaths from Latent Cancer per Total Body Dose (number/million person-rem)
BEIR III†[2]	75 - 210
BEIR I	100 - 450
UNSCEAR	125
ICRP	125

†[1] BEIR III: Committee on the Biological Effects of Ionizing Radiation (1980).

BEIR I: Committee on the Biological Effects of Ionizing Radiation (1972).

UNSCEAR: United Nations Scientific Committee on the Effects of Atomic Radiation (1977).

ICRP: International Commission on Radiological Protection (1977a, 1977b).

†[2] Calculated based on linear quadratic model on absolute and relative risk model, respectively.

at West Valley and at the various waste storage sites are very small. The incremental chances of health effects to maximally exposed individuals are less than one in 50,000 for alternative 4 and less than one in 100,000 for alternatives 1 through 3. The incremental chance of a health effect to the hypothetical individual who receives the maximum radiation exposure from transportation of radioactive wastes is one in 500,000. The incremental chance of a health effect to the maximally exposed individual for the long-term period after the waste storage and disposal sites are no longer under institutional control is estimated to range from less than one in 3000 for alternatives 1a, 1b, and 2 to one for alternative 4. The high risk of an eventual cancer death for the maximally exposed individual for alternative 4 is due to the very high dose received by a hypothetical intruder digging into the HLW and being exposed to its penetrating radiation.

In Table 4.20, the potential cumulative health effects in the form of fatal cancers and hereditary defects that might occur among the population in the vicinity of West Valley, a regional burial ground, a Federal repository, and the transportation routes have been estimated for both the short-term (100-year) and long-term (10,000-year) periods from normal and abnormal releases of

Table 4.18. Dose-Effect Estimators Used to Predict Health Effects from Ionizing Radiation

Type of Risk	Predicted Incidence per Million Person-rem
Fatal cancers from total body exposure	50 - 500
Genetic effects to all generations from total body exposure	50 - 300
Total health effects	100 - 800

Source: U.S. Department of Energy (1980c).

Table 4.19. Risk to the Maximally Exposed Individual from Implementing Each Alternative

	Incremental Chance of Health Effect†[1]				
Site of Exposure	1a	1b	2	3	4
Cumulative Risk for the Period 1987-2087					
West Valley	0.1×10^{-5} to 1×10^{-5}	0.1×10^{-5} to 1×10^{-5}	0.1×10^{-5} to 1×10^{-5}	1×10^{-6} to 9×10^{-6}	0.2×10^{-5} to 2×10^{-5}
Regional burial ground	1×10^{-9} to 8×10^{-9}	1×10^{-9} to 8×10^{-9}	1×10^{-9} to 8×10^{-9}	NA†[2]	NA
Transportation	0.2×10^{-6} to 2×10^{-6}	0.2×10^{-6} to 2×10^{-6}	0.2×10^{-6} to 2×10^{-6}	NA	NA
Cumulative Risk for the Period 2088-2188					
West Valley	0.4×10^{-4} to 3×10^{-4}	0.4×10^{-4} to 3×10^{-4}	0.4×10^{-4} to 3×10^{-4}	0.4×10^{-1} to 3×10^{-1}	1†[3]
Regional burial ground	0.4×10^{-4} to 3×10^{-4}	0.2×10^{-4} to 2×10^{-4}	0.2×10^{-4} to 2×10^{-4}	NA	NA
Federal repository	0.2×10^{-7} to 2×10^{-7}	0.2×10^{-7} to 2×10^{-7}	0.2×10^{-7} to 2×10^{-7}	NA	NA

†[1] Health effects refers to induction of a fatal cancer within the exposed populations or a hereditary defect in future generations of the exposed population. Natural sources refers to sources not associated with any of the solidification alternatives.

†[2] NA = not applicable.

†[3] The very high risk of an eventual health effect is based on the assumption that an intruder would dig into the HLW within a 100-year period during which institutional controls would no longer be in effect.

Table 4.20. Estimated Cumulative Health Effects Among the Surrounding Population of Each Storage/Disposal Site

	Cumulative Health Effects					Expected Health Effects from Natural Sources†[1]	
Site of Exposure	1a	1b	2	3	4	Fatal Cancer†[2]	Hereditary Defect†[3]
100-Year Cumulative Effects for the Period 1987-2087							
West Valley	0.5×10^{-2} to 4×10^{-2}	0.5×10^{-2} to 4×10^{-2}	0.5×10^{-2} to 4×10^{-2}	0.4×10^{-2} to 3×10^{-2}	0.05 to 0.4	3×10^{5}	9×10^{4}
Regional burial ground	0.9×10^{-5} to 7×10^{-5}	0.9×10^{-5} to 7×10^{-5}	0.9×10^{-5} to 7×10^{-5}	NA†[4]	NA	3×10^{5}	9×10^{4}
Transportation	0.3×10^{-1} to 2×10^{-1}	0.3×10^{-1} to 3×10^{-1}	0.4×10^{-1} to 3×10^{-1}	NA	NA	3×10^{5}	1×10^{5}
10,000-Year Cumulative Effects for the Period 2087-12087							
West Valley	0.5×10^{-3} to 4×10^{-3}	0.5×10^{-3} to 4×10^{-3}	0.5×10^{-3} to 4×10^{-3}	0.5 to 4	12 to 96	3×10^{7}	9×10^{6}
Regional burial ground	0.1×10^{-1} to 1×10^{-1}	0.4×10^{-3} to 3×10^{-3}	0.4×10^{-3} to 3×10^{-3}	0.4×10^{-3} to 3×10^{-3}	NA	3×10^{7}	9×10^{6}
Federal repository	0.6×10^{-2} to 5×10^{-2}	0.6×10^{-2} to 5×10^{-2}	0.6×10^{-2} to 5×10^{-2}	NA	NA	4×10^{7}	1×10^{7}

†[1] Health effects refers to induction of a fatal cancer within the exposed population or a hereditary defect in future generations of the exposed population. Natural sources refers to sources not associated with any of the solidification alternatives.

†[2] Assuming that 20% of the population at each site would eventually die from cancers (Garfinkel and Silverberg 1979).

†[3] Assuming that the normal occurrence of hereditary disease in the offspring of the population at each site would be about one in 17, or 6% (based on information in the report of Committee on the Biological Effects of Ionizing Radiation 1972).

†[4] NA = not applicable.

radioactivity. The number of health effects predicted as a result of exposure to these releases is compared with the number of expected cancer deaths and genetic defects that would be predicted from unavoidable causes other than these releases in the same population during the same periods.

The expected number of health effects that are not associated with the solidification plans were calculated on the basis of current statistics of cancer deaths and genetic abnormalities in the United States. The comparison indicates that, over the short term, the incremental chance of a fatal cancer to the population or a genetic defect to descendents of the exposed population due to activities of any solidification plans considered in this EIS is about one in one million. However, over the long term, 0.5 to 4 health effects are predicted for alternative 3, and 12 to 96 health effects for alternative 4, during the 10,000-year period of HLW disposal at the West Valley site. These predicted health effects involve only a limited number of intruders who would dig into the waste and be exposed to its radiation. If these intrusional event were excluded, only 0.007 to 0.05, and 0.2 to 1.2 health effects would be predicted for alternatives 3 and 4, respectively. For alternatives 1 and 2, the highest predicted probability of a single fatal cancer induction is less than one in 10 for the population in the vicinity of the LLW burial ground and less than one in 20 for the population in the vicinity of the Federal repository. Even though statistically unlikely, if such an effect did occur as a result of radiation originating from the implementation of an immobilization plan at West Valley, it would be one among millions of other cancer deaths or genetic disabilities, so that its cause would be entirely unrecognizable.

The values for cancer deaths for the preferred alternative 1a are so low that they are difficult to interpret. The meaning of 0.03 to 0.27 health effects in the affected population for the next 100 years is not clear. This points to the probabilistic nature of this type of analysis. These estimates are based on mathematical models and statistics and the assumption that any amount of radiation is capable of causing cancer. No single cancer death could be attributed to the solidification project because the probability of the project causing a cancer death is low and because the normal incidence of cancer death in the United States is high (about 61 million persons will die of cancer in the next 100 years). Background radiation alone over the same 100-year period will result in about 312,000 premature deaths from cancer in the United States.

The occupational doses from normal operation during the course of the solidification operation may result in somatic and genetic effects. The cumulative exposure to the work force from implementing each alternative ranges from 880 to 2200 person-rem (Table 4.11). For the least cumulative dose case (alternative 4b), it is expected that 0.04 to 0.4 additional fatal cancer would be caused. For the highest dose case (alternative 2), about 0.1-1 additional cancer fatality would result. The expected number of genetic defects among the offspring of the work force would be 0.04 to 0.3 for the least cumulative dose and 0.1 to 0.7 for the highest cumulative dose alternative. The normal incidence rate for a hypothetical work force of 1000 persons, excluding the occupational dose, would be about 200 cancer deaths and 60 hereditary defects among the offspring of this same work force.

4.2 NONRADIOLOGICAL IMPACTS

4.2.1 Nonsocioeconomic Impacts

The nonradiological impacts of the various alternatives (excluding socioeconomic impacts) and some of the options for different steps within an alternative are discussed below.

4.2.1.1 Modifications/Construction Impacts

Implementation of alternative 1a would require initial decontamination of the existing process building plus subsequent modifications. These activities would occur within the process building and would cause no major impacts to the external environment. Alternative 1a would also require modifications to the existing LLW treatment facility, a new temporary HLW storage facility, and a new temporary storage facility for LLW, TRU wastes, and salt cake. In addition, some new laydown areas and possibly some upgrading of the existing access road and railroad spur may be required. Although design details and exact locations of construction activities on the site are not yet known, it is known that these new facilities would be constructed near the existing buildings inside the security fence. The new facilities plus laydown areas should occupy no more than about 4 hectares (10 acres). The area that would be impacted is the central flat area of the site, which was already cleared when the reprocessing facilities were built. This area is currently covered with grass, gravel, and cement. The land immediately outside the fence is open fields (formerly cropland and pasture). Thus, construction impacts such as loss of habitat, preclusion of other land uses, and dusting would be insignificant. The construction impacts would occur over a period of about three years (see Table 2.1).

Although there would be some excavation, it is expected that standard engineering practices, such as balancing of cut and fill (so as to keep the amount of borrow or storage minimal), would be followed. Also, given the nature of the soils, vegetation, and climate at West Valley, it is also expected that standard measures to control soil erosion, runoff, vegetation, etc., can readily be followed (U.S. Environ. Prot. Agency 1973).

The preliminary engineering design indicates that existing electric, water, and natural gas services at the site would be adequate.

There would be some risk of worker injury/fatality, which is associated with any construction project. Injuries could range from minor injuries requiring only first aid and no days lost from work, to major injuries involving lost work days, to death. The assumptions and risks associated with accidents and the various alternatives are given in Tables 4.21 and 4.22 (transportation assumptions and analysis are given in Section 4.2.1.4). For alternative 1a, it is anticipated that the modifications/construction activities would result in about 19 injuries and no deaths.

The nonradiological impacts for alternative 1b would be about the same as for alternative 1a. Although alternative 1b would require a larger temporary HLW storage building, this would be partly offset by the smaller storage building for LLW and TRU wastes (no salt cake to store).

Table 4.21. Assumptions Used in Calculating Nonradiological Occupational Injuries and Deaths (Excluding Transportation)

1. Workers for construction and decontamination and decommissioning are assumed to have the same accident rate as any other construction workers: 15.86 injuries per million person-hours and 0.16 deaths per million person-hours (Hanford Eng. Dev. Lab. 1980).

2. Workers for operations and disposal are assumed to have the same accident rate as experienced by the Atomic Energy Commission for operational and surveillance workers, 1943-1970: 2.1 injuries per million person-hours and 0.023 deaths per million person-hours (U.S. Atomic Energy Comm. 1972b).

3. The estimated person-hours (in millions) associated with each activity and alternative are:

	Alternative					
Activity	1a	1b	2	3	4a	4b
Modifications/ Construction	1.2	1.2	1.6	0.6	-	1.2
Operations	2.0	2.0	0.9	0.4	-	1.2
Decontamination and Decommissioning	1.5	1.5	1.5	0.3	-	-
Disposal (monitoring, maintenance, guarding)	0.3	0.3	0.3	4.7	-	8.8

4. The person-hours associated with each alternative are those expected to occur within the 100 years of assumed institutional controls. For alternative 4b, no action, it was assumed that the current work force at West Valley would continue for the duration of the 100 years.

5. The person-hour figures are only rough estimates. Detailed design information and work force estimates will not be made until after ongoing research, development, and design activities are completed.

6. Available information on transportation-related injuries and deaths included both workers and the public. The occupational component could not be determined separately. The assumptions and bases for calculating the transportation numbers are given separately in Section 4.2.1.4 and in Appendix B, Section B.5.

Table 4.22. Estimated Nonradiological Occupational Injuries and Deaths†[1]

Activity	Injuries per Alternative						Deaths per Alternative					
	1a	1b	2	3	4a	4b	1a	1b	2	3	4a	4b
Modifications/ construction	19.0	19.0	25.4	9.5	--	19.0	0.19	0.19	0.26	0.10	--	0.19
Operations (including storage)	4.2	4.2	1.9	0.8	--	2.5	0.05	0.05	0.02	0.01	--	0.03
Final decontamination and decommissioning	23.8	23.8	23.8	4.8	--	--	0.24	0.24	0.24	0.05	--	--
Transportation	5.2	8.1	9.0	--	--	--	0.31	0.53	0.61	--	--	--
Disposal	0.6	0.6	0.6	9.8	--	18.5	0.01	0.01	0.01	0.11	--	0.20
Total	52.8	55.7	60.7	24.9	--	40.0	0.80	1.02	1.14	0.27	--	0.42

†[1] Estimates of transportation-related injuries and deaths include both workers and the general population. The occupational component could not be determined separately (see Section 4.1.2.4 and Appendix B, Section B.5, for details).

For alternative 2, the impacts would also be about the same as for alternative 1a. Although there would be no HLW storage building at West Valley, there would be construction of a new handling/storage facility for the interim-form wastes at an offsite Federal solidification facility. The location of this offsite facility is not known. However, the construction would cover less than one hectare and would be an insignificant increment to construction activities that would be going on for the offsite Federal waste processing facilities. Worker injuries/deaths (25/0.26) would be greater because the total person-hours at West Valley and the offsite Federal facility would be greater.

Although alternative 3 would not require construction of temporary HLW and LLW storage facilities, there would still be additional construction of a cement plant and mixing facility in the tank area. Overall, there would be less construction activity for this alternative and, thus, less risk of worker injuries/deaths [9.5/0.1 (Table 4.22)].

For alternative 4a (delay decision for 10 years), the modifications/construction impacts would occur in the future. Thus, if a regional burial ground for LLW would become available during this time, there would be no need to construct the two temporary waste storage buildings. For alternative 4b (continued storage in tanks), there would be construction impacts associated with the construction of new tanks every 40 or more years. These impacts would be slightly less than those for alternative 1a.

4.2.1.2 Operations Impacts

Operations for alternative 1a would include removal of the HLW from the tanks; separation/concentration/solidification of the HLW; and temporary storage of the solidified HLW, LLW, TRU wastes, and salt cake residue.

Removal of the wastes from the tanks would involve pumping, sluicing with water, and cleaning with acids. No significant nonradiological impacts are expected.

The LLW treatment facility would be operated so that the effluents would meet State and Federal standards. The very small releases to the environment would not be expected to have an impact. Storage of the various wastes would be a passive operation with no nonradiological impacts.

The rates and amounts of use of electricity, water, and natural gas are expected to be similar to the rates and amounts used when the nuclear fuel reprocessing facility was operating. This use of natural resources is not expected to have significant impact during the solidification program. The risks of worker injuries/deaths are small [4.2/0.05 (Table 4.22)] and about the same as those associated with any industrial operation.

Some gases of sulfur oxides (SOx) and nitrogen oxides (NOx) would be released to the atmosphere. Estimates of release rates, concentrations, and total amounts over three years of operations will be much below the EPA primary air quality standards.

The nonradiological operations impacts at West Valley for alternative 2 are expected to be about the same as for alternative 1a, although worker injuries/

deaths (1.9/0.02) would be less because there would be less activity at West Valley. Nonradiological impacts at an offsite Federal waste facility from the West Valley wastes would be only a very small increment to the total impacts at that facility.

The operations impacts for alternative 3 would also be about the same as for alternative 1a, the only differences being that, for alternative 3, there would be less worker injuries/deaths (0.8/0.01) and large amounts of cement would be produced. Although cement dust can never be entirely eliminated, appropriate controls should minimize the impacts to workers and to the old-field vegetation nearby (U.S. Environ. Prot. Agency 1973).

For alternative 4a (delay 10 years), the above-mentioned operations impacts would simply be postponed. For alternative 4b (continued storage in tanks), the impacts would be similar to the removal-from-tanks part of alternative 1a because there could be up to three transfers to new tanks during the 100-year period of institutional controls.

4.2.1.3 Decontamination and Decommissioning Impacts

The nonradiological impacts associated with decontamination and decommissioning would generally be small. They would be greatest for the alternatives that involve dismantlement (1a, 1b, and 2).

The water used for decontamination would be taken from existing artificial lakes that previously provided water for plant operation. The amounts would be no more than that used for the operations and should not affect water supplies. The decontamination solutions would be treated in the LLW treatment facility, which would be operated so that the effluents would be below appropriate State and Federal standards. Noise and dust associated with mechanical decontamination should be confined within the buildings. The greatest decontamination impact would be risks of worker injuries, particularly during the handling of caustic cleaning chemicals and mechanical decontamination equipment.

During dismantlement there would be noise and dust resulting from the use of drills, jackhammers, rock splitters, other power machines, and explosives. However, because of the already disturbed nature of the nearby land onsite and the absence of any nearby residences, the impact to terrestrial communities and to the public should be minimal. Fugitive dust generated during demolition, grading, etc., should be minimal and confined to the immediate vicinity of the work activity if proper control measures are used (U.S. Environ. Prot. Agency 1973). It is expected that most of the noncontaminated rubble from demolition would be used as backfill onsite. There could be some loss of terrestrial habitat if soil were taken from some other place to spread over the backfilled and graded area to facilitate revegetation. The necessity for backfill will not be known until decontamination and dismantlement have been completed because it is uncertain how much material must be hauled away and disposed of as radioactive waste. As with any demolition project, there would be risks of accidental worker injuries/deaths. The combined accident risks associated with decontamination and decommissioning are estimated to be 24 injuries and 0.24 deaths (Table 4.22).

During entombment of the tanks, cement dust would be released. However, if proper controls are used, this impact should be confined to the immediate work area (U.S. Environ. Prot. Agency 1973).

For alternative 3, the existing process building and LLW treatment facility would eventually be decontaminated and entombed. The decontamination impacts would be the same as for alternative 1a. Entombment would require structural preparations and cement mixing and pouring. Noise would probably be less than for alternative 1a, but there would be cement dust instead of demolition dust. Since there would be no massive demolition, risk of worker injuries/deaths should be less than for alternative 1a [about five injuries and 0.05 deaths (Table 4.22)].

For alternative 4a (delay 10 years), the decontamination and decommissioning (either dismantlement or entombment) impacts would simply occur in the future. For alternative 4b (continued storage in tanks), the old tanks would have to be entombed every 40 or more years. The impacts would be minor, as they would be for the entombment of the tanks for alternative 1a. There would be no noise, dust, or worker injury associated with decontamination and decommissioning of the exisiting buildings because it is assumed the present activities of guarding the facilities in a safe shutdown condition would continue.

4.2.1.4 Transportation Impacts

Transport of the wastes associated with alternative 1a would cause some non-radiological impacts of the type that would occur from the transport of any type of cargo. The sources of these impacts would be the diesel fuel burned in truck and train engines, the dust generated by vehicular movement, and the likelihood of accidents.

To compare vehicular emissions to current pollution standards, the emissions resulting from the hourly passing of one diesel-powered truck or one railcar pulled by a diesel locomotive were used to calculate an average air pollution concentration (Table 4.23). Current estimates of the total number of truck-loads required for each of the three alternatives involving the transport of wastes (1a, 1b, 2) are about 2000-2200 (Table 4.24) and the period of time during which these wastes would be transported is in excess of three years; therefore, it is doubtful that the assumption of one truck per hour would be exceeded. Emissions related to train transport of the wastes would be about the same. Although the emissions resulting from diesel fuel combustion, per railcar, exceed those of a diesel truck, the number of railcar loads involved would be comparably smaller (Table 4.24). Thus, the time between trains would be greater and the concentrations should not exceed those associated with trucks. In addition, trains produce less fugitive dust because their wheels travel on rails.

The concentrations of all pollutants shown in Table 4.23 are below current air quality standards (U.S. Environ. Prot. Agency 1977), and the pollutants are therefore assumed to cause no harmful effects. Although it is recognized that the trucks and trains transporting West Valley wastes would use a portion of the allowable air quality increment, it is not feasible here to calculate the effects of other vehicles using the same routes. On the basis of the impacts from these pollutants, it is also not possible to choose a clearly preferred alternative from among the alternatives involving the transport of wastes. The pollution impacts would be in proportion to the distances traveled. As can be seen in Table 4.24, the distances associated with each of these alternatives would not differ greatly. The impacts associated with the terminal-form alternative 1b (nonseparated salt/sludge) would be somewhat more than

Table 4.23. Comparison of Calculated Vehicular Pollutant Concentrations and Air Quality Standards

Pollutant	Pollutant Concentration†[1] ($\mu g/m^3$) Truck	Rail	Primary Standard†[2] ($\mu g/m^3$)
Particulates†[3]	0.63	0.09	260 (24-hour)
SO_2	0.02	0.05	365 (24-hour)
NO_2	0.06	0.3	100 (annual mean)
Hydrocarbons	0.02	0.09	160 (3-hour)
Carbon monoxide	0.1	0.1	40,000 (1-hour)

†[1] Calculated assuming that a diesel-powered truck or train would pass once an hour and that, of the total distances traveled, 90% would be through a low population zone, 5% through a medium population zone, and 5% through a high population zone.

†[2] Primary standards of the U.S. Environmental Protection Agency (1977).

†[3] Including fugitive dust.

Table 4.24. Risk of Injuries and Deaths from Transport Accidents

Alternative	Waste Form	Number and Type of Shipments†[1]	Round-trip Distance (km)	Total Travel (10^6 km) Truck	Railcar	Accident Injuries/Deaths for All Shipments†[3] Injuries	Deaths
1a	HLW	43 R	9600		0.4	1.0	0.08
	TRU	573 T	9600	5.5		3.1	0.17
	LLW	1576 T	1280	2.0		1.1	0.06
				7.5	0.4	5.2	0.31
1b	HLW	162 R	9600		1.6	3.9	0.3
	TRU	573 T	9600	5.5		3.1	0.17
	LLW	1471 T	1280	1.9		1.1	0.06
				7.4	1.6	8.1	0.53
2†[2]	HLW	130 R (162)	3200 (9600)		0.4 (1.6)	1.0 (3.9)	0.08 (0.3)
	TRU	573 T	9600	5.5		3.1	0.17
	LLW	1454 T	1280	1.9		1.0	0.06
				7.4	2.0	9.0	0.61

†[1] R refers to railcar loads, T to truckloads.

†[2] The radiological impacts for alternative 2 are for shipping the interim-form HLW 1600 km to a Federal waste facility for final processing, followed by shipping the terminal form 4800 km to a Federal repository; the impacts for the transuranic and low-level wastes generated at West Valley are for shipping these wastes to appropriate disposal sites.

†[3] Both workers and the general population would be affected, but it was not possible to separate out the occupational component.

those associated with alternative 1a. The impacts associated with the interim-form alternative 2 would be slightly greater than those associated with alternatives 1a and 1b because it would be necessary to transport the HLW twice--the interim form from West Valley to the Federal waste facility and the terminal form to a Federal repository. There would be no emissions impacts for alternatives 3 and 4b since there would be no transportation associated with these alternatives.

The nonradiological impacts of accidents during transport of the wastes are defined in terms of deaths and injuries. If it is assumed that the potential for transportation accidents involving shipments of radioactive wastes is comparable to that for general truck and rail transportation in the United States, 1.1 truck accidents for every million kilometers and 9.3 railcar accidents for every ten million kilometers traveled would occur (Table 4.25) (Clarke et al. 1976; U.S. Atomic Energy Comm. 1972a). Each truck accident would result in about one injury and no deaths, and each railcar accident would result in about three injuries and no deaths. Based on these rates, about six injuries for every ten million kilometers and about three deaths for every hundred million kilometers traveled would occur if the wastes were shipped by truck, and about three injuries for every million kilometers and about two deaths for every ten million kilometers traveled would occur if they were shipped by railcar. Both workers and the general population would be affected, but it is not possible to separate out the population component. The number of injuries and deaths for alternatives 1a, 1b, and 2--based on the rates given in Table 4.25--are summarized in Table 4.24.

Table 4.25. Projected Accidents, Injuries, and Deaths from Transportation of Radioactive Wastes

Vehicle	Accident Rate (number/kilometer)	Injuries (number/accident)	Injuries (number/kilometer)	Deaths (number/accident)	Deaths (number/kilometer)
Truck	1.1×10^{-6}	0.51	5.6×10^{-7}	0.03	3.1×10^{-8}
Railcar	9.3×10^{-7}	2.7	2.5×10^{-6}	0.2	1.9×10^{-7}

As in the case of emissions, alternative 2 would have the greatest number of injuries and deaths (9.0 and 0.61 respectively), alternative 1b fewer (8.1 and 0.53), and alternative 1a even fewer (5.2 and 0.31) (Table 4.24)--corresponding with the distances traveled. Alternatives 3 and 4b would have no transportation-related deaths and injuries.

4.2.1.5 Waste Disposal Impacts

Alternative 1a

The major nonradiological impact of waste disposal is dedication of the land to nuclear use. For alternative 1a, the HLW and TRU wastes would be permanently disposed in an underground Federal repository when it became available, and there could be some restrictions on the use of the land above the repository. Because the amount of West Valley wastes would be less than 1% of the wastes in the repository (most of which would come from the defense wastes and from nuclear power reactors), the aboveground land-use impact at the repository from West Valley wastes would be insignificant. The LLW and salt cake would require less than one hectare (2.5 acres) in a burial ground that would be permanently dedicated to West Valley wastes. This area is based on the volume of wastes generated during the project and burial of the wastes in trenches. The West Valley wastes would be only a small percentage of the wastes in a regional burial ground because most of the wastes would come from hospitals, research institutions, and the nuclear power industry. There would be insignificant, typical construction impacts such as loss of terrestrial habitat, dust, erosion, noise, and a small risk of worker injury [about one injury and no deaths (Table 4.22)]. Salt cake disposal would have to be carefully controlled since nitrates are considered hazardous because of their potential for fire, explosion, or violent reaction when mixed with other chemicals (U.S. Environ. Prot. Agency 1978).

There is some potential for chemical pollution associated with disposal of the wastes. For alternative 1a, disposal of the salt cake and LLW in the regional burial ground and the entombed tanks at West Valley must be considered. The salt cake would be of most concern. During the short term (100 years), it is expected that institutional controls (monitoring, mitigating measures) would serve to avoid or control any releases of chemicals before drinking waters were affected. However, during the long term, since there would be no institutional controls, it must be assumed that eventually the steel drums containing the salt cake would rust and that water could enter the burial trenches and dissolve the salt. Of particular concern would be the nitrate salts, which are very soluble in water (92,000 mg/L for sodium nitrate). As discussed in Section 4.3.5, there are no restrictions imposed by the regulatory agencies with respect to disposal of the salt cake. However, there are domestic drinking water criteria for concentrations of nitrate, specifically 10 mg/L as nitrogen, or about 45 mg/L as nitrate ion (U.S. Environ. Prot. Agency 1976). Nitrates become toxic under conditions in which they are reduced to nitrites.

Using the same groundwater model (Nucl. Safety Assoc. 1980) used for potential releases of radioactive elements from a regional burial ground and making the assumption that the nitrates would move through the soils in the same manner as water, the eventual concentrations of nitrate in the surface stream would be about one-thousand times less than the EPA limit (Table 4.26).

To reduce the long-term risk of the water being contaminated with nitrates at the burial ground, the following mitigative measures might be taken: (1) use of a binder such as cement or asphalt in the salt cake to reduce rates of dissolution and the concentration in water, (2) use of double containers, such as stainless steel liners over the 55-gallon drums, to provide two barriers against water infiltration, and (3) careful engineering and disposal practices.

The same groundwater model was also used to estimate the potential concentrations of other chemicals such as uranium, plutonium, and chromium (from the residues left in the entombed tanks at West Valley or from the LLW buried in a regional burial ground). The concentrations of these chemicals in surface streams would also be below limits by several orders of magnitude (Table 4.26).

Table 4.26. Concentrations of Potentially Toxic Chemicals

	Limits (mg/L)	Concentration in Surface Stream (mg/L)†[1] per Alternative		
		1a	3	4b
Uranium	0.5†[2]	1.7×10^{-8}	1.7×10^{-5}	1.7×10^{-4}
Plutonium	0.0008†[2]	1.0×10^{-10}	1.0×10^{-7}	1.0×10^{-6}
Chromium	0.05†[3]	6.5×10^{-9}	6.5×10^{-6}	6.5×10^{-5}
Nitrate	10.0†[3]	5.1×10^{-1}	2.5×10^{-3}	2.5×10^{-2}

†[1] Estimates based on same groundwater transport model used for radiological analysis.

†[2] Data from Dawson (1974).

†[3] Data from U.S. Environmental Protection Agency (1976).

Other Alternatives

Although the volume of HLW needing disposal would be greater for alternative 1b, there would be no salt cake to be disposed. Thus, in terms of land required for land disposal of LLW, alternative 1b would have less impact than alternative 1a.

The impacts associated with disposal of radioactive wastes for alternative 2 would be similar to those for alternative 1b. There would be no salt cake to dispose and, although there might be slightly less LLW to dispose in a LLW burial ground, there would be additional LLW to dispose at the offsite Federal waste facility. Eventually, the HLW would also be disposed in the Federal repository after processing into a terminal form--the amount depending on the specific process.

For alternative 3, all the HLW would be fixed in the existing tanks and would not need space in the Federal repository. The volumes of LLW and TRU wastes needing disposal would be much less because the buildings would not be dismantled and there would be no salt cake to dispose. To assess the long-term potential for water to leach chemicals from the concrete containing the HLW, the same groundwater model (Nucl. Safety Assoc. 1980) used for the radiological analysis was used to estimate potential drinking water concentrations. It was found that nitrate and chromium concentrations would be about ten-thousand times lower than the EPA limits of 10 mg/L nitrate-N and 0.05 mg/L chromium (U.S. Environ. Prot. Agency 1976) (Table 4.26). The concentrations of plutonium and uranium would also be about ten-thousand times lower than the maximum concentrations based on chemical toxicity (0.0008 mg/L for plutonium and 0.5 mg/L for uranium) (Dawson 1974) (Table 4.26). Worker injuries/deaths (9.8/0.11) for disposal would be much higher than for alternative 1a because it is assumed that there would be several persons remaining at West Valley for the 100 years of institutional controls to monitor and guard the entombed wastes and facilities.

Alternative 4a (delay 10 years) would simply postpone the disposal impacts. For alternative 4b (continued storage in tanks) new land at the West Valley site would be dedicated to new tanks every 40 or more years, totaling less than 4 hectares (10 acres) over the 100 years of institutional controls. Also, LLW would be continuously generated during safeguarding and monitoring of the HLW, the existing shutdown buildings, and the existing burial grounds. Land in the existing onsite burial area would be used for these LLW. To assess the long-term release of toxic chemicals from the liquid wastes in the tanks, the same groundwater model used for the radiological analysis was used to estimate the concentrations of potentially toxic chemicals. Nitrate concentrations are estimated to be about one hundred times less and chromium concentrations ten times less than the EPA limits (U.S. Environ. Prot. Agency 1976); plutonium concentrations are estimated to be ten times less and uranium concentrations one hundred times less than chemically toxic concentrations (Dawson 1974) (Table 4.26). Worker injuries/deaths (19.5/0.2) would be much higher than for alternative 1a because it is assumed that several persons would remain at the site for 100 years to carry out the monitoring, maintenance, and guarding that currently take place.

4.2.2 Socioeconomic Impacts

The direct socioeconomic impacts that are traditionally of greatest concern for construction/industrial projects (e.g., worker influx, local economy, community services) are not expected to be significant for any of the West Valley waste solidification project alternatives (Section 4.2.2.1). The land is already committed to nuclear activities. There would be some indirect socioeconomic impacts (such as fear and changes in governmental and social relationships) associated with public perceptions of radiological risks and inequitable distribution of such risks (Section 4.2.2.2). However, it is not clear which of the alternatives would be perceived to have the least risks by the entire affected public (at West Valley, along transportation routes, and at disposal sites). It is also not clear what mitigating measures might be taken with respect to the equitable distributions of risks.

4.2.2.1 Direct Impacts

Local Economy

Since the construction and required project design work and operations equipment would be specialized, there would be only limited opportunity for local or regional businesses to provide supplies and services. With respect to in-migration of workers, it is expected that none of the alternatives would have a significant impact. The work force would range from about 50 (no action, alternative 4b) to 500 (estimated upper limit for the action alternatives 1a, 1b, or 2). Based on experience at nuclear power plant projects (Malhotra and Manninen 1980), 15 to 35% or 75 to 175 workers can be expected to in-migrate into the local area. The workers would be dispersed among neighboring counties, mostly among the 1.5 million people in the greater Buffalo area, because (1) available local housing is limited, (2) there is relatively high unemployment in the Buffalo area (Section 3.1.6), (3) the influence of more rural surroundings is to increase the commuting distance, (4) the labor unions are headquartered in the greater Buffalo area, and (5) the majority of the 500 workers would be construction workers who have a greater tendency to commute than management personnel (Malhotra and Manninen

1980). Thus, the economic impact of a West Valley project would be diluted over a large area with a large population and would not be significant.

However, the specific work force composition (especially relative proportions of construction/nonconstruction, management/clerical, and scarce/nonscarce skills) is an important factor in predicting in-migration and associated socioeconomic impacts. Because details on work force composition will not be available until after an alternative is chosen and engineering plans are more complete, this prediction will have to be reviewed at a later date. If significant impacts are identified at the time, the Department will determine mitigative measures in cooperation with any communities adversely impacted.

Economic growth, including a government project, has the potential for altering a rural lifestyle. However, since none of the alternatives would require in-migration of large numbers of workers, and since the effects on the local economy would be very small, it is expected that none of the alternatives for the solidification project would have a noticeable impact on the rural nature of the area.

Local Taxes

The loss of tax revenues due to the former commercial operator (Nuclear Fuel Services) leaving the site is independent of the proposed waste solidification project. The State of New York is already committed to interim payments in lieu-of-taxes (Section 4.3.9) to help make up for the loss of tax revenues to Ashford Township, which currently account for nearly one-fifth of the township's tax revenues. These interim payments will allow time for Ashford to gradually cut expenses or develop new sources of revenue. None of the alternatives for the waste solidification project would restore the site or facilities to private industry with taxable status.

Public and Community Services

It is expected that there would be no great influx of workers for any of the alternatives, and, therefore, the project is not expected to overtax public and community services. Occurrence of a major accident under any of the alternatives could place great demands on local governments at all levels, but some of this impact could be mitigated by adequate emergency planning and financing (see Section 4.3.10, Emergency Preparedness). Special hospital facilities already exist for handling radiation cases. Part of the emergency planning for a solidification project would include reevaluation of the adequacy of these facilities.

Housing

Availability of housing in Cattaraugus County is limited, which would force many of the incoming employees to reside in adjoining counties. The new Highway 219 (controlled access/four lanes, partially completed at present) would facilitate commuting from the Buffalo metropolitan area for both these incoming employees and the workers from the labor unions. Although some demand on local housing would occur, probably benefiting the local market, most housing requests would be channeled outside the immediate area to areas where sufficient housing is available.

Cultural Resources

Currently, no systematic field study has been made of the West Valley property. However, in Section 3, it was pointed out that the plant site has a potential for containing prehistoric and historic cultural resources. Since the Department will use portions of the site already disturbed for industrial use, a cultural resource management program for the West Valley project property is not planned at this time.

4.2.2.2 Indirect Impacts

In the case of the proposed West Valley waste solidification project, some members of the public (U.S. Dep. Energy 1980d) have suggested some potential indirect socioeconomic impacts resulting from public perceptions of risks and effects of radioactivity. These include impacts on the local real estate market, on local tourism and recreation, and during an emergency. Additional general indirect impacts would include fear and changes in social and government relationships.

Before discussing these impacts, it is appropriate to discuss the problem of differences in perception between the public and technical experts. First, the public and technical experts tend to estimate risks differently. Technical experts tend to judge risks to be least for events that are rare and statistically improbable, whereas laymen tend to judge risks to be least for events whose postulated worst-case includes the fewest number of potential human fatalities, irrespective of the improbability of the event (Slovic et al. 1980). This divergence in perception is "one of the most important risk characteristics responsible for .... irresolvable disputes between experts and the public .... and the fear of nuclear power." For the technical assessment of risks in this EIS, the risks were determined by multiplying the consequences of an event times the probability that the event will occur. The total risks were obtained by adding the risks from normal operations to the risks from accidents. However, the public perception of risks will tend to focus only on the accident risks, specifically on the consequences of the theoretical accidents, irrespective of the probability of the accident. (The question of equitable distribution of risks is discussed in Section 4.2.2.3).

Second, with respect to concern for the potential health effects due to exposure to radioactivity, both the public and technical experts agree with the philosophy of the less exposure, the better. The "as low as reasonably achievable" policy of both the Department of Energy and the Nuclear Regulatory Commission is evidence of this. There is divergence, however, when some members of the public insist on supporting a requirement for zero release or zero exposure to radioactivity. Not only is the achievement of zero impacts technically impossible, but the majority of technical experts agree that very low levels of radioactivity present very little, but acceptable, risk to human health (Section 4.1). This concept of zero has become a dilemma for many areas of technology (Bradley 1980).

It is apparent that there would be risks and exposure to radioactivity for both the public and workers for any of the West Valley waste solidification project alternatives. However, it is not possible to predict the causes and effects of fear associated with the various alternatives for management of the West Valley HLW. It is not clear which of the alternatives would be perceived to have the least risks by the entire affected public (at West Valley, along transportation routes, and at disposal sites). Thus, technical assessments and public perceptions could be at odds for any of the alternatives, and there is no clear way to distinguish among the alternatives based on public perceptions of risks. Following is specific discussion on the previously identified potential indirect impacts.

Real Estate

Although some local people consider the local real estate market to be depressed and likely to get worse because of the presence of nuclear facilities at West Valley, this depressed condition is general for the region and there is no apparent correlation with proximity to West Valley. If there were a connection with public perceptions of risk, it might seem that the alternatives which call for the greatest removal of radioactive material from the West Valley site would have the most potentially positive effect on the local real estate market. However, there would be radioactive materials remaining at the site, subject to separate government decision making, under any of the alternatives (e.g., the two burial grounds, LLW treatment facility, and lagoons). Thus, it is not clear that any of the alternatives would significantly alter public perception of risks at the site.

Tourism and Recreation

It has also been suggested that the existence of nuclear activities at the West Valley site, particularly any accidents releasing even moderate amounts of radioactivity to the environment, will adversely affect local tourism and recreation. However, the experience in Pennsylvania after the Three Mile Island accident has shown that the area around the plant lost 1-6% of the anticipated number of tourists during the summer season following the accident. Preliminary figures for the 1980 tourist season indicated no continuing TMI-related impact (Pa. Gov. Off. Policy Plan. 1980). At any rate, there could be an accident under any of the alternatives, and, as noted previously, the public would tend to make judgements based on theoretical worst-case consequences rather than the improbability of an accident.

Safety-Related Social Impacts

There is no clear distinction among alternatives with respect to safety-related social impacts (see Sections 4.3.10, 4.3.11, and 4.3.12 for further discussion). For any of the alternatives, possible mitigative measures with respect to accident risks and impacts are of two types: (1) those measures that do, in fact, reduce actual risks--such as careful choice of contractors, quality assurance programs, safety procedures, security, monitoring, scheduling of operations to reduce conflicts, and implementation of emergency preparedness plans, and (2) those measures that reduce misinformation and increase credibility of individuals and institutions responsible for assessing, mitigating, and managing risks.

With respect to contractor selection, quality assurance, safety procedures, security, monitoring, and scheduling, the Department of Energy already has organizational capabilities and formal policies that have in the past served to avoid or reduce risks of accidents and that would be applicable to the West Valley solidification project. These subjects are discussed in Sections 4.3.10-

4.3.12. The Department envisions that it would have prime responsibility for developing onsite emergency-preparedness plans, whereas the State would coordinate offsite plans. The cooperative agreement between the Department and New York State provides that the State coordinate and integrate local, State, and Federal preparedness programs. Further mitigative measures would include providing funds and work force for the program, without unduly burdening local and state resources, and conducting appropriate practice emergency program tests.

The following are some measures that are intended to reduce misinformation and increase credibility. There should be promotion of candor and accurate and ample flow of information among the Department of Energy, other government agencies, and members of the public (Section 4.3.12.3). Means for accomplishing this might include regularly scheduled programs to inform both the general public and citizen groups of the program status and progress through the communications media, talks to local groups, school programs, and site tours.

4.2.2.3 Equity and Distribution of Risks

One major socioeconomic impact that has already been under review by Congress (U.S. House Rep. 1977; U.S. Gen. Account. Off. 1977) and was addressed in the special one-year study of West Valley facilities commissioned by Congress (U.S. Dep. Energy 1978a; Public Law 95-238) is the question of equity: specifically, the allocation of existing and future responsibilities among the Federal government, State of New York, and industrial participants. This question has been partially resolved by legislation (Public Law 96-368 and Public Law 95-224), particularly the financing of the proposed waste solidification project. As evidenced by allocation of 90% of the solidification project costs to the Federal government, Congress views the West Valley wastes as being largely a national responsibility. (The Federal government promoted the reprocessing activities that produced the wastes, and much of the fuel to be reprocessed came from defense production reactors.) However, the fact that New York must pay 10% of the costs is an indication that New York must assume some responsibility.

Although the question of distribution of financial costs has been addressed by Congress, there remain numerous questions regarding the distribution of risks associated with solidifying, storing, transporting, and permanently disposing of the West Valley wastes. From a social impact point-of-view, the risks of most concern are those related to the radiological nature of the wastes (the nature and probabilities of these risks are discussed in detail in Section 4.1 and Appendix B). For each of the alternatives discussed in this EIS, different people in different states at different times will bear different risks. Also, even though the West Valley wastes are largely a national responsibility, some states will not have to take any risks under any of the alternatives.

Distribution of Risks for Each Alternative

To date, the people living near West Valley in the State of New York and the workers at the site have borne all the risks associated with the storage of the liquid HLW in the tanks.

If the solidification alternatives 1a, 1b, or 2 were implemented:

- The people near West Valley would continue to bear the additional short-term risks associated with a few more years of storage of the HLW as a liquid, removal of the wastes from the tanks, solidification of the wastes, temporary storage of wastes generated during solidification, and final decontamination and dismantlement of the facilities.*

- Other people in New York State and in several other states would subsequently bear the short-term risks associated with transportation of the various radioactive wastes to offsite facilities.**

- Long-term risks associated with disposal of the LLW would be borne by the people residing in the vicinity of West Valley or the residents near a regional LLW burial ground.

- Future generations in other states would have to bear the long-term risks associated with permanent disposal of the HLW and TRU wastes in a Federal repository. (However, the purpose of disposal of the HLW in solid form in the underground repository is to make it extremely unlikely that humans might intrude into the wastes and to isolate the radioactivity from the environment.) These risks would decrease over time because of the radioactive decay of the wastes. For alternative 2, there would be an additional state that would have to bear the short-term risks associated with temporary storage and terminal-form processing of the HLW.**

- The solidification project workers of the current generation would bear the risks associated with exposure to radioactivity (higher individual exposures than the general population) in order to reduce the potential risks to future generations.

For alternative 3 (in-tank solidification), the distribution of risks would be substantially different from alternatives 1a, 1b, and 2:

- All of the radioactive wastes--including the solidified HLW, the LLW, and the wastes generated during solidification--would be permanently disposed at West Valley. Thus, the people living near West Valley would bear all the risks to future generations, both in the short term and the long term.

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*The existing State-licensed radioactive waste-burial grounds are not a part of the proposed solidification project. Future generations near West Valley would thus continue to bear the long-term risks associated with these burial grounds.

**There is also some spent fuel currently stored in the West Valley spent fuel pool. Disposition of this spent fuel is not considered to be a part of the proposed solidification project. However, this spent fuel would have to be removed and transported to some other state and temporarily stored before the spent fuel pool could be dismantled. The pool is considered to be part of the main process building that would be dismantled. Eventual removal of this spent fuel would be common to all the alternatives (see Section 4.4, Cumulative Impacts).

- Because of the form of the HLW (solidified in concrete) and the location (in the tanks near the surface), and because the buildings would be entombed instead of dismantled, the risks to future generations would be greater than in alternatives 1a, 1b, and 2 (additional risk because of water pathway and potential human intrusion, Section 4.1). These risks would be substantially reduced in about 300 years when most of the radioactive fission products had decayed away.

- People in other states would bear no risks associated with transportation and disposal of wastes.

- The solidification project workers of the current generation would not bear as much total risk (less exposure to radioactivity because the wastes would not be handled so much), but they would still be taking some risk in order to reduce the potential risks to future generations.

If alternative 4a (delay 10 years) were implemented:

- There would be an increase in the period of time that the people living near West Valley would have to bear the risks associated with storage of the liquid HLW in the tanks. However, if alternative 1a or 1b were implemented after a 10-year delay, the risks associated with temporary storage of the wastes might be reduced or eliminated because there would be more time to get a Federal repository and a regional burial area ready to accept the West Valley wastes directly, without temporary storage. The risks to workers would also be less because the wastes might not be handled so many times. Otherwise, the risks would be the same as those for whatever alternative was chosen after the 10-year delay.

For alternative 4b (continued storage as liquid in tanks for 100 years), the risks would also be substantially different from alternative 1a:

- People living near West Valley would continue to bear all risks, both short term and long term. Three times during the short term (100 years), the risks would be temporarily increased while the wastes were being transferred to new tanks.

- The total long-term risks to future generations would be greater than in the case of alternative 1a, primarily because there would be no institutional controls and no new tanks after 100 years. Thus, people might intrude into the wastes and be exposed to radioactivity. Also, the tanks would eventually corrode and release radioactivity to the environment. These risks would be substantially reduced in about 300 years after most of the radioactive fission products had decayed away.

- People in other states would bear no risks associated with transportation or disposal of wastes.

- Workers of the current generation would bear less risk than in alternative 1a, but workers of future generations would still have to take some risks when the liquid wastes were transferred to new tanks and during monitoring and maintenance of the shut-down contaminated facilities. After 100 years, there would be no institutional controls and, thus, no worker exposures to radioactivity.

Thus, for all the alternatives, there would be unequal distribution of risks with respect to: geographic location, time, and between workers and the public.

4.3 INSTITUTIONAL ISSUES

4.3.1 Standards for High-Level Waste Disposal

Both the Nuclear Regulatory Commission and the Environmental Protection Agency have regulatory responsibilities to ensure the safe handling and disposal of high-level radioactive wastes (HLW). The NRC has issued its final rule regarding licensing procedures for disposal of high-level radioactive wastes in geologic repositories (U.S. Nucl. Reg. Comm. 1981b) and a proposed rule 10 CFR 60 specifying technical criteria for siting, design, and performance of the repository as well as design and performance of the waste package (U.S. Nucl. Reg. Comm. 1981c). The EPA is drafting a proposed rule 40 CFR 91 on environmental standards and Federal radiation protection guidance for management and disposal of spent fuel, HLW, and transuranic wastes.

The Department of Energy has the responsibility to develop technology for the safe, permanent disposal of these wastes. The current philosophy for HLW disposal is to specify standards for a total waste package, of which waste form is only one aspect. A discussion of these responsibilities and a summary of the current status of regulations and of waste-form technology are given in Appendix B, Sections B.2.1 and B.4.2.

For any of the action alternatives (i.e., alternatives 1a, 1b, 2, and 3), the decision-making, detailed planning, and construction activities for the proposed West Valley waste solidification project must proceed in consonance with the development of waste standards and supporting technology. For these alternatives, this planning has already begun under the legislation for the West Valley HLW solidification project.

Selection of the waste standards and detailed planning for the West Valley waste solidification project will be very closely coordinated with, and based on, the latest developments with respect to HLW of the Environmental Protection Agency, Nuclear Regulatory Commission, and Department of Energy. It is unlikely that in-tank solidification of the West Valley wastes in cement (alternative 3) would meet the final standards.

For the delayed-action alternative 4a, there would be ten more years before any action is taken and, thus, ten more years for the waste standards to be finalized before the West Valley detailed planning begins and before the wastes are actually solidified.

For the no-action alternative 4b (continued storage in tanks), the waste criteria become a moot issue.

4.3.2 Transportation Regulations and Jurisdictions

The transportation of radioactive materials is subject to the regulations and jurisdiction of many Federal, state, and local authorities. All wastes generated during the waste solidification project will be subject to those controls.

Four Federal agencies that have significant jurisdiction over shipments of radioactive materials are the Department of Transportation, the Nuclear Regulatory Commission, the Interstate Commerce Commission, and the Department of Energy:

- The Department of Transportation (DOT) has primary responsibility for issuing regulations for the safe transportation of all hazardous materials, including radioactive materials. The DOT regulations apply to all shippers and carriers of radioactive materials except for shipments made on Federal government vehicles.

- The Nuclear Regulatory Commission (NRC) issues additional regulations for certain highly radioactive materials such as spent fuel and HLW. Those regulations apply to all NRC licensees. The NRC regulations also apply in certain cases to commercial carriers.

- The Interstate Commerce Commission regulates rates, charges, and conditions of truck and rail services operating in interstate commerce.

- The Department of Energy exerts operational control of the shipment activities of its "government-owned" contractors. Except for shipments made on government-owned vehicles, all Department shipments are subject to DOT regulations. By the Department's own internal directives, the additional safety standards imposed by NRC also apply to Department shipments, although the administrative requirements of NRC do not apply.

Although some memoranda of understanding between the various Federal agencies have been negotiated to clarify the overlapping jurisdictions, there are still several areas that are not clear relative to the West Valley project.

Several state and local governments have issued regulations and passed statutes that impose restrictions on shipments of radioactive materials. Although the U.S. Congress has, by statute, given DOT preemptive regulatory authority over state and local jurisdictions in the matter of transportation of radioactive materials, many state and local authorities have challenged DOT's authority in that regard. In some cases, DOT has legally ruled against the state and local jurisdictions. In one such case, the city of New York has filed suit against DOT, challenging DOT's ruling. The intent of Congress seems clear in its preamble to the enabling DOT legislation: states and cities are not to impose any regulations or laws that are inconsistent with DOT regulations. Until the challenges are dealt with, perhaps by further Congressional legislation, the degree to which shipments from West Valley are adversely affected by state and local restrictions is not known.

It is also not totally clear just what effect the carriers' tariffs and operating restrictions will have on West Valley shipments. Air and water shipments are not being seriously considered; highway carriers seem willing to transport nuclear materials without undue restrictions. The nation's railroads have been engaged in litigation with industrial and governmental shippers by rail for nearly 10 years. At one time, the railroads refused to carry spent fuel or HLW except under special train conditions, with commensurate high tariffs, and some railroads refused to carry them at all. The Interstate Commerce Commission has ruled against the carriers in each case, and the Federal courts have upheld the shippers. However, the rail carriers are still persistent in their demands for special trains and high freight rates. Further litigation is likely, although the railroads have apparently given up their alleged right of refusal to carry nuclear shipments.

Questions have also been raised as to whether certain railroads are safe enough to carry hazardous materials of any kind. Roadbeds, especially in the East, and railroad-owned railcars are often below standards. Because shipping casks for spent fuel and HLW are designed to withstand serious rail accidents, this should not present a real problem. Railcars are also specially built and maintained to provide increased safety assurances.

It should be pointed out that 1997 is the projected date for the availability of a Federal repository for disposal of the solidified West Valley HLW and TRU wastes (Section 4.3.3). For purposes of analysis in this EIS, it is assumed that the earliest date for availability of a regional burial ground for the West Valley LLW would be 1990. Over the next ten or more years, the laws and regulations governing the transportation of radioactive wastes can change, and perhaps some of the jurisdictional problems will be resolved. At this time, there are no clear differences between alternatives 1 and 2--that is, between the terminal waste-form alternative and the interim waste-form alternative--with respect to the jurisdictional problems and regulations for transporting the radioactive wastes generated during the proposed project. For alternative 3 (in-tank solidification) and alternative 4b (continued storage in tanks), there are no issues related to transportation because no wastes would be shipped offsite. For alternative 4a, there would be a delay of at least 10 years during which time the institutional issues could be resolved. The reader is referred to Appendix B, Section B.5, for further discussion of this subject.

4.3.3 Availability of a Federal Repository

The Department of Energy has decided to adopt a strategy to develop mined geologic repositories for disposal of commercially generated high-level and transuranic wastes (U.S. Dep. Energy 1981a, 1981c).

Implementation of this national waste disposal strategy will result in the establishment of operating geologic repositories. The exact date of operation depends upon a number of variables, which will be determined only by the outcome of existing programs. Examination of potential repository sites in a variety of geologic environments with diverse rock types might indicate that a site in bedded or dome salt is preferred for the initial repository, since the construction time for a repository in salt could lead to the operation of a repository in 1997. On the other hand, if further examination indicates that a repository in hard rock (such as granite) would be preferable, construction in that medium would require more time before the operation of a repository could begin. Furthermore, allowances made for other uncertainties--such as the time required for licensing proceedings or for collection of more extensive preliminary data than currently planned prior to the licensing proceedings--could result in further delay of initial repository operation.

For this EIS, it was assumed that a Federal repository would be available to receive solidified wastes in 1997. The alternatives most affected by the availability of a Federal repository with regard to time are the terminal waste-form alternatives 1a and 1b (see Section 2). If a repository is not available until some time after 1997, the period of temporary storage of the solidified wastes at West Valley would be extended, possibly by 20 years. This would not significantly alter the environmental impacts (Section 4.1) of these alternatives, nor would it alter the overall comparison among alternatives. Alternative 2, leading to an interim-waste form, would be affected more by the availability of an offsite Federal waste facility for converting the interim form to a terminal form than by the availability of a Federal repository. Alternative 3 (in-tank solidification) and alternative 4b (continued storage in tanks) would not be affected by availability of a Federal repository, but under either alternative the site would become a defacto repository. For the delayed-action alternative 4a, the time would not be so constraining. Action would not begin for 10 years or more, and the earliest the wastes could actually be solidified would be in the late 1990s. If the repository was still not available in 1997, there would be a need for temporary onsite storage as in alternative 1a.

4.3.4 Participation by the U.S. Nuclear Regulatory Commission

The State of New York and the commercial operator at West Valley, Nuclear Fuel Services, were jointly licensed by the U.S. Nuclear Regulatory Commission to operate the nuclear fuel reprocessing facilities. In accordance with the legislation for the proposed waste solidification project, the State of New York and the Department of Energy submitted an application to the Nuclear Regulatory Commission for a licensing amendment providing for the demonstration [Public Law 96-368, Section 2(b)(4)(D)]. A license amendment, providing for transfer of the facilities to the Department for the duration of the demonstration project, was granted in September 1981 (U.S. Nucl. Reg. Comm. 1981a). In addition, the Department of Energy and the Nuclear Regulatory Commission entered into an agreement which provides that "review and consultation by the Commission pursuant to this subsection shall be conducted informally by the Commission and shall not include nor require formal procedures or actions by the Commission pursuant to the Atomic Energy Act of 1954 ..." [Public Law 96-368, Section 2(c)(1)]. After the Department of Energy makes a decision and submits a plan for the waste solidification project, the Nuclear Regulatory Commission is to comment on the plan. Then, if the Department of Energy "does not revise the plan to meet objections specified in the comments of the Commission, the Secretary shall publish in the Federal Register a detailed statement for not so revising the plan" [Public Law 96-368, Section 2(c)(1)]. Details of the official interactions have been worked out in the Memorandum of Understanding between the Department and Commission (U.S. Dep. Energy 1981d).

4.3.5 Disposal of Toxic Substances (Nitrate Salt Cake)

During the course of environmental analysis for disposal of the salt cake produced in the separated salt/sludge option leading to a terminal waste form (alternative 1a), some question arose as to the potential chemical toxicity of this LLW because of its high content of nitrate salts. Since this salt cake would be slightly radioactive, its disposal would be in accordance with applicable licensing requirements. The chemical toxicity of LLW has been studied by the Commission (U.S. Nucl. Reg. Comm. 1980), but nitrate salt-cake wastes were not considered. The Environmental Protection Agency does not have specific criteria with respect to disposal of nonradioactive nitrate salts. However, the Agency does have criteria with respect to the concentrations of nitrate-nitrogen (N) for domestic water supply: specifically, levels should not be greater than 10 mg/L of nitrates as nitrogen (U.S. Environ. Prot. Agency 1976).

Because the quantity of salt cake (mostly sodium nitrate) to be disposed would be large and because it would be slightly radioactive, strict criteria would have to be applied to the disposal of this waste in a regional burial ground. One important consideration for burial of the salt cake would be prevention of any significant contact by water that might carry radioactive materials away from the burial site. (See Section 4.2 for a discussion of potential impacts and possible mitigative measures.)

4.3.6 Interaction with Indian Tribes and Canadian, New York State, and Local Governments

The interaction of the Department of Energy with the State of New York is spelled out in the West Valley legislation (U.S. Congress 1980) and in the U.S. Department of Energy/New York State (1980) cooperative agreement.

It is expected that, under normal conditions, there would be no significant impact on Indian water, air, land, people, etc. Although one tribe, the Cattaraugus, is located downstream from West Valley, the liquid effluents would be in compliance with existing State and Federal regulations and should not significantly affect downstream users. Under conditions of a major accident involving release of radioactivity to the environment, the tribal government would be brought into the emergency response activities (see Section 4.3.10). The tribes in western New York will be provided copies of this EIS and other project documents.

The Department will interact with local governments on an ongoing basis. These governments will be on the project mailing list. They will also receive notices of meetings and copies of any status reports. The emergency planning will be coordinated with local authorities (Section 4.3.10).

It is expected that under normal conditions for any of the alternatives, there would be no major interaction between the U.S. Department of Energy/New York State and the Canadian government since there should be no significant impacts to Canadian water, air, land, people, etc. The Canadian government will be kept abreast of the West Valley activities through distribution of material to the Great Lakes Water Quality Board of the International Joint Commission. Under conditions of a major accident involving release of radioactivity to the environment, the Canadian government would be brought into the emergency response activities (see Section 4.3.10).

It is expected that these interactions would be similar for any of the alternatives for the West Valley waste solidification project.

4.3.7 Insurance/Liability

Section 170(d) of the Atomic Energy Act of 1954, as amended by Public Law 85-256 (the "Price-Anderson Act") authorizes the Department of Energy "to enter into agreements of indemnification with its contractors for the construction or operation of [nuclear] production or utilization facilities...." The Department has determined that the proposed West Valley solidification facilities qualify as a "production facility" as defined in department procurement regulations (U.S. Dep. Energy 1979). Thus, under the terms of the contract for operation of the West Valley solidification facility (U.S. Dep. Energy 1981b), the Department agrees to indemnify the contractor or any other persons who may be liable for public liability up to $500 million against claims arising out of, or in connection with, the contractual activity. The indemnity applies to covered nuclear incidents that (1) take place at a contract location, (2) arise out of, or in, the course of transportation of source, special nuclear, or by-product material to or from a contract location, or (3) involve items produced or delivered under the prime contract. This agreement is without limitation relating to availability of funds and without reference to any exception based upon misconduct, bad faith, or negligence on the part of the contractor or subcontractor.

4.3.8 Acceptance of the Wastes by Other States

The question of whether other states would accept wastes from the proposed West Valley solidification project arose during the scoping process. Several states have already taken initiatives to prohibit or limit both disposal and transportation of radioactive wastes from other states (U.S. Nucl. Reg. Comm. 1981d, Green and Zell 1980). The legalities of these initiatives (especially Federal versus states' rights) will likely be unresolved for some time. Also, how each state may specifically view the West Valley wastes cannot be determined. Some states may take a very narrow viewpoint and not allow transportation, disposal, storage, or processing because New York has legal title to the wastes. Under the recent West Valley legislation, New York will not relinquish title to the wastes, and the U.S. Department of Energy is specifically forbidden to take title to the wastes. Furthermore, states may change their positions when regional compacts for LLW disposal are negotiated.

This question of acceptance by the states is especially important for alternatives 1 and 2, since the high-level, TRU, and low-level wastes generated during the solidification project would be transported through and disposed of in other states. For alternative 2, there would be an additional issue in that solidification of the HLW to an interim form would be followed by temporary storage and a second processing of the interim form to the terminal form in another state, with additional generation of TRU and low-level wastes. For alternatives 3 and 4b, this institutional question would not be a problem since all wastes would remain at the West Valley site. For alternative 4a, there would be 10 more years for this institutional issue to be resolved. This question is addressed further in Section 4.2.2.3 under the discussion of equity.

4.3.9 Payments In Lieu of Taxes

On June 4, 1980, Governor Hugh Carey of New York signed Assembly Bill No. 8193-B relating to temporary waste repositories. Among its provisions, the statute included a new section, added as an amendment to the Public Lands Law, authorizing payments to provide State aid to offset the decrease in tax revenue that has occurred as a result of the discontinuation of private ownership of some of the facilities at the Western New York Nuclear Service Center. This State aid is to be equal to the amount levied against the facilities on the last assessment roll completed in 1980. Thus, there would be interim relief for the local government, but none of the alternatives for the proposed West Valley waste solidification project envisions having any of the property or facilities under private ownership with taxable status.

4.3.10 Emergency Preparedness

Emergency preparedness will be very important with respect to mitigating the effects of any potential accidents or other hazardous incidents during the solidification project. This applies to activities at West Valley as well as to activities away from West Valley. The emergency preparedness effort will be directed at potential situations that may cause, or threaten to cause, hazards affecting the safety and health of both workers and the public or resulting in damage to the environment or property. For the West Valley project, radiological hazards will be of prime concern.

Currently, although the site is still in a safe shutdown condition, the emergency plan is still in effect that was set up under the Nuclear Regulatory Commission's requirements for the Nuclear Fuel Service's reprocessing activities (under 10 CFR 50). After a decision is made among the alternatives for the proposed waste solidification project and after detailed project plans become available, a new emergency plan will be prepared to comply with Department regulations and to be compatible with New York State's emergency plan and any applicable regulations of the Federal Emergency Management Agency and the Nuclear Regulatory Commission. No major activities will take place until this plan is ready.

For alternative 1a, the emergency plans for project construction and operations at the West Valley site would be under the joint jurisdiction of the Department of Energy and the State of New York. The Department would take the lead role for onsite activities, the State for offsite activities. Construction and operation activities would be carried out under a prime Department contractor (see Section 4.3.12). It is the Department's policy to have major contractors be responsible for planning and implementing emergency measures within the site boundaries. The contractor would also be responsible for planning for incidents that might have an impact beyond the site boundaries. This overall plan would delineate arrangements and agreements among the contractors, local authorities, State and Federal agencies, and the Canadian government, as appropriate. The Department will ensure that the contractor's emergency plans and response capabilities meet all appropriate standards and provide adequate protection.

Currently, there are numerous changes being made in the guidance and criteria for emergency preparedness plans. The current Department guidance documents include the DOE/ERDA Manual (U.S. Energy Res. Dev. Admin., undated) and 10 CFR 50 (U.S. Nucl. Reg. Comm., undated). As a result of the Three Mile Island reactor accident, a new document titled "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants" has been issued by the U.S. Nuclear Regulatory Commission and Federal Emergency Management Agency (1980). Although this document was prepared for nuclear power plants, the basic philosophy of emergency preparedness will be applicable to the proposed activities at West Valley.

Both the Department and its contractors will use this document as guidance in preparation of the solidification project emergency plans.

The emergency plan will include the following general categories:

1. Assignment of responsibility (organizational control, both onsite and offsite)
2. Emergency response support and resources
3. Emergency classification system
4. Notification methods
5. Emergency communications
6. Public education and information
7. Emergency facilities and equipment
8. Accident assessment
9. Protective response
10. Radiological exposure control
11. Medical and public health support
12. Recovery and reentry planning and post-accident operations
13. Exercises and drills
14. Radiological emergency response training
15. Responsibility for the planning effort: development, periodic review, and distribution of emergency plans.

The Department also has a Radiological Assistance Plan (RAP) for each region. The West Valley project is located in Region 1 under the jurisdiction of the Department's Brookhaven Area Office. Department resources, such as the Lawrence Livermore Laboratory's Atmospheric Release Advisory Capabilities (ARAC) services (Knox et al. 1980), can be called upon to support a response to an incident at the West Valley facility (see also Section 4.3.11, Security and Safeguards).

It should be noted that emergency plans and response procedures will also be required to cope with other types of onsite emergencies--such as fire, personal injury, and adverse weather conditions. In addition, since the reference alternative would involve handling of toxic chemicals (e.g., during decontamination) and oil (e.g., emergency generators, construction equipment), a Spill Prevention Control and Countermeasures (SPCC) plan will be developed (40 CFR 112). Emergency response procedures will also be developed under the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 1510) to deal with any offsite releases.

Funding for the emergency planning and response capabilities will be part of the overall project costs, which are funded 90% by the Federal government (Congressional appropriations) and 10% by the State of New York.

Alternative 1a would also involve many offsite shipments of radioactive wastes: assumed 4800 km (3000 miles) to a Federal repository for the solidified HLW and the TRU wastes and 640 km (400 miles) to a regional burial ground for the LLW and salt cake. Regulations governing the transportation of these wastes are discussed in Appendix B, Section B.5. If an accident occurred during transportation, the emergency plan for whatever state the accident occurred in would be activated. Also, the Radiological Assistance Plan (RAP) and the Federal Interagency Radiological Assistance Plan (IRAP) would be available to support the state's response effort. The state and Federal plans could be activated at any time of the day or night.

For alternative 1a, all the radioactive wastes generated during the solidification project would be disposed offsite. The HLW and TRU wastes would eventually be placed in a Federal repository when it became available. The Department will have separate emergency plans for this repository. The LLW and salt cake would be disposed in a regional burial ground. It is expected that the state having this regional burial ground will have primary responsibility for emergency planning at the burial site.

The emergency planning for alternative 1b would be the same as for alternative 1a. For alternative 2, there would be an additional need for emergency planning at the offsite facility for storing/handling/processing the interim-form wastes into final form. These activities would be a very small addition to the activities at a Federal waste-processing facility. Potential emergencies at the small additional facility for the West Valley wastes would be included in the overall emergency planning for the Federal waste facility.

For alternative 3, emergency planning at West Valley would be the same as for alternative 1a. However, there would be no transportation and disposal of wastes offsite and, thus, no need for related emergency planning.

For alternative 4a (delay 10 years), current emergency plans would remain in effect until an action alternative is chosen. For alternative 4b (continued storage in tanks), the Department would not be involved in emergency planning since there would be no solidification project. The site owner, New York State, would be responsible for emergency planning.

4.3.11 Security and Safeguards

4.3.11.1 Oversight of Security Functions

Currently, the West Valley facilities are being maintained in a safe shutdown condition under a new safeguards and security system (carried out by the new site operator [West Valley Nucl. Serv. Co. Inc. 1982]). For the proposed waste solidification project, the Department of Energy, Safeguards and Security Division, has primary responsibility for defining security requirements at the West Valley site. The facility will be surveyed, at least annually, to evaluate the adequacy of physical protection provisions. In addition, surveys will be conducted as often as is necessary to maintain a high standard of performance The Department currently operates sites containing radioactive waste burial grounds, spent fuel pools, and chemical processing facilities. Department policies that apply to those site activities will be applied to the West Valley operations.

4.3.11.2 Planning Philosophy

The proposed solidification project will have a graded safeguards and security system for protection of radioactive materials, special nuclear materials, classified information, and property. Standards and requirements, which are specified in several Department Orders that are periodically updated, provide the basis for a system of deterring, preventing, responding to, and effectively counteracting the malevolent perpetration of harmful acts such as onsite radiological sabotage or theft of radioactive materials.

The philosophy for protection against sabotage/theft at the West Valley site will be clearly one of prevention.

The consequences of onsite sabotage or theft are very strongly dependent on the waste form and site location.

4.3.11.3 Alternative 1a

West Valley Nuclear Services Company, Inc., has been selected by the Department of Energy as the site operator. The company has established a security organization to provide for the training and equipping of qualified personnel in accordance with Department orders and directives and will develop a Safeguards and Security Plan to deal with special nuclear materials, radioactive materials, personnel, facilities, and equipment in a normal operating environment.

Protection of the West Valley facilities from acts of violence, destruction, theft, or sabotage will be enhanced by onsite physical security and by controlled access to the site. About 100 hectares (250 acres) of the 1355-hectare (3345-acre) site is the fenced-in protected area. The fence will be equipped with security devices such as closed-circuit television and night lighting. Control over areas adjacent to the fence will be provided by periodic patrols. Access to the protected area will be limited and controlled by armed security personnel. Controls will include techniques such as badges, searches, security clearances, and escorted visitors. Employee vehicle parking will be outside the fence. Security monitoring will be provided from a special communications center that will be manned 24 hours per day. This center will have radio and telephone channels for communication with security personnel and with local law enforcement agencies. It will be equipped with emergency power and alarms, and all equipment will be periodically tested.

Response to security incidents will be handled by the onsite security force, supplemented as necessary with response from local law enforcement agencies, the New York State Police, and the Federal Bureau of Investigation (FBI). The FBI will assume operational control of all major security incidents. The FBI and the Department of Energy will put into effect a preplanned crisis-management system that will be in direct communication with several resources and will be coordinated with the site emergency plan.

Offsite shipment of radioactive wastes will conform with appropriate Department security requirements for shipments of irradiated materials. Primary responsibility for security during transportation will be that of the shipper. Upon arrival at either a Federal repository or a regional burial site, security will become the responsibility of the receiver. In the event of a security incident in transit, the response will be the same as previously described under the emergency preparedness program.

4.3.11.4 Security Requirements for the Other Alternatives

Safeguards and security requirements would be about the same for alternatives 1 and 2. The level of protection required for alternative 3 (in-tank solidification) would be less when correlated with the possible consequences; in addition, no offsite transportation would be involved. Alternatives 4a and 4b would require a medium level of safeguards and security to oversee the site and the HLW. However, this protection would be the responsibility of the State of New York and not the Department since there would be no solidification project.

Except for the option of fused salt (which would require a higher level of protection because of the interim form), none of the various options to the above alternatives would significantly alter the level of safeguards and security.

4.3.12 Selection of Contractors and Quality Assurance

Many citizens' concerns about environmental, health, and safety issues relate to the planning and management of the proposed waste solidification project. These citizens seek to ensure that procurement decisions reflect an awareness of the potential environmental, health, and safety impacts and that monitoring and quality assurance programs provide for the adjustment of mitigating measures as necessary.

For all the action alternatives (1, 1b, 2, and 3), the quality assurance program would be administered by the Department of Energy through the site operator. Under current legislation, the Department would not be involved for the no-action alternatives (4a and 4b).

The Department will perform annual environmental, health, safety, security, and property management appraisals and procurement reviews to evaluate the contractor's performance, progress, and conformance with its contractual obligations. The contract with West Valley Nuclear Services Company, Inc., a wholly-owned subsidiary of the Westinghouse Electric Corporation (U.S. Dep. Energy 1981b), is a cost-plus-fixed-fee contract, with an option for the Department to convert to a cost-plus-award-fee incentive-type contract. Should the Department exercise its option to convert to an incentive-type contract, the award fee evaluation criteria would be in accordance with established Department procedures (U.S. Dep. Energy 1978b).

An effective Quality Assurance Program will be implemented during the initial planning phase of the alternative selected and continue through final cleanup. This program will provide the administrative controls and quality assurance provisions necessary to ensure that all activities are carried out in a systematic and controlled manner, to minimize risk to the health and safety of personnel.

The Quality Assurance Program would encompass all quality-related activities including design, fabrication, inspection, testing, operations, maintenance, and shipping.

4.3.12.1 Operations

The potential for adverse environmental impacts will be greatest during the operations phase of the project. Therefore, in the spirit of the National Environmental Policy Act and accompanying Council on Environmental Quality (1978) regulations, this EIS has been prepared very early in the decision-making process.

The Department will obtain any necessary environmental, health, and safety permits and will also prepare the Safety Analysis Report. After all permits, reports, and concurrences are finalized, the contracting officer will authorize construction and/or operations activities to begin. The Department will monitor compliance with environmental, safety, and health requirements until ultimate completion of the project, project closeouts, certification of the site, and return of the facilities to the State of New York. Finally, the Department will certify the environmental condition of the site. All contract closeouts will then be finalized.

4.3.12.2 Citizen Participation

Citizens were invited to present their comments on the scope of the EIS and had an opportunity to comment on the draft EIS. This type of public participation is called for under regulations of the Council on Environmental Quality (1978) for implementing the National Environmental Policy Act.

Normally, there is no provision for direct public participation in the Department's procurement activities and no provision for routine public participation in project implementation activities. However, the Department intends to fully inform the public about the West Valley Demonstration Project. It has assigned its operating contractor, West Valley Nuclear Services Company, Inc., the responsibility for implementing a public communications program. In addition to providing information about the project to the public, the program will be sensitive to local citizen concerns. Specific facets of the program are to be based on meeting the information needs of the community as they are assessed, to achieve balanced and informed public interaction with the project.

In addition to direct interaction with the community and its leaders, the following specifics are included as part of the communications program:

- Assessment of community information needs and concerns
- Project fact sheets
- Employee speakers bureau
- Facility open house and tour
- Media involvement

4.3.13 <u>Seismic Criteria</u>

The question of what seismic criteria should be applied to the proposed waste solidification project has been discussed in Appendix B, Section B.3.1.1. This question is especially relevant to alternatives 1a, 1b, and 2 where there would be extensive operations within the existing processing building or in a new facility (Section 2.2.1). Although these criteria will probably not be resolved by the time one of the alternatives must be chosen for the waste solidification project, appropriate design criteria will be established by the Department and safety analyses will be performed to verify compliance with such criteria. It appears at this time that use of the existing building may be acceptable. However, since uncertainties remain, further detailed safety analyses will have to be made when more detailed design/operations information becomes available. If the likelihood of an accident proves to be unacceptable, structural modifications of the existing building or construction of a new building would be required. This may delay start of the solidification project. For alternative 3, the question of seismic criteria is not as significant an issue. For alternatives 4a and 4b, there would be a delay of at least 10 years during which this institutional issue would be resolved.

4.3.14 Spent Fuel Storage

As discussed in Section 1.5.1, the Department is no longer considering use of the existing West Valley spent fuel pool in an away-from-reactor (AFR) spent fuel storage program. However, for alternatives 1a, 1b and 2, there would still be some institutional issues regarding the spent fuel storage that would need to be resolved before these alternatives could be implemented. Under these alternatives, it was assumed that the entire main processing building, including the existing spent fuel pool, would be dismantled. Thus, the spent fuel that is currently being stored in the pool would have to be removed and transported to some other site for either disposal (e.g., in the Federal repository) or further storage. There will, therefore, have to be some negotiations among the owners of the fuel, the State of New York, the Department of Energy, and the appropriate authorities at the site to which the fuel would be shipped.

For the terminal waste-form alternative 1a, there is an option to use the existing fuel pool to store the solidified HLW until a Federal repository is available rather than use a new temporary HLW storage facility. This could be accomplished while leaving the existing spent fuel in the pool. (There may not be sufficient space in the pool to store the larger volume of HLW produced under alternative 1b.)

For the in-tank solidification alternative 3, no institutional conflict between the waste solidification program and spent fuel storage is apparent. The spent fuel pool could continue to be used for storing the existing spent fuel while the rest of the facility was decontaminated and entombed. Eventually, the fuel would be removed.

For alternative 4a (delay 10 years), there would be more time to resolve any institutional issues, and for alternative 4b, there is no apparent conflict.

4.3.15 Availability of a Federal Waste Processing Facility

The completion of alternative 2 (interim form) is contingent on the availability of a Federal waste processing facility for converting the interim-form wastes to a terminal form suitable for disposal in a repository. Such a facility may be located at any of the Federal sites that have large amounts of HLW. Currently, a final environmental impact statement has been issued for a defense waste processing facility at the Savannah River Plant in Aiken, South Carolina (U.S. Dep. Energy 1982). A decision has not yet been made regarding this proposed facility, and Congress has not approved funding for the project. In addition, this facility would not have provision for handling, storing, transferring, and processing West Valley interim-form wastes. If alternative 2 were implemented, there is a possibility that the interim-form wastes would have to stay in storage somewhere for many years until a Federal waste-processing facility became available.

4.3.16 Compliance with the West Valley Demonstration Project Act

Alternatives 1a and 1b would comply with the West Valley Demonstration Project Act (Appendix C). Alternative 2 would not comply because the West Valley facilities would not be used for preparing the wastes for disposal; they would be used only for preparing the wastes to an interim form for shipment and later offsite preparation for disposal. Alternatives 3 and 4b would not comply with the Act, primarily because the wastes would not be solidified and transported to a repository. Alternative 4a would also not comply with the Act because this alternative only delays the decision regarding disposition of the HLW.

4.4 CUMULATIVE IMPACTS

Implementation of any of the alternatives will result in additional impacts not directly related to any specific alternative but which may have a cumulative impact in the forseeable future. The cumulative impacts associated with any of the alternatives are those associated with maintenance of the remainder of the site and disposition of the spent fuel. Although the Department of Energy had been considering use of the West Valley fuel storage pool in an Away-From-Reactor (AFR) storage program, the Department is discontinuing its efforts to provide Federal AFR spent fuel storage. The Department is increasing its efforts on spent fuel storage to develop technologies that will allow utilities to increase spent fuel storage capacities at reactor sites. Thus, there are no cumulative impacts with AFR fuel storage at West Valley.

The spent fuel storage pool at West Valley currently contains about 165 MTU of spent fuel. It is not necessary for this fuel to be removed from the existing storage pool to allow solidification of the liquid HLW. However, it is not feasible to decommission the existing facility by dismantlement (as assumed in alternatives 1a, 1b, and 2) with the fuel still in storage. Hence, the impacts associated with removing this fuel and transporting it 1600 km (1000 miles) to a storage pool are given to indicate the magnitude of these impacts. Since this fuel will have to be removed from West Valley at some time for all alternatives, these impacts are applicable to all alternatives considered in this EIS. However, the time at which these impacts occur could vary.

In assessing the environmental impacts associated with movement of this fuel, it has been assumed that the fuel is transported by truck to a storage pool 1600 km (1000 miles) from West Valley. The occupational dose for this movement is estimated to be about 150 person-rems--about 50 person-rem for loading the fuel into shipping casks at West Valley, 60 person-rem during transit, and 40 person-rem to unload the fuel at the storage facility. The population risk is estimated to be about 19 person-rem, primarily to the population along the transport route. The nonradiological impacts from this transportation would be similar to those given in Table 4.23 for atmospheric pollutants. About 1 injury and no deaths would result from this transport.

The environmental impacts associated with maintenance of the site consist of an annual occupational dose of 16 person-rem and an annual population dose of 0.55 person-rem (see Appendix B, Section B.7.3.1). These impacts will continue to occur indefinitely until actions are taken by the responsible agency to clean up the site.

4.5 MITIGATIVE MEASURES

Following is a discussion of additional measures that might be taken to avoid, reduce, or otherwise mitigate the predicted environmental impacts. Mitigative measures will be detailed further in the Department's record of decision to be published in the Federal Register after one of the alternatives is chosen.

4.5.1 Mitigative Measures Common to All Alternatives

4.5.1.1 General

The most effective general mitigative measure is to have a sound management and quality assurance system for all stages of a project, from design through procurement, construction, operation, and final cleanup. The Department of Energy has a formal system that provides for consideration of environmental, health, safety, and socioeconomic factors throughout all phases of a project (U.S. Dep. Energy 1980a, 1980b). Certain aspects of this system (emergency preparedness, security and safeguards, selection of contractors, and quality assurance) are discussed in more detail in Section 4.3.

Environmental monitoring is a mitigative measure in the sense that it can identify impacts which may need mitigation. Monitoring would be the responsibility of the Department of Energy and would be carried out by the operating contractor in cooperation with the New York State Department of Environmental Conservation. With respect to the ongoing maintenance activities at the site, the Department conducted an industrial hygiene and safety audit and an environmental and occupational safety review in October 1981 in preparation for its takeover of the site. In general it was found that the existing environmental and personnel monitoring is thorough and that the facility is in reasonably good condition with regard to safety. However, there is a need for updating some of the procedures and equipment, and some conventional (nonradiological) safety matters need corrective action. A security review has been conducted.

Preoperational monitoring of the site would begin at least one year prior to initiation of any significant action. Its purpose would be to (1) establish background levels of radioactivity, nonradioactive pollutants, and toxic materials, and (2) identify specific pathways for human exposure and/or environmental stress as a basis for determining the nature of the subsequent operational environmental monitoring program. The operational monitoring program would determine (1) whether containment and control of site operations are functioning as planned, (2) whether and to what extent environmental levels of radioactivity released from the site comply with the Department's policy and applicable standards, and (3) the overall impact of operations on the environment. Quality assurance with respect to sampling and analytical procedures, data processing, and reporting would be an integral part of the program.

In addition to review within a project, an effective mitigative measure can be independent review from outside the project. Thus, in addition to independent Department reviews and audits, the West Valley legislation has provided for consultation and review of the solidification project by the Nuclear Regulatory Commission.

4.5.1.2 Radiological

Exposure of workers to radioactivity can be mitigated by careful training, monitoring, inspections, record-keeping, and constant striving to keep exposures as low as reasonably achievable. Furthermore, proper management and quality assurance programs can lower the probability and/or consequences of accidents. The details of a worker training/monitoring program will be determined after an alternative is selected, taking into consideration specific design and engineering details. This program will be implemented before any activities are undertaken that might expose workers to radiation.

To be consistent with the recent U.S. Environmental Protection Agency draft guidelines on disposal of radioactive wastes, it was assumed that there would be no institutional controls after 100 years for all the alternatives. The predicted impacts thus include the risks of human intrusion into the wastes and migration of radioactive materials from the wastes after 100 years. One possible mitigative measure with respect to the risk of human intrusion is to have some institutional controls for a longer period of time until the radioactive fission products (which account for most of the radioactivity) decay away. The hazard to a potential intruder after 300 years would be much less than at 100 years. Furthermore, institutional controls such as monitoring would allow time for corrective measures to be taken before any significant migration of radioactive material to the biosphere occurred.

4.5.1.3 Social

There are no clear mitigative measures regarding the social impacts associated with public perception of risks. It is possible that measures which reduce misinformation and increase credibility (e.g., candor and accurate and ample flow of information) may mitigate some of these problems. The Department is drafting a plan for public interaction in the West Valley solidification project, which will be available in the near future (see Section 4.3.12.2). With respect to the inequitable distribution of risks, some mitigation may be achieved by negotiations among various parties taking various types of risks.

If ongoing environmental review during the project identifies any significant socioeconomic impacts due to worker influx, the Department will determine mitigative measures in cooperation with any communities adversely impacted.

4.5.2 Mitigative Measures Specific to Certain Alternatives

4.5.2.1 Transportation (Alternatives 1a, 1b, and 2)

Most of the short-term radiation doses to the general population for alternatives 1a, 1b, and 2 are due to transportation of radioactive materials. The levels of radioactivity at the surface of transport vehicles could be lowered by careful loading of the vehicles wherever possible, i.e., placing the higher activity packages in the middle of the vehicle and surrounding these with lower activity packages. Further mitigative measures during transport include careful routing, timing, traffic control, and security.

4.5.2.2 Nitrate Contamination from Buried Salt Cake (Alternative 1a)

As discussed in Section 4.2.1.5, some mitigative measures might be taken to reduce the long-term risk of water being contaminated with nitrates from the buried salt cake at the regional burial ground. These measures include: (1) use of a binder such as cement or asphalt in the salt cake to reduce rates of dissolution and concentration in water, (2) use of double containers, such as stainless steel liners over the 55-gallon drums, to provide two barriers against water infiltration, and (3) careful engineering and disposal procedures.

4.5.2.3 Long-Term Radiological Impacts (Alternative 3)

In addition to the previously mentioned institutional controls (Section 4.5.1.1), physical barriers and exclusion devices (cement cap, fences, etc.) could mitigate some of the risk of potential human intrusion into the wastes solidified in the tanks. Also, other engineered barriers, such as a grout curtain, might mitigate some of the risk of potential migration of radioactive materials from the solidified wastes into the groundwater.

4.5.2.4 Radiological Impacts (Alternative 4b)

Although implementation of mitigative measures for the no-action alternative 4b would make the alternative an "action" alternative, there are some "minimal" measures that could be taken which would not entail solidification of the wastes. The short- and long-term risks associated with the potential for sabotage, an airplane crash, and human intrusion could be substantially lowered by adding further engineered barriers such as placing more earth and/or a cement cap on top of the tanks, a grout curtain around and underneath the vaults, etc. Such physical barriers, in combination with institutional controls for 300 years (Section 4.5.1.1) would substantially reduce the radiological risks during the period while the wastes lose much of their radioactive hazard through radioactive decay.

4.6 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

No matter which of the various alternatives is implemented, certain adverse impacts would be unavoidable. The impacts would occur even with the best possible overall program planning, engineering design, quality assurance programs, safety programs, and other mitigating measures.

Following is a summary of major unavoidable adverse environmental impacts (details given in Sections 4.1 and 4.2 and Appendix B):

- Exposure of workers to radiation in addition to the amount they would normally receive from natural background.

- Exposure of the public to a very small amount of radiation in addition to the amount they would normally receive from natural background.

- Risks of accidents that might cause release of radioactive materials to the environment.

- Risks of worker injuries that are present during any industrial project.

- Continued use of some land that is already dedicated to nuclear activities.

- Social impacts associated with public perceptions of risks and unequitable distribution of risks.

An additional unavoidable impact associated with alternatives 1a, 1b, and 2 would be the incremental use of the planned Federal HLW repository and regional burial ground.

4.7 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Implementation of alternative 1a would require the irreversible and irretrievable commitment of resources such as land, water, electricity, diesel fuel, glass frit, steel, cement, chemicals, and manpower. The exact amount of each resource committed cannot be determined until detailed engineering design work is completed, but no significant stresses on supplies of these resources are anticipated and no particularly scarce resource would be required. The amounts required for modification/construction activities would likely be less than the amounts originally committed to construction of the West Valley reprocessing facilities; and the amounts needed in operations and final decontamination and decommissioning activities would likely be less than the amounts needed when the processing facility was in full operation. Only if a new solidification facility were constructed would the resources needed for construction approach the resources committed to construction of the existing process building.

Transport of the various wastes offsite would require commitments of diesel fuel to propel trains a total of about 400 thousand kilometers (250 thousand miles) and trucks a total of about 8 million kilometers (5 million miles). The special steel casks and the overpacks used to transport the HLW and TRU wastes would probably eventually be reused to transport the much greater volume of defense wastes and other commercial and/or government wastes.

Alternative 1b would require about the same amount of resources as alternative 1a. Alternative 2 would require a small incremental amount of these types of resources at an offsite Federal waste facility. Alternative 3 would not require the glass frit, but it would require a larger quantity of concrete. On the other hand, there would be no need for the diesel fuel, casks, etc., since the wastes would not be transported offsite. Total manpower requirements would also be less than alternative 1a. Alternative 4a (10-year delay) would simply postpone the commitment of resources. Alternative 4b (continued storage in tanks) would require a low level of commitment of these types of resources over the 100-year period of institutional control while maintenance and monitoring were continued and possibly three transfers of the HLW were made to new tanks. Total commitments of resources would be less than for alternative 1a.

4.8 RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Following is a summary of the relationships between short-term uses of the environment and the maintenance and enhancement of long-term productivity (see Sections 4.1, 4.2, 4.3, and Appendix B).

Implementation of alternative 1a, 1b, or 2 would require continued short-term use of the land at West Valley for nuclear activities. After completion of project activities, part of the site could be returned to unrestricted uses. A small incremental amount of land would also be permanently committed to disposal of the solidified HLW and TRU wastes at a Federal repository and to disposal of the LLW at a regional burial ground. Other short-term costs would be commitment of depletable resources (materials, manpower, energy), risk of worker injury, and exposure of workers and the public to radiation in addition to the amount they would normally be exposed to from natural background sources.

The most important long-term gain would be the conversion of the HLW into a terminal form and the disposal of these terminal-form wastes in an underground Federal repository. This would provide greater assurance that the radioactivity would remain isolated from man's environment.

The short-term costs of alternative 3, wherein the HLW would be isolated onsite in cement and steel, would be less; however, because these wastes would be buried near the earth's surface, they would be subject in the long term to potential human intrusion and to leaching and transport to man's environment by groundwater. Thus, this method of isolating the wastes would have slightly greater long-term risks and may not be as acceptable to society as isolation of the wastes in a terminal form in a Federal repository.

Alternative 4a (10-year delay before reconsidering the alternatives) would postpone the short-term costs, and the long-term aspects would be those associated with whatever alternative was chosen after 10 years. Alternative 4b (continued storage in tanks) would spread the short-term costs over the 100-year period of institutional control. The long-term risks would still be small, but would be greater for this alternative because the wastes would remain in the liquid form near the earth's surface.

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APPENDIX B. EVALUATION AND SELECTION OF OPTIONS IN THE ALTERNATIVES FOR MANAGEMENT OF WEST VALLEY WASTES

Four principal alternatives for management of the West Valley liquid high-level wastes (HLW) have been identified. Three of these alternatives require the solidification of the HLW and are referred to as action alternatives. This is in contrast to alternative 4, which is referred to as a no-action alternative. Alternative 1 is further divided depending on whether or not the supernate is separated from the sludge before the HLW are solidified. The separated process (alternative 1a) is the preferred alternative. Alternative 4 is divided depending principally on the time period during which the HLW continue to be stored in underground tanks.

The descriptions of the available options that comprise the alternatives form the major portion of this appendix. In making the selections, each step in the action alternatives (1a, 1b, 2, and 3) was carefully evaluated. Consideration was given to the options available for the various steps and to the equipment and facilities needed to carry out these steps. The activities, equipment, and facilities considered were: (1) removal of the HLW from the tanks and the equipment needed for the removal; (2) HLW processing and the required equipment; (3) facilities needed for processing the HLW, for temporary onsite storage of the solidified HLW, for treatment of low-level wastes (LLW), and for temporary storage of transuranic (TRU) wastes* and LLW; (4) onsite and offsite management (handling, storage, and disposal) of HLW, LLW, and TRU wastes; (5) transportation of the wastes; and (6) decontamination and decommissioning of the facilities used in the solidification of the liquid HLW. The no-action alternative is treated separately in Section B.7.

The selection of processes, equipment, and facilities was based largely on technological information obtained from earlier Department of Energy reports, the open literature, and several Department of Energy contractors. Every effort was made to fill informational gaps and to reconcile differences in data arising from differences in assumptions or bases of analyses. Remaining uncertainties and informational gaps are identified, and the technical work required to obtain the information needed to allow implementation of the action alternatives is briefly outlined.

The environmental impacts at each step are summarized at the end of each subsection. In the case of radiological impacts, estimates of both the occupational doses and population risks are given. The methodology used to

*As used in this EIS, transuranic (TRU) wastes are those non-high-level wastes that contain more than 10 nanocuries of transuranic elements per gram of wastes. These elements are man-made elements that have atomic numbers greater than 92 (uranium) and are environmentally important because most transuranic elements have very slow rates of radioactive decay (long-lived).

estimate the occupational doses is presented in the appropriate section of this appendix because these estimates are strongly dependent on the particular activity involved. In general, the methodology used to estimate the population risks and the detailed results are given in Section 4.1 of this EIS. For nonradiological impacts, the detailed analyses are given in Section 4.2.

Where information was lacking, it was necessary to make assumptions to analyze the environmental impacts. The assumptions were conservative so as to overstate, rather than understate, the impacts. Ongoing studies are expected to close many of the informational gaps prior to selection of a waste management alternative for the West Valley HLW. The assumptions used were consistent within the alternatives.

It is important that the environmental impacts at each step be considered in relation to the entire waste management alternative. In comparing the alternatives, the total environmental impacts are often dominated by the impacts at one particular step (e.g., transportation). Therefore, differences in impacts among options at some other steps can be relatively insignificant when the total alternative is considered.

B.1 REMOVAL OF LIQUID HIGH-LEVEL WASTES FROM THE STORAGE TANKS

In the following sections, the two types of HLW tanks (Section B.1.1) and the two types of HLW are described (Section B.1.2), and the proposed procedures for removing the wastes are discussed (Section B.1.3).

B.1.1 Description of Tanks

Only a brief description of the West Valley waste tanks will be given here. They are described in considerable detail in reports by the U.S. Department of Energy (1978) and Janicek (1980).

There are two large carbon-steel tanks (8D1 and 8D2) housed in separate concrete vaults. Tank 8D2 contains neutralized HLW from the Purex processing of uranium-base fuels, and Tank 8D1 is an intended spare. There are also two smaller tanks (8D3 and 8D4) constructed of stainless steel and housed in a common vault; Tank 8D4 holds the acidic HLW from the Thorex processing of thorium-base fuels and Tank 8D3 is a spare. The neutralized-waste tanks 8D1 and 8D2 each have a steel pan that surrounds the bottom of the tank and projects upward for a portion of the height of the tank. The purpose of the pan is for temporary containment of the waste if a small leak should occur and for detection. A testing of the pan by Nuclear Fuel Services, Inc., in connection with a safety evaluation of the transfer system revealed that the pan under Tank 8D2 has a defect that impairs the ability of the pan to hold water. The pan under Tank 8D1 has no such defect. In their evaluation of the pan defect, the U.S. Nuclear Regulatory Commission (1979) concluded that the threat to the public or operating personnel has not changed appreciably as a result of the defect in the pan and the wastes should not be transferred at this time to the spare tank, 8D1. It was further noted that recent results of seismic analyses indicate that even the largest credible earthquake would not cause tank failure.

The Nuclear Regulatory Commission (NRC) requested that Rockwell International plan a program to inspect the West Valley HLW storage tanks, determine their condition, and predict the potential for radionuclide transport through soils surrounding the HLW tank vaults (Rockwell Int. 1980a). The resulting program plan elements (Rockwell Int. 1980b) that pertain specifically to the HLW storage tanks include: (1) a possible photographic inspection of the neutralized Purex HLW tank interior, and photographic and television inspection of the tank's exterior and its concrete vault interior surfaces; (2) determination of the wall thickness of the neutralized HLW tank; and (3) a review of the structural specifications, static and design loads, thermal history, fabrication reports, and prior corrosion data of the HLW tanks.

B.1.1.1 Neutralized High-Level Waste Tanks 8D1 and 8D2

The neutralized HLW Tanks 8D1 and 8D2 are carbon-steel-walled structures, 21.3 m in diameter and 8.2 m high; each has a nominal capacity of 2.8 million liters (L) and contains elaborate internal structures primarily for support of the tank roofs and the concrete containment vaults. In each tank, the support structure for the tank roof consists of forty-five 20-cm-diam pipe columns based about 60-cm above the bottom of the tank on a complex system of girders. The internal structure of the two tanks is shown in Figure B.1. The six supports for the roof of the concrete vault are carried up through the tank in steel pipe columns, each 76 cm in diameter. There are also four air-lift circulators, each formed by a 15-cm tank nozzle extending from grade through the vault roof and the tank top to a point about 100 cm above the tank bottom and terminating in a 76-cm-diam air-distribution shroud. The presence of so many obstructions within the tank, coupled with the few existing tank penetrations, could make the removal of the Purex waste a complex operation.

Access to the HLW in Tank 8D2 is projected to be made through existing openings. It was assumed in this statement that no new penetrations would be needed. A recent review (Janicek 1980) of postconstruction drawings revealed the existence of sixteen 25-cm openings, currently sealed, around the periphery of the tank roof; these were used during heat-treatment operations after construction of the tank. The tank-emptying proposal discussed below is based on the use of these peripheral openings.

Some of the features of Tanks 8D1 and 8D2 in their vaults are shown in Figure B.2. The vault for each tank has sides and roof of reinforced concrete, 60 cm in thickness. Each vault is buried under a minimum of 2.4 m of silty till, soil of low permeability and high ion-exchange capacity.

There are existing underground pipe connections between the tanks and the main process building. These may be utilized for removing the wastes from the tanks (Section B.1.3.3).

B.1.1.2 Acidic High-Level Waste Tanks 8D3 and 8D4

The acidic Thorex HLW Tanks 8D3 and 8D4 are stainless-steel tanks, 3.7 m in diameter and 4.8 m high; each has a nominal capacity of 57,000 L. There are two side-mounted sets and one bottom set of cooling coils and four air-sparging recirculators installed in each tank to mix the contents and to purge radiolytically generated hydrogen. The two acidic-waste tanks are interconnected and are tied into the chemical process cell (CPC) process system through a 7.6-cm jacketed stainless steel line. Spare access lines to the chemical process cell also terminate underground outside the vault. Although no means

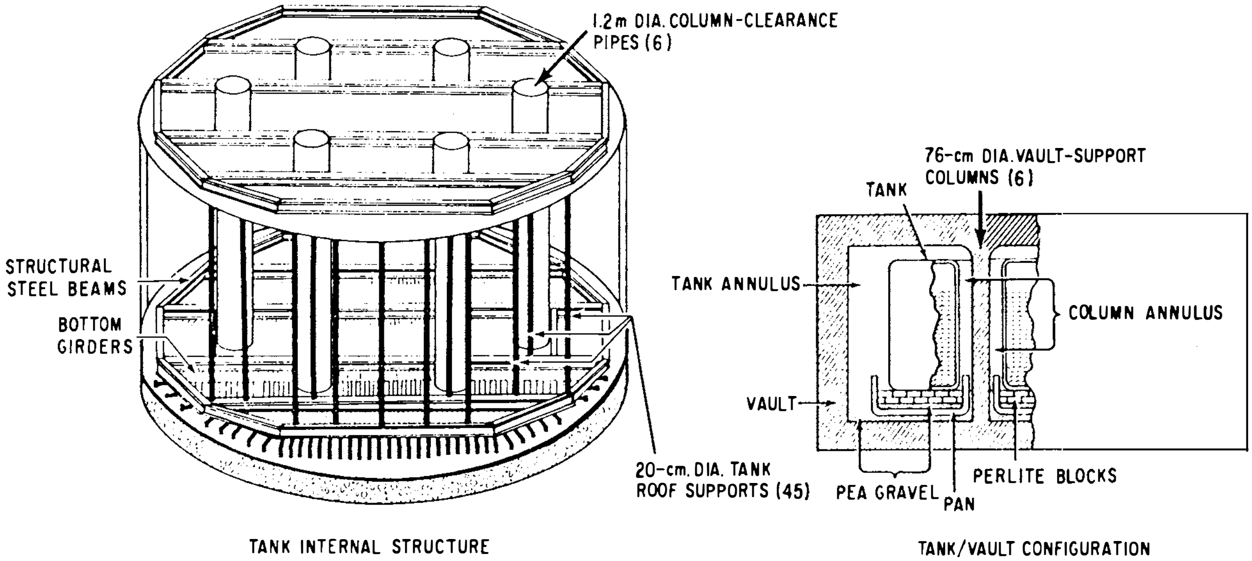


Figure B.1. Internal Diagram and Vault Configuration for the Neutralized High-Level Waste Tanks 8D1 and 8D2. Source: Rockwell International (1980b).

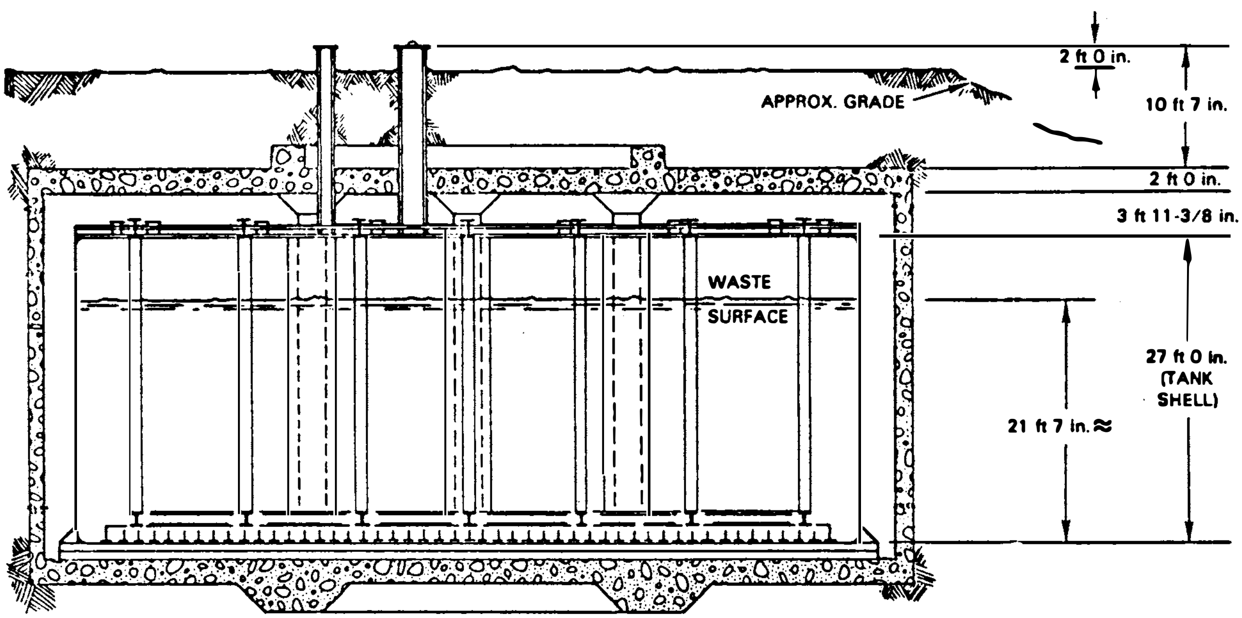


Figure B.2. Diagram of Neutralized High-Level Waste Tank Showing Vault Elevation. Source: Janicek (1980).

of extracting the contents are currently installed in either tank, the removal of the Thorex wastes should be a fairly straightforward operation because it is believed that there is very little, if any, solid material in the tank. It is believed that a submersible pump can be introduced through an existing access port and that this, along with a tie-in to the existing transfer line to the chemical process cell, would allow satisfactory removal of the tank contents with comparatively little difficulty. If a new facility were to be used for waste solidification, new transfer lines would have to be installed.

The Thorex tanks in their common vault are shown in Figure B.3. As with the Purex tanks, the vault sides and roof are of reinforced concrete, 60 cm in thickness. The vault also is buried under a minimum of 2.4 m of silty till soil.

B.1.2 Description and Characterization of the Stored High-level Wastes

Two different types of HLW are stored in the tanks at West Valley: (1) neutralized Purex wastes, consisting of a layer of sludge below a layer of supernate, are stored in one of the carbon-steel, 2.8 million-L tanks (8D2); and (2) acidic Thorex wastes, which are assumed to be a homogenous solution (but which may, in fact, contain some separated solids), are stored in one of the stainless-steel, 57,000-L tanks (8D4). The neutralized Purex wastes are similar to the defense HLW at Savannah River and Hanford in that these latter wastes also consist of a neutralized supernate and an associated sludge.

The fuels processed at West Valley will, in 1987, have a minimum "out-of-reactor" time of 17 years, with the average time for the entire group being somewhat over 20 years. In addition, many of the fuels processed had low reactor burn-up. Thus, the radioactivity content of the West Valley HLW in 1987 will be substantially lower than that of commercial HLW derived by processing current power-reactor spent fuel, but will be higher than that of the various defense HLW. The West Valley HLW are, however, somewhat unusual chemically because of the unusually large quantity of iron in the neutralized sludge and the existence of the separate acidic Thorex wastes.

A concern in past studies of the West Valley HLW has been the lack of data concerning their specific composition. This is particularly true for the actinides, where calculational methods devised for other purposes had to be used in the absence of complete data. This situation should be improved when samples of the West Valley HLW are analyzed.

B.1.2.1 Neutralized High-Level Wastes

Tank 8D2 contains by far the largest quantity (2 million L) of the West Valley HLW from the 1966-1972 period of plant operation. This tank is still used for the disposal of various radioactive effluents (e.g., sump drainage and decontamination solutions) that have been generated during the period subsequent to plant shutdown. The bulk of the HLW were derived from reprocessing 625 metric tons (MT) of uranium fuel to recover uranium and plutonium. Approximately 56% of this quantity was from fuels used in defense-related plutonium-production reactors and the balance from commercial power reactors. The defense fuels, on the average, had about 20% less reactor burn-up than the commercial fuels reprocessed at West Valley and furnished only 31% of the recovered plutonium. The present radioactivity content of the tank was thus primarily derived from the smaller quantity of commercial fuels.

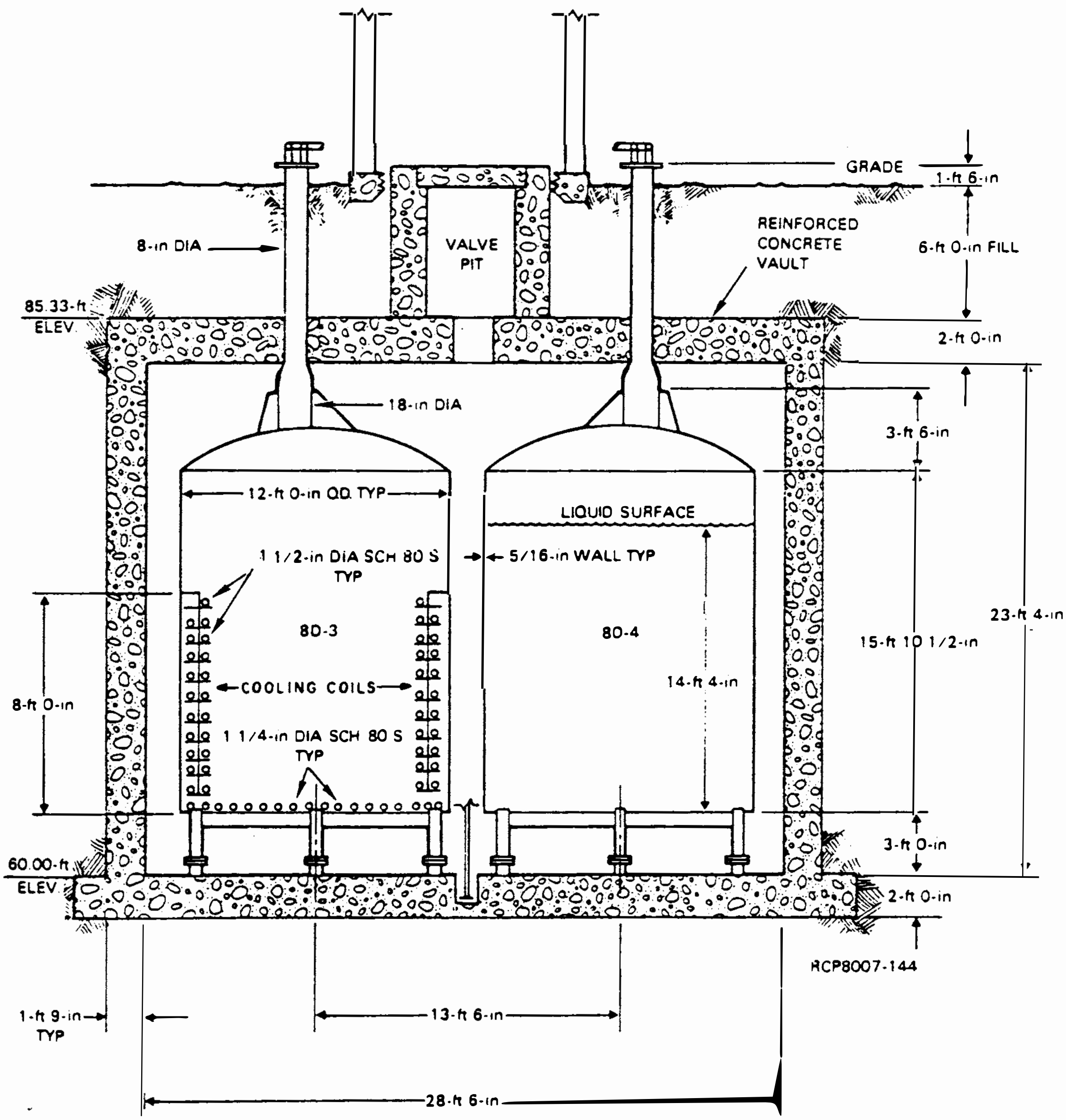


Figure B.3. Diagram of Acidic High-Level Waste Storage Tanks 8D3 and 8D4 and Their Vault. Source: Janicek (1980).

The HLW left the Purex separation process as highly concentrated nitric-acid solutions, but were neutralized with sodium hydroxide before storage in Tank 8D2. The HLW in Tank 8D2 currently consist of a supernate with a very high dissolved-salt content that overlays an alkaline sludge. The volume, physical condition, and chemical composition of the sludge are uncertain, although the sludge is known to consist largely of inert iron and aluminum hydroxides.

The average depth of the sludge is believed to be about 140 cm. The upper portion of the sludge is believed to be a somewhat soft, high-water-content accumulation of hydrated iron and aluminum hydroxides. This sludge material is thought to overlay a thinner layer of more dense components on the bottom of the tank (U.S. Dep. Energy 1978). Table B.1 presents an estimate of the composition of the neutralized HLW. An estimate of the radioactivity in this tank in 1978 was given in the U.S. Department of Energy (1978) report. The estimated radioactivity in Tank 8D2 in 1987 is given in Table B.2. In 1987, the radioactivity of the fission products--particularly strontium, yttrium, cesium, and barium--will dominate the total radioactivity.

Tank 8D1 is located in a separate vault adjacent to Tank 8D2 which contains the neutralized HLW. This companion tank (8D1) contains some small amount of liquid with a low radioactivity content, such as condensates from the filled tank, but is essentially in unused condition.

Radioactive decay continues to reduce the radioactivity level in the neutralized HLW tank and thus the heat generated by the wastes; both characteristics are already dominated by the cesium-137 and strontium-90 fission-product decay chains and will continue to be so dominated for decades to come. The cerium-144 will have essentially disappeared by 1987, and the other intermediate half-life fission or capture products (ruthenium-106, cesium-134, antimony-125, promethium-147) will be at minor levels as compared with those of cesium-137 and strontium-90. More will be known about the characteristics of the sludge and supernate after completion of a sampling program.

B.1.2.2 Acidic Thorex High-Level Wastes

Tank 8D4 contains all 47,000 L of the acidic Thorex-process HLW generated at West Valley. This waste was generated during a single processing campaign wherein the uranium was recovered from an experimental reactor fuel originally composed of 93.5% thorium and 6.5% highly enriched uranium.

The HLW coming from the Thorex process also contained a high concentration of nitric acid. To avoid precipitation of over 15 MT of thorium estimated to be in the solution, the wastes were <u>not</u> neutralized and thus remain in the tank in what was thought to be a single-phase acidic solution, primarily of thorium nitrate. However, as a result of a recent analysis of the contents of the acidic-HLW tank, a thorium concentration that is only about 75% of what might be expected was reported. This might indicate that the acidic wastes have also fractionated into a supernate and a bottom sludge. The estimated composition of the acidic HLW is given in Table B.3; the estimated radioactivities of the fission products in 1987 are given in Table B.4. Estimated 1978 radioactivities were presented in the U.S. Department of Energy (1978) report.

The estimated fission-product inventory in the acidic HLW is ten times less than that in the neutralized HLW. It can be assumed that, owing to the low original uranium content of the processed fuel, the transuranic content of the acidic wastes is much lower than that of the neutralized wastes. Otherwise, the mechanisms of radioactive decay and resulting decay heat for the acidic HLW are similar to those ascribed to the neutralized HLW.

Within the same vault, the spare acidic-waste tank (8D3) is essentially unused.

Table B.1. Estimated Composition of Neutralized Purex Wastes (Tank 8D2)

Compound	In Sludge		In Solution	
	10^3 Moles	Kilograms	10^3 Moles	Kilograms
$(Na,K)_2\ SO_4$	--	--	630	89,800
$(Na,K)\ NO_3/NO_2$	--	--	12,300	1,090,000
(Na,K) OH	--	--	386	15,400
(Na,K) Cl	--	--	8.4	500
$Fe(OH)_3$	460	49,500	--	--
$FePO_4$	190	28,500	8.3	1,250
$Cr(OH)_3$†[1]	38	3,900	21	2,100
$Ni(OH)_2$†[1]	18	1,700	<8.3	<750
$Al(OH)_3$	11	830	--	--
AlF_3			<18.7	<1,570
Rare earth $[M(OH)_3]$†[2]	8.3	1,620	--	--
Fission products, remainder			2.9†[3]	550
$(M'SO_4)$	5.5	1,240	--	--
$[M'(OH)_4]$	9.6	1,580	--	--
(M''_2O_3) (MO_x^{-1})	0.7	210	1.2†[4]	220
Mo, as Na phosphomolybdate $(Na_3PO_4\text{-}12MoO_3)$	7.8	980	4.2	500
Mn, as MnO_2 (estimated)	25	2,200	--	--
Pu, as PuO_2	--	35	--	--
U, as $Na_2U_2O_7$	21	6,700	--	--
Actinides, total as oxides	--	19	--	--
TOTALS		99,000		1,203,000
	~28,000 liters @ assumed dry density of 3.5 g/mL			557 g/L

†[1] Assuming ratio of chromium to nickel to be 19:9 (the ratio in which it occurs in 304 stainless steel).

†[2] Average atomic weight - 143.9.

†[3] $(Rb, Cs)No_3$, average molecular weight - 189.52.

†[4] Technetium as $NaTcO_4$. It is considered very doubtful that this is present; the Tc is most likely to be present as a Ba pertechnetate, coprecipitated with $BaSO_4$ (Martin & Miles, "Chemical Processing of Nuclear Fuels," Academic Press, 1958; p. 77).

Source: U.S. Department of Energy (1978).

Table B.2. Estimated 1987 Radioactivity of Neutralized Purex Wastes (Tank 8D2)

Fission Product	Radioactivity (curies) Sludge	Supernatant	Total
Tritium (H-3)	0	2.4×10^3	2.4×10^3
Selenium-79	0	5.0×10^1	5.0×10^1
Strontium-90	6.6×10^6	6.7×10^4	6.7×10^6
Yttrium-90	6.6×10^6	6.7×10^4	6.7×10^6
Zirconium-93	2.5×10^2	<1	2.5×10^2
Niobium-93m	2.4×10^2	<1	2.4×10^2
Technetium-99	0	1.9×10^3	1.9×10^3
Ruthenium-106	1.0×10^2	1.0×10^1	1.1×10^2
Rhodium-106	1.0×10^2	1.0×10^1	1.1×10^2
Palladium-107	6	<1	6
Antimony-125	6.0×10^3	6.0×10^1	6.1×10^3
Tellurium-125m	0	6.1×10^3	6.1×10^3
Tin-126	4.0×10^1	<1	4.0×10^1
Antimony-126m	4.0×10^1	<1	4.0×10^1
Antimony-126	4.0×10^1	<1	4.0×10^1
Iodine-129†[1]	0	4.7	4.7
Cesium-134	0	2.1×10^4	2.1×10^4
Cesium-135	0	3.5×10^1	3.5×10^1
Cesium-137	0	8.9×10^6	8.9×10^6
Barium-137m	0	8.4×10^6	8.4×10^6
Cerium-144	1.1×10^1	<1	1.1×10^1
Praseodymium-144	1.1×10^1	<1	1.1×10^1
Promethium-147	6.0×10^4	6.0×10^1	6.0×10^4
Samarium-151	2.0×10^5	2.0×10^1	2.0×10^5
Europium-152	4.1×10^2	<1	4.1×10^2
Europium-154	1.3×10^5	1.4×10^3	1.3×10^5
Total			3.1×10^7

Actinide	Radioactivity (curies) Sludge	Supernatant	Total
Uranium-235	8.0×10^{-2}	0	8.0×10^{-2}
Uranium-238	8.2×10^{-1}	0	8.2×10^{-1}
Neptunium-237	2.3×10^1	<1	2.3×10^1
Neptunium-239	2.2×10^2	<1	2.2×10^2
Plutonium-238	1.5×10^3	1.5	1.5×10^3
Plutonium-239	1.8×10^3	1.8	1.8×10^3
Plutonium-240	9.7×10^2	<1	9.7×10^2
Plutonium-241	7.0×10^4	7.0×10^1	7.0×10^4
Plutonium-242	<1	0	<1
Americium-241	2.0×10^4	2.0×10^1	2.0×10^4
Americium-242	1.8×10^2	<1	1.8×10^2
Americium-242m	1.8×10^2	<1	1.8×10^2
Americium-243	2.2×10^2	<1	2.2×10^2
Curium-242	<1	0	<1
Curium-244	8.8×10^3	8.8	8.8×10^3
Curium-245	1	0	1
Curium-246	<1	0	<1
Total			1.0×10^5

†[1] No iodine should remain after Purex reprocessing of the fuel; however, the iodine was included to yield conservative doses.

Source: U.S. Department of Energy (1978), with appropriate radioactive decay taken into account.

Table B.3. Estimated Composition of Acidic Thorex Wastes (Tank 8D4)

Compound	Weight (metric tons)
$Th(NO_3)_4$	32†[1]
$Al(NO_3)_3$	3.4
NaF	0.2
HNO_3	3.0
HPO_4	0.2
H_3BO_3	0.4
$M(NO_3)_x$ (M = Fe, Cr, Ni)	0.8

†[1] Approximately 15,500 kg thorium.

Source: U.S. Department of Energy (1978).

Table B.4. Estimated 1987 Radioactivity of Acidic Thorex Wastes (Tank 8D4)

Fission Product	Radioactivity (curies)
Cobalt-60	1.5×10^3
Strontium-90	6.5×10^5
Yttrium-90	6.5×10^5
Cesium-134	5.4×10^2
Cesium-137	6.9×10^5
Barium-137m	6.4×10^5
Europium-154	4.2×10^3
Total	2.6×10^6

Source: U.S. Department of Energy (1978), with appropriate radioactive decay taken into account.

B.1.3 High-Level Waste Removal Procedures

Of the two types of liquid HLW at West Valley, the removal of the neutralized Purex wastes, with the sludge layer at the bottom, would be more difficult than the removal of the acidic Thorex wastes. These difficulties are associated with the large volume of neutralized HLW, the presence of sludge of uncertain nature and quantity, limited access to the tank, and probable interference owing to the complex structures within the tank. Because the acidic HLW has a smaller volume with essentially no solid component, its removal may be easier. In the following section, a proposed procedure is described for the removal of liquid wastes from both tanks. The removal step, of course, is a necessary prerequisite for any of the proposed action alternatives. In addition to the conceptual removal procedures discussed in this section, other procedures are under investigation. One such procedure involves decanting the supernate and treating it separately before removing the sludge.

The liquid HLW-removal concept developed by Rockwell International (Janicek 1980) would employ the following general actions:

- HLW removed intermittently, concurrent with solidification operations.
- Acidic Thorex waste removed and processed first.
- The spare, acidic HLW tank (8D3) used as a batch-feed tank in the neutralized-HLW solidification process.
- Neutralized HLW mixed to provide a more uniform feed to solidification.
- The residual solids in the neutralized-HLW tank sluiced with solvents as required.

A schematic drawing depicting this general liquid waste-removal concept is given in Figure B.4.

B.1.3.1 Ancillary Facilities and Equipment to be Installed

If the existing reprocessing building were utilized, the liquid waste-removal system could use the existing underground process piping to transport the wastes to the chemical processing cell. These lines are made of 7.6-cm (3-in.) diameter stainless steel pipe. To use these lines, a number of tie-ins and interconnections would have to be made in the tank-farm area. This could be accomplished by installing a belowgrade diversion box to which all necessary tie-ins would be piped underground. If processing were to take place in a new building specifically constructed for that purpose, additional piping would be required to transport the wastes to the new processing facility.

The waste-removal system would also require a utility station tie-in via the diversion box to supply water, steam, or chemical solutions needed for the operations. Chemical solutions would probably be delivered to the utility station by tanker (either rail or road).

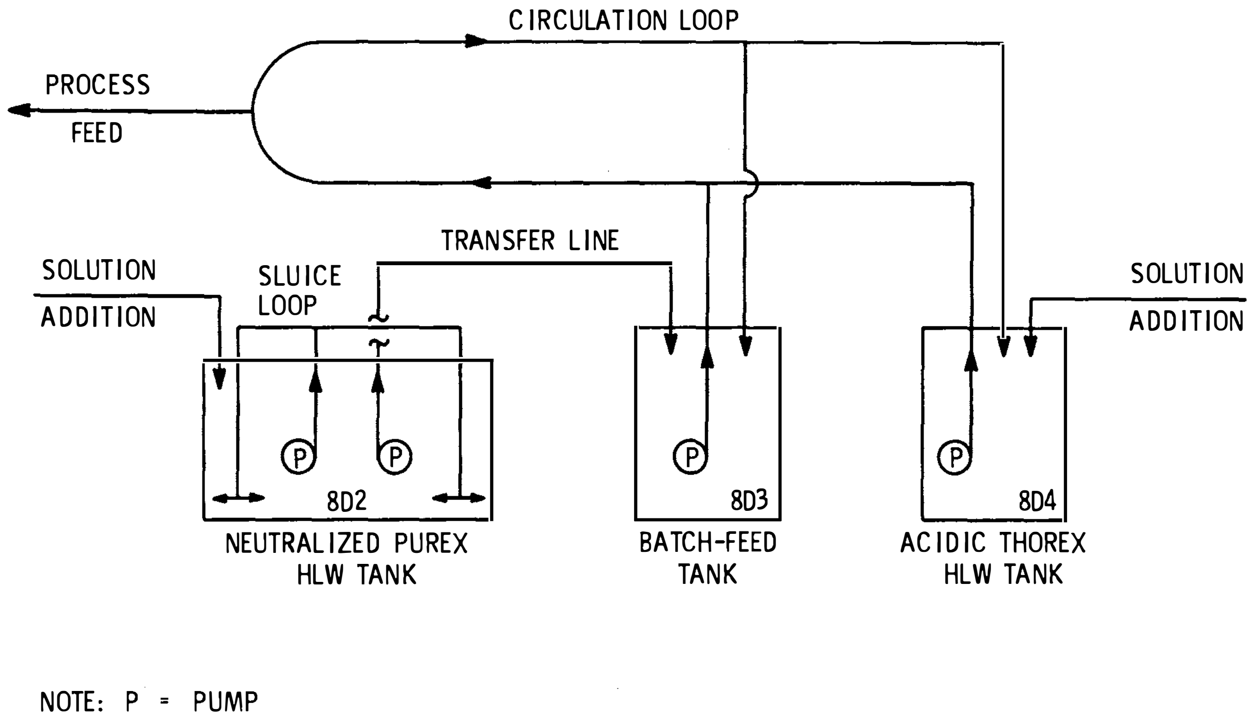


Figure B.4. Schematic of the Removal of High-Level Wastes from Underground Storage Tanks 8D2 and 8D4.

The neutralized-HLW tank might have to be outfitted with a bridge to support the waste-removal equipment to be installed in the tank, and the interconnecting piping to carry out the waste-removal operation. However, the current proposal is to install all pump and nozzle stations in individual, covered pits and the interconnecting piping in belowgrade troughs because it is thought that the existing concrete vault roof has adequate strength to support all this equipment.

B.1.3.2 Removal of Acidic Wastes from Tank 8D4

The acidic-HLW Tank 8D4 would be outfitted with a stainless steel turbine pump installed in an existing opening on the top of the tank. Piping would be installed so that the pump could continuously circulate the contents of the tank in a loop to and from the processing cell in the existing plant. Circulation of the contents would promote greater uniformity of the feed to the solidification process. If processing were to take place in a new building constructed for that purpose, additional piping would be needed to establish the circulation loop between the tank and the new building.

In a separate campaign, the Thorex HLW would be fed to the solidification system. As discussed in Section B.1.2.2 (Acidic Thorex High-Level Wastes), a layer of solids might remain after the initial pumpout campaign. If this were the case, dilution water and/or wash solutions could be added to the tank via an existing spare line. If the suspected residual sludge or heel was diluted to the original waste volume (anticipated) and the contents processed (probably at a higher rate), the resultant heel from this second campaign would likely contain only a fraction of a percent of the tank's original contents. The Thorex wastes could, alternatively, be combined with the Purex wastes for solidification.

B.1.3.3 Removal of Neutralized Wastes from Tank 8D2

Removal of the neutralized HLW from Tank 8D2 and the transfer of these wastes to a processing cell would involve three separate operational phases. In addition to the installation of removal equipment, transfer lines would have to be installed between Tank 8D2 and Tank 8D3, which is to be used as a batch-feed tank.

Phase One

The first operation would involve turning over the contents of the neutralized-waste tank at a high rate of flow while sluicing to mix the sludge with the supernate. To accomplish this, a bottom-suction mixed-flow pump would be installed in the tank through a riser; the pump would discharge by means of a manifold assembly to sluicing nozzles installed in the peripheral openings of the tank. The pump would discharge at about 15,000 L/min (4000 gpm) to the submerged, rotatable sluicing nozzles. The flow at each nozzle would depend on the number of nozzles being fed; for example, eight nozzles would have flow rates of 1900 L/min (500 gpm) each. At this flow rate, the system would turn over a volume of liquid equivalent to the volume of the waste in the tank in about 2.5 hours. It is assumed that the wastes would be mixed to the fullest extent possible in about 10 such tank turnovers, or in about 25 hours.

The second operation would involve the transfer of some 45,000 L of the mixed waste to a batch-feed tank, in this case the 57,000-L unused spare acidic-waste Tank 8D3, by a centrifugal or turbine pump installed in a riser of the neutralized-waste tank. This pump would make the transfer at about 380 L/min (100 gpm), thus requiring about two hours to complete the transfer.

At this point in time, the pumps in the neutralized-waste tank would be shut down to await the next batch transfer in three to four weeks. Meanwhile, the next part of this operation, which is similar to the processing of the acid wastes, would proceed for three to four weeks. A centrifugal pump installed in the riser of the batch-feed tank would discharge to the chemical processing cell at about 380 L/min. There, a side stream feed would be drawn off to the immobilization process operation, and the bulk of the flow would return to the batch-feed tank, thus maintaining homogenization of sludge and supernate. The return flow would enter the tank through a newly installed riser (second choice) or through the same riser in which the circulating pump was installed (first choice).

Phase Two

The immobilization processing of the contents of the neutralized-waste tank is expected to span about three years. In somewhat more than two years, when the contents of the tank would be down to about a 2-m depth, the first operation--turnover of the contents at 15,000 L/min with a mixed-flow pump--would become infeasible due to the head requirements of the pump. At this point, turbine pumps would be installed in eight of the sixteen peripheral openings, each pump feeding one of the sluicing nozzles already installed in the other eight openings. Waste removal from the neutralized-waste tank would thus continue with the other two operations remaining the same.

Phase Three

The residual sludge or heel (~50,000 L) after the second-phase sluicing/pumpdown campaign would probably be about 15-cm deep. At this point, one or two dilutions of the heel with 30-60 cm of clean water would be carried out either using the same equipment as that used in the second phase (fixed-pole-length sluicers) or going directly to the use of elevator sluicers*. Final cleanup of the tank would be done with the elevator sluicers. In excess of 99% of the waste would be removed at this point. However, if areas of sludge buildup and encrustation were not removed from the tank by the sluicing operations described above, the use of an articulated-arm sluicer might be needed to help clean these areas. Articulated arm and elevator sluicers are diagrammed in Figure B.5. The batch tank would also be cleaned because all the wash solutions introduced into the neutralized-waste tank would also pass through the batch tank. The expected degree of waste removal upon completion of this phase could be as much as 99.9%.

B.1.4 Development Needs

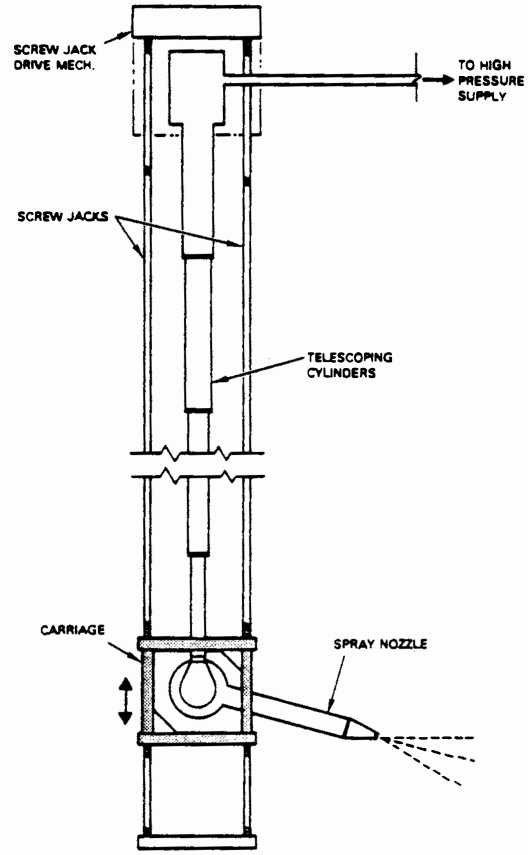
A number of uncertainties remain concerning removal of the wastes from the tanks. Some of these uncertainties can and must be resolved by experimental work conducted before removal operations are undertaken. Others are unlikely to be resolved by any feasible prior experimental work and must, therefore, be taken into account in the planning and design of the equipment and operation. Areas of resolution include:

- Structural analysis of the neutralized-waste tank.
- Investigation of the physical properties of the sludge.
- Chemical and radiological analyses of the wastes.
- Development and testing of methods and equipment to be used in sluicing and in other operations such as coring of the vault roof and installing new tank openings. A mockup of the neutralized-waste tank will be tested using simulated waste.
- Safety analysis (of tanks, pipes, pumps, etc.) based on detailed removal-from-tank operations.

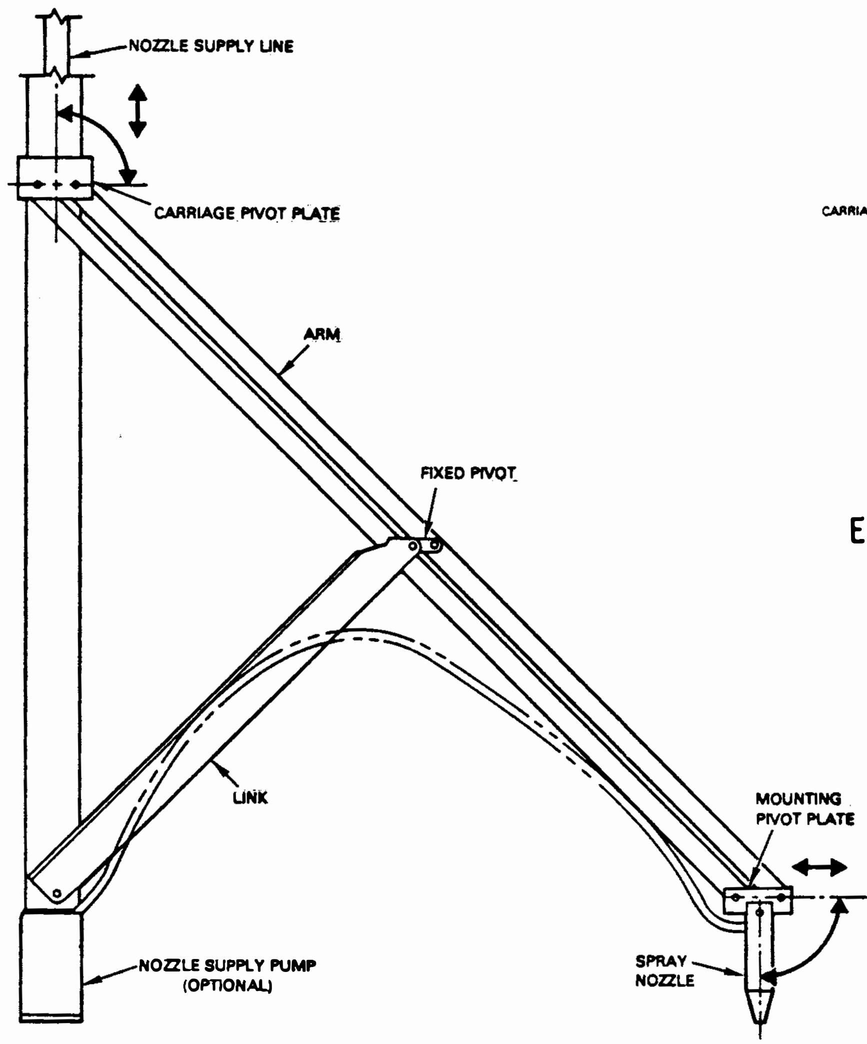
B.1.5 Environmental Impacts

The environmental impacts associated with removal of the liquid HLW from Tanks 8D2 and 8D4 are applicable to all action alternatives because the HLW must be removed from the tanks prior to solidification or transfer to another tank.

*Design details of the various sluicers--fixed-pole, elevator, and articulated-arm--are given in Janicek (1980).



ELEVATOR SLUICER



ARTICULATED ARM SLUICER

Figure B.5. Diagram of Articulated Arm and Elevator Sluicers for the Neutralized High-Level Waste Storage Tank. Source: Janicek (1980).

B.1.5.1 Radiological Impacts

The radiological impacts associated with retrieval of the liquid HLW would consist of an occupational dose to the work force accomplishing this activity and a radiological risk to the general population in the vicinity (80 km) of West Valley from the potential release of radioactivity to the surrounding area.

The occupational dose is based on an average annual radiation dose of 0.65 rem per worker, which was determined from data and experience at the HLW tank farm at Hanford (Janicek 1980) along with the projected work effort required. The Janicek (1980) report estimated that 33 person-years would be required for installation of the waste-retrieval equipment and 5 person-years annually for operations. For alternatives 1a, 1b, and 2, it is estimated to require three years to retrieve the wastes plus an additional year for tank flushing. For alternative 3, two years are projected for waste retrieval. The occupational doses for waste retrieval are summarized in Table B.5.

Table B.5. Occupational Doses from Waste Retrieval

	Occupational Dose (person-rem)		
Alternative	Equipment Installation	Waste Removal	Total
1a	21.5	13.0	35
1b	21.5	13.0	35
2	21.5	13.0	35
3	21.5	6.5	28

For alternatives 1a, 1b, and 2, the occupational dose for waste retrieval is estimated to be 35 person-rem; for alternative 3, it is estimated to be 28 person-rem. The differences in occupational doses for waste retrieval are based on assumptions related to the length of time required to perform this activity for the various alternatives. Within the accuracy of these estimates, there is no significant difference among the alternatives.

The risk to the population in the vicinity of West Valley resulting from routine releases and potential accidents is estimated to be 48 person-rem for alternatives 1a, 1b, and 2, and 32 person-rem for alternative 3 (Table B.6). The major cause of this risk is a potential airplane crash or sabotage event during the waste-retrieval process, with subsequent release of radioactivity to the surrounding area. Within the accuracy of these estimates, there is no significant difference among the alternatives.

B.1.5.2 Nonradiological Impacts

No significant nonradiological impacts were identified.

Table B.6. Population Risks from High-Level-Waste Retrieval

Alternative	Population Risk (person-rem)
1a	48
1b	48
2	48
3	32

B.2 HIGH-LEVEL-WASTE IMMOBILIZATION PROCESSES

Optional processes for the immobilization (solidification) of the West Valley HLW are described and assessed in this section. The current status of waste-form research and development is given in Section B.2.1. Immobilization procedures can be divided into three general categories in accordance with the end product produced: (1) processes generating a terminal-form waste product suitable for transport and disposal in a Federal repository (Section B.2.2), (2) processes yielding an interim-form product that is amenable to offsite transport to a not-yet-constructed Federal waste facility for final processing with subsequent transport to a Federal repository (Section B.2.3), and (3) a process wherein the wastes are mixed with cement and returned to their storage tanks for onsite solidification (Section B.2.4). The environmental impacts associated with each of these optional processes are given in Section B.2.5.

B.2.1 Status of Waste-Form Development

The U.S. Department of Energy has established a national program for the long-term management of HLW. Within this program, several governmental, educational, and industrial institutions are involved in research activities aimed at developing techniques for the solidification of liquid HLW. The following properties appear to be important considerations in the development of a suitable waste form:

- Chemical and physical durability of the solid waste form, i.e., resistance to leaching.
- Heat load and radiation level in the waste form.
- Fissile material content.
- Homogeneity of the waste form.

The following sections describe the current state of development in the areas of terminal-form, interim-form, and in-tank HLW solidification procedures.

B.2.1.1 Terminal Waste Forms

An extensive review of current U.S. research and development on different possiblities for HLW forms appeared in a recent Savannah River programmatic EIS (U.S. Dep. Energy 1979b) and in the final environmental impact statement for the defense waste-processing facility (U.S. Dep. Energy 1982). Among the solidification processes and/or waste forms being investigated are: borosilicate glass at Pacific Northwest Laboratory (PNL) and Savannah River Laboratory; concrete formed under elevated temperature and pressure ("FUETAP") conditions, cermets, and sol-gel technology at Oak Ridge National Laboratory; stabilized ("super") calcine at Pennsylvania State University and PNL; porous glass matrix at Catholic University; high-alumina glass at Westinghouse; clay ceramics and tailored ceramics at Rockwell-Hanford; glass ceramics, coated pellets, and matrix forms at PNL; metal matrices at Argonne National Laboratory; titanates at Sandia Laboratory; and SYNROC at Lawrence Livermore Laboratory, Pennsylvania State University, Argonne National Laboratory, and North Carolina State University. These waste terms are defined more fully in the glossary of this EIS.

It should be noted that, for most processes, the base technologies are available, but must be specifically adapted to West Valley conditions. The development status of each solid waste form, expressed as the estimated number of years still required to develop a workable production process, is as follows (U.S. Dep. Energy 1979b):

Development Status	Waste Form
Available	Borosilicate glass, calcine, rich clay, normal concrete
5 years	Hot pressed concrete, agglomerated (pelletized) calcine, clay ceramics, pellets in metal matrix
10 years	Cermets
15 years	Supercalcine, SYNROC, glass ceramics, coated supercalcine in metal matrix

Of the four forms listed under "available" (i.e., currently ready for application), the last three (calcine, rich clay, and normal concrete) are considered to be primarily suitable for onsite temporary storage and offsite shipment of HLW but not for final disposal. Thus, the Savannah River programmatic EIS indicates that incorporation into borosilicate glass is the only currently available process leading to a suitable terminal-form product for offsite shipment to a Federal repository.

A more recent evaluation and review of alternative waste forms for immobilization of high-level radioactive wastes was made by an eight-member panel of engineers and scientists outside the Department of Energy (Alternative Waste Form Peer Review Panel 1980). The present scientific merits, research priority, and engineering practicality of various HLW forms were ranked in three levels--top, intermediate, and bottom; the findings of the panel are summarized in Table B.7.

Table B.7. Waste-Form Rating by Alternative Waste Form Peer Review Panel (1980)

Waste Form	Present Scientific†[1] Merit	Research Priority	Engineering Practicality
Glass	Top	Intermediate	Top
Multibarrier (Glass in lead)	Top	Bottom	Top
Multibarrier (Glass in glass)	Top	Top	Top
Porous glass matrix	Intermediate	Top	Intermediate
SYNROC	Intermediate	Top	Intermediate
Tailored ceramics	Intermediate	Top	Intermediate
Titanates	Intermediate	Intermediate	Intermediate
Multibarrier (Ceramics in lead)	Intermediate	Bottom	Intermediate
Agglomerated (pelletized) and stabilized calcine	Bottom	Bottom	Top
Clay ceramics	Bottom	Bottom	Intermediate
Cermet	Bottom	Bottom	Bottom
Concrete	Bottom	Intermediate	Intermediate
Multibarrier (CVD†[2] coatings)	Bottom	Intermediate	Bottom
Multibarrier (Coextruded)	Bottom	Intermediate	Bottom

†[1] The Panel also considered safety merit or least risk for use today.

†[2] Refers to ceramics or glass with chemically vapor deposited (CVD) coatings.

Much attention in the United States and abroad has been given to borosilicate glass as a waste form, which accounts for the relatively advanced status of its production technology. To produce borosilicate glass waste, a glass-forming granule, called frit, is blended with radioactive waste, and the two substances are then melted together. Borosilicate glass has gained prominence because it offers several advantages. The glass will accept a large variety of glass formers and waste compositions, and essentially all of the radionuclides and inert components normally found in wastes can be incorporated into the glass. About 25 to 35 wt% of waste oxides can be loaded into molten glass. Large monoliths, chemically compatible with the usual metal canister materials, can be cast. These canistered monoliths are structurally strong and have relatively good impact resistance, high heat capacity, and good resistance to radiation damage, helium buildup from entrained alpha emitters, and water leaching at moderate temperatures. The properties of the finished glass are not critically dependent on small variations in waste or glass-former compositions or on processing conditions.

The fact that incorporation of radioactive wastes into borosilicate glass is a currently proven technique is the chief reason for using this waste form as the reference terminal waste form for environmental analysis in this EIS. As stated in the notice of intent (U.S. Dep. of Energy 1979c) announcing the preparation of this statement, "Glass will be used as the reference waste form for the immobilization process. Because of their advanced stage of development, borosilicate glass monoliths are utilized as the reference waste form in the analyses in this statement. However, these analyses do not imply a decision to actually use this waste form."

The Department of Energy has narrowed the range of waste forms being developed and will select a single high-level waste form for the West Valley wastes in the near future. When a waste form is selected, appropriate documentation will be provided to comply with the National Environmental Policy Act under Department of Energy compliance guidelines.

The schedule for the project calls for construction to begin in 1983 and operation to begin in the late 1980s. Design of the project is proceeding based on the reference borosilicate glass process. If, however, an alternative form is selected instead of borosilicate glass, the major impacts would be: (1) delay in the immobilization schedule to allow for process and waste-form development; (2) cost of additional development and design; and (3) cost of the abandoned design.

B.2.1.2 Interim Waste Forms

The HLW at West Valley represent only about 1% by volume (U.S. Dep. Energy 1979d) of the total defense wastes stored at Hanford (Washington), Savannah River (South Carolina), and Idaho. Current plans are to convert some or all of these latter materials to repository-acceptable forms. If an acceptable method could be used to convert the West Valley HLW to a form suitable for shipment to a site where they could be processed into a final form along with other wastes, the existing West Valley plant might require less modification if it were to be used. In addition, the need to construct a new temporary storage facility for HLW canisters at West Valley would no longer exist.

With regard to disadvantages, some timely means for receiving and temporarily storing the interim-form canisters would have to be provided at an offsite Federal waste facility. Additionally, new facilities would eventually have to be built at this offsite facility for canister opening, emptying, decontamination, and disposal; such facilities have not yet been demonstrated with radioactive materials.

Early in 1980, the Department of Energy convened a panel of experts from the Department's facilities to survey the West Valley HLW treatment options. In evaluating interim waste forms, this panel--the Advisory Panel on NFS High-Level Waste Forms (1980)--considered the primary criterion of a suitable matrix for fixing HLW to be the effectiveness of the matrix in preventing dispersal of the wastes in the event of a transportation accident. Thus, powders that could become airborne would not be acceptable, and the waste form would be required to have a resistance to leaching by water that would allow remedial action (days or weeks) to be taken before an appreciable amount of radioactivity was released. The following criteria related to processing requirements at West Valley and at the final destination were also enumerated:

(1) technology for large-scale production should be well established, (2) solidification temperatures should be low, (3) additives should not increase the volume of waste to be shipped by more than two- or threefold, (4) the solidification process should be readily reversible to allow conversion to a form suitable for terminal storage, and (5) the additives should be compatible with the terminal waste-form processes. In addition, the panel considered the desirability of pretreating the West Valley wastes to separate cesium-137.

The findings of the Advisory Panel on NFS High-Level Waste Forms are summarized in Table B.8. Evaluations are given of the principal criterion, dispersion resistance, and of the processing requirements. The last column compares the approximate volume of product that would be obtained by processing the combined neutralized Purex and acidic Thorex wastes. The zeolite entry refers to a process variation wherein the neutralized-waste supernate would be separated

Table B.8. Possible Interim Forms for West Valley Wastes

Waste Form	Dispersion Resistance: Air	Dispersion Resistance: Water	Technology Available	Process Temperature (°C)	Reversibility	Compatability with Terminal Processing	Approximate Volume (gallons)†1
Fused salt	Good	Fair	Yes	300-350	Good	Good	1×10^5
Aqueous silica	Excellent	Excellent	No	100	Fair	Good	1×10^6
Organic polymers†2	Excellent	Excellent	Yes	Ambient	Poor/Fair	Fair	6×10^5 to 3×10^6
Concrete	Good	Good	Yes	Ambient	Poor	Poor	3×10^6
Dry salt	Poor	Poor	Yes	100-150	Good	Good	2×10^5
Calcine†3	Poor	Poor	Yes	~500	Good	Good	2×10^5
Zeolite†4	Excellent	Excellent	Yes	Ambient	Good	Good	1×10^4
Agglomerated (pelletized) calcine†3	Good	Fair	Yes	500-550	Good	Good	2×10^5

†1 To convert gallons to cubic meters, multiply by 3.78×10^{-3}.

†2 The organic polymers would probably be used only if the sludge were centrifuged and separately fixed for transport and terminal processing elsewhere.

†3 Total wastes calcined.

†4 Volume of cesium-bearing zeolite if the separated salt/sludge option is chosen.

Source: Advisory Panel on NFS High-Level Waste Forms (1980).

from the sludge as thoroughly as possible and decanted through zeolite columns to strip out cesium-137. The treated supernate could possibly be returned to the waste tank farm and used to dilute the neutralized waste; the zeolite columns would be packaged and shipped separately. Removal of the major portion of cesium-137 by this preliminary step would reduce the quantity of material requiring heavy shielding and thus simplify subsequent handling of the wastes.

Concrete and asphalt are used routinely as disposal matrices for LLW, but are not suitable for application here as an interim form because of the difficulty of further conversion to a form acceptable at an HLW repository. The same is true if organic resins are used as binders, with the further objection that an explosive release of energy might occur if the mixture of nitrate salt and organic compounds were exposed to fire, as might happen during a transportation accident. Resins, asphalt, and concrete were accordingly eliminated from further consideration here.

Aqueous silicate refers to a process whereby alkaline salt solutions are allowed to react at relatively low temperatures with clays such as bentonite to form silicate minerals having low dispersibility and good resistance to water leaching. The chemistry of this process is well established, but further engineering development is needed. The product would have to be ground for conversion to a terminal waste form; conversion of the ground product to borosilicate glass would be straightforward. This alternative was eliminated from further consideration primarily on the basis of the very large volume of interim-form wastes that would be produced for shipment.

Drying the salt/sludge mixture at 100-150°C would be a simple process, but would yield a powder or granular product that would be highly dispersible and water soluble. The form was judged to be unacceptable because of these limitations.

The remaining three forms given in Table B.8--calcine, agglomerated calcine, and fused salt--are the most promising possibilities and have all been examined (Vogler et al. 1980). As a result of that study, the number of viable interim waste-form alternatives was narrowed to two: agglomerated calcine and fused salt. These processes are discussed and evaluated in Section B.2.3. Calcine without a binder was ruled out, primarily because of its dispersibility.

The calcining process is common to the formation of agglomerated calcine as an interim waste form and to the formation of the glass waste described as a terminal waste form in Section B.2.2.1. A description of the calcining process is included only in the discussion of the glass waste form. In experiments with agglomerated calcine made from simulated mixed feed containing both sludge and supernate constituents, Vogler (1981--personal communication) found that it was unsuitable as an interim waste form; thus, consideration is given only to agglomerated calcined sludge from which the supernate, with its high salt content, has been removed. The agglomerated calcine and fused salt processes are compared and discussed in Section B.2.3.

B.2.1.3 In-Tank Solidification

In terms of a final waste form, in-tank solidification allows only a single option: a HLW-cement mass contained in one of the neutralized-HLW tanks. Procedural and cement-formulation possibilities are discussed in Section B.2.4.

B.2.2 Vitrification Technology

One of the considerations associated with the West Valley HLW is that inert, nonradioactive constituents are present in much larger quantities than the radioactive species and, as a result, greatly increase the volume of the solidified product to be handled and transported. For the West Valley wastes, the weight ratio of nonactive to active components is on the order of 100 if the uranium and thorium are part of the active fraction, and about 5000 if these two relatively low-activity species are ignored. Any steps that can be taken to reduce this ratio by separating out nonactive constituents should simplify disposal and reduce storage costs. In the West Valley case, the major constituents are the sodium nitrate, sodium nitrite, and sodium sulfate in the neutralized-waste tank supernate, which also contains the bulk of the cesium-137, the most abundant remaining radioactive species. Minor amounts of strontium-90 and technetium-99 are also likely to be present in the supernate, as well as trace quantities of actinides and rare earths. These materials are all in solution; thus, separation of the nonactive (mainly sodium nitrate/nitrite) and active fractions in the supernate by proven techniques appears to be quite feasible.

Several options for the incorporation of the West Valley wastes into glass are being considered. Two of these process options were selected by the Pacific Northwest Laboratory for additional study (Hill 1981). In the first option, the acidic waste would first be incorporated separately into glass. Then, the contents of the neutralized-waste tank would be homogenized, followed by separation of the supernate and sludge by centrifugation and filtration. The supernate would be decontaminated by ion exchange, and the absorbed species on the exchangers would be transferred to a feed tank where they would be mixed with the sludge and fed to a spray calciner/in-can melter or continuous-fed ceramic melter for incorporation into glass. This process option, referred to as the separated salt/sludge option, is diagrammed in Figure B.6 and is termed alternative 1a. Processing the acidic wastes first allows use of Tank 8D4 as a surge tank for transfer of alkaline wastes from Tank 8D2 and also provides a demonstration of vitrification of wastes from the thorium fuel cycle.

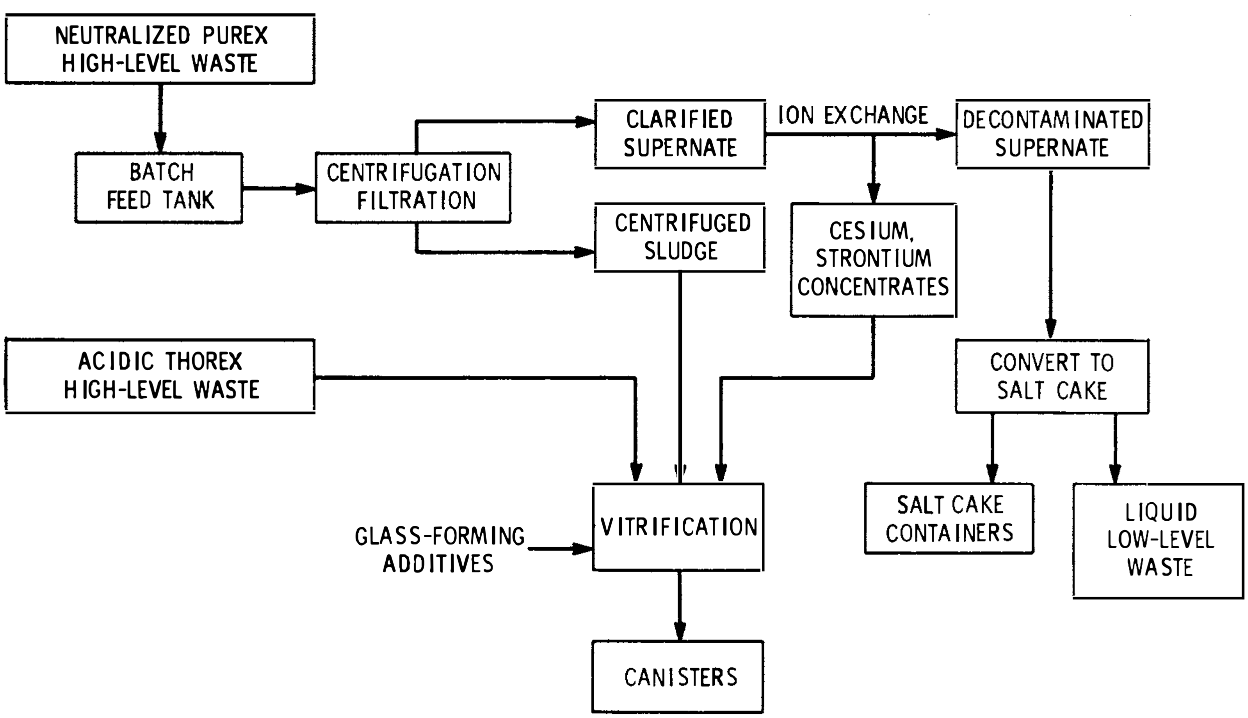


Figure B.6. Schematic of the Separated Salt/Sludge Option for Immobilization of Neutralized High-Level Wastes in Glass. The acidic Thorex wastes would be immobilized separately. Adapted from Hill (1981).

In the second option, the acidic HLW would first be mixed with the neutralized HLW. Next, the contents of the neutralized-waste tank would be homogenized as in the first option; however, the supernate would not be separated from the sludge. Instead, the homogenized waste would be fed directly to a continuous-fed ceramic melter. This process option, referred to as the nonseparated salt/sludge option, is diagrammed in Figure B.7 and is termed alternative 1b.

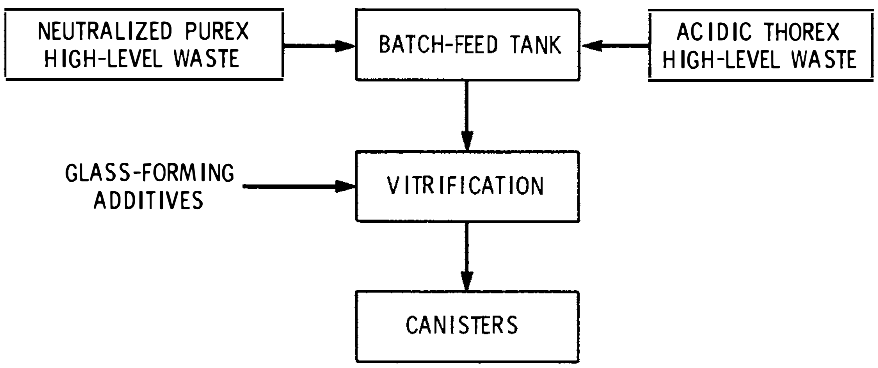


Figure B.7. Schematic of the Nonseparated Salt/Sludge Option for Immobilization of Combined Acidic and Neutralized High-Level Wastes in Glass. Adapted from Hill (1981).

Both the separated salt/sludge and the nonseparated salt/sludge options are described in greater detail below. Estimates of product container requirements, along with container radioactivity and heat loading, are given in Table B.9. These estimates are based on a waste loading of 25 wt% for the separated salt/sludge option and 19 wt% for the nonseparated salt/sludge option. The acidic-waste loading for alternative 1a was assumed to be 15%. A 30% contingency was assumed in calculating the number of canisters.

As currently envisioned, the HLW canister would be cylindrical, 0.6 m (2 ft) in diameter by 3 m (10 ft) tall and would be constructed of steel. If steel should prove to be incompatible with the repository medium that is selected for these wastes, the canisters would be provided with a suitable overpack.

B.2.2.1 Separated Salt/Sludge Option

Pacific Northwest Laboratory (PNL) has, in connection with the preparation of this EIS, developed a detailed flowsheet and material balance (Holton et al. 1980; Holton 1981) for immobilization of the West Valley liquid HLW. The waste form assumed is borosilicate glass. The main features of the processing approach are presented below.

As indicated earlier, the acidic Thorex waste would be processed first to accommodate the waste-removal procedure (Section B.1.3). The acidic waste would be agitated and circulated while in Tank 8D4. A side stream would be drawn off the recirculation loop and transferred to the solidification facility where it would be sampled to determine the proper glass-former composition.

Table B.9. Calculated Number of Containers of Solid Wastes and Associated Properties

Procedure Option	Number of Containers†1	Waste Load (wt %)†2	Curies per Container†3	Watts per Container†3	Surface Radiation (rem/hour)†3
Separated Salt/Sludge					
Acidic Thorex HLW	82	15	3.2×10^4	90	4.5×10^3
Neutralized Purex HLW sludge	218	25	1.4×10^5	410	2.0×10^4
Salt cake	5100†4	-	6.5×10^{-1}	2 mW	5.0×10^{-3}
Nonseparated Salt/Sludge					
Acidic Thorex and neutralized Purex HLW salt/sludge	1300	19	2.6×10^4	80	4.5×10^3
Sulfate sludge†5	890†4	-	1.5×10^{-8}	-	-

†1 Canisters are 2 ft in diameter by 10 ft high; fill height is 9 ft.

†2 Percentage of waste incorporated into glass.

†3 Basis: 3.1×10^7 curies in Tank 8D2 (year 1987) and 2.6×10^6 curies in Tank 8D4 (year 1987).

†4 Containers are 55-gallon drums.

†5 From scrubbing sulfur oxide containing off-gas with calcium carbonate solution.

The liquid waste would then be vitrified. This vitrification procedure is described later in more detail as it would pertain to the treatment of the neutralized-waste sludge. Once processing of this smaller volume of acidic waste had been completed, treatment of the neutralized Purex HLW could begin.

The main steps in the separated sludge/supernate process would be: (1) slurrying the contents of Tank 8D2, (2) pumping the slurry to a batch-feed tank for transfer to the processing facility, (3) separating the sludge and supernate by centrifugation, settling, and filtration, (4) decontaminating the supernate by ion exchange, (5) vitrifying the mixture of sludge and stripped nuclides from the ion-exchange decontamination of the supernate, (6) concentrating the supernate by evaporation to form a slightly radioactive salt cake, and (7) treating the process effluent. The major products of the process would be borosilicate glass, decontaminated salt cake, decontaminated water, and solid TRU and low-level wastes. Process simplifications are being explored.

In developing process flow sheets, a number of assumptions had to be made. Some of these are as follows:

1. The sludge-supernate slurry feed rate would be 160 L/h (∿0.7 gpm). This rate would allow vitrification of the total wastes to be completed in a three-year period, assuming a 60% onstream factor for the plant.

2. Twenty-five percent of the spent ion-exchange resins and filters from the cesium-strontium stripping columns is assumed to be TRU wastes; the remainder is LLW.

3. The waste loading of oxides in the borosilicate glass matrix would be 25%.

The first step in the process, preparing a slurry from the sludge and supernate in Tank 8D2, would be accomplished by means of a bottom-suction pump discharging to sluicing openings (see Section B.1.3.3). It is estimated that the contents of the tank would be turned over in 2.5 hours and that 10 turnovers would produce a fully homogenized mixture. The mixture would be transferred in batches to an empty batch-feed tank. It would be routed to the processing cell of the waste solidification facility where the mixture would undergo the second major process step--the separation of the sludge from the supernate. This would be accomplished by passing the homogenized mixture through two centrifuges, with water washing to remove sodium nitrate in each machine to reduce the salt content. This processing would be followed by gravity settling (aided by a flocculant) and sand filtration. The sludge would be transferred to a feed tank.

Supernate Treatment

The supernate would pass through two Duolite ARC-359* ion-exchange resin columns to be stripped of cesium isotopes (decontamination factor, DF = 10^2) and actinides (DF for Pu = 1.5×10^2), then through a Chelex-100** resin column for removal of strontium-90 (DF = 10^3). There would be substantial removal in both systems of the trace amount of plutonium, other actinides, and rare earths present in the supernate. The decontaminated supernate would then be evaporated and the solids converted to a 22% residual-water salt cake that would be stored in standard 55-gallon steel drums. The two evaporators used for salt solidification would each have a DF of about 10^4.

An estimate was made of the radiochemical content of the salt cake. The radioactivity of the salt cake was calculated by (1) assuming the fraction of each remaining active isotope in the supernate, based on data of Holton et al. (1980), (2) determining the effective separation of supernate from sludge, based on data developed at Savannah River Laboratory (SRL), (3) applying decontamination factors for the isotopes absorbed during the ion-exchange process, based on data developed at SRL (Wiley 1976) and applied in the B-Plant at Hanford (Baumgarten et al. 1979), and (4) computing the residual radioactivity of each isotope in a salt-cake product with a 22% water content. From these calculations, the concentration of total fission products is estimated to be 2 µCi/g, and that of the actinides to be 0.4 nCi/g. This is considered to be a conservative estimate because the decontamination factors employed are conservative.

The cesium-, strontium-, and actinide-stripping columns would be periodically eluted to remove the separated active isotopes, and the columns regenerated for further use. The cesium-bearing eluate would be concentrated and loaded onto a zeolite column. This zeolite column and the eluate from the strontium column would then be mixed with washed sludge and fed to melter equipment to produce the vitrified waste form, i.e., waste immobilized in borosilicate glass.

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*Trademark of Shamrock Corp., Redwood City, CA.

**Trademark of Bio-Rad Laboratories, Richmond, CA.

There is an ongoing program to improve performance of the ion exchangers and simplify procedures for decontamination of the supernate.

Spray Calcination and In-Can Melter Vitrification

In the spray calciner (Figure B.8), liquid HLW would be atomized by a spray nozzle into very small droplets, about 70-μm in diameter. These droplets would be dried and would decompose from the nitrate form to metal oxides as they fell through an electrically heated spray-calciner furnace. The temperature of this furnace would vary from 300 to 800°C, depending on the characteristics of the HLW. Reaction products, which would include water (H_2O), nitric acid (HNO_3), and oxides of nitrogen (NOx), would form during the calcining. After passing through sintered stainless steel filters, these vapors and gases would be routed to an off-gas treatment system. Most of the tritium (as tritiated water) reaching the calciner would also pass into the off-gas as tritiated water vapor. The balance of the radionuclides would remain in the calcine, which would be mixed with glass frit (a specially formulated borosilicate glass powder) as the calcine falls through the cone at the bottom of the calciner into the canister where it would be melted to form glass. The glass frit would be metered into the calciner cone at a rate proportional to the liquid HLW feed rate. The process diagrammed in Figure B.9 would use a frit/calcine weight ratio of 3:1.

The in-can melter would melt the calcine-frit mixture into a glass, using the canister--which would be contained in a zone-heated (and -cooled) furnace--as the melting crucible. The calcine-frit mixture would flow into the canister at a rate that would not exceed the melting rate. The molten mixture would be maintained at about 1050°C. Once the canister was filled and the contents melted to a glass, the heating would be terminated and cooling of the outer retort wall and the canister begun. The small volume of gas generated during the melting would be routed to the off-gas treatment system.

The HLW product would be borosilicate glass contained in a steel canister. The filled canister would be removed from the calciner connections, and the lid placed on the canister. To aid in later testing for leaks, a prepackaged helium source might be placed in the canister freeboard prior to closure. The filled canister would then be seal-welded and inspected. The time cycle for canister filling and related operations would be 90-100 hours. The filled canisters would be decontaminated with water and/or steam sprays to remove loose radioactive particles such as calcine. This solution would be accumulated in a tank and periodically jetted to another tank for combination with liquid HLW prior to calcination. Details of the technology involved in in-can melting can be found in Larson (1980).

Effluents

The calciner off-gas, after passing through the sintered stainless steel filters, would be subjected to the following process operations to remove particulate radionuclides, vaporized radionuclides, water vapor, and NOx: (1) particulate separation, (2) condensing, (3) mist elimination, (4) adsorption on silica-gel and silver mordanite, (5) filtration, and (6) NOx destruction. After these steps, the off-gas would be released to the stack. The canister cooling air, canister cover gas, and cell ventilation air would be

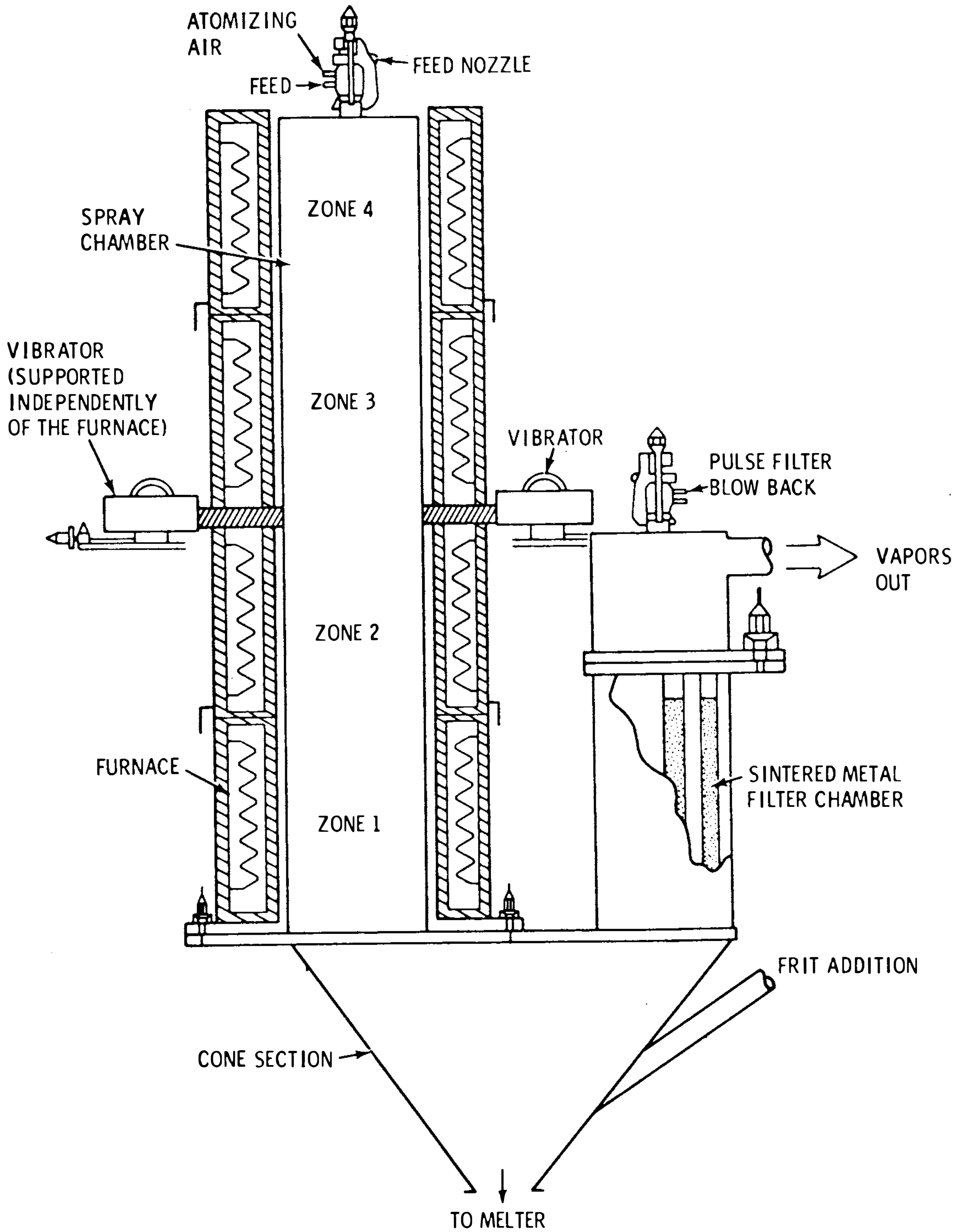

Figure B.8. Diagram of a Spray Calciner.
Source: Dierks et al. (1980).

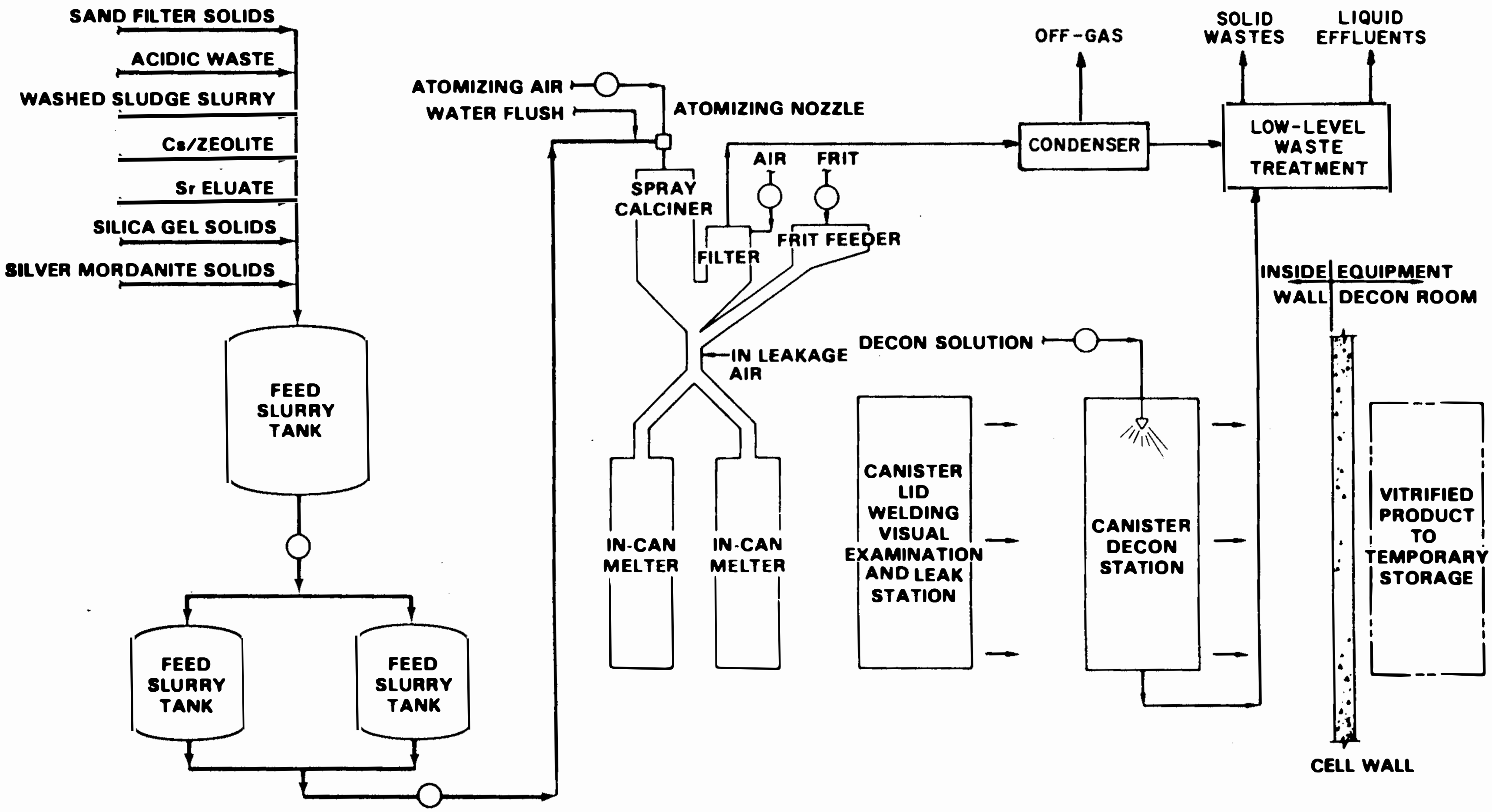

Figure B.9. Schematic of the Spray Calciner/In-Can Melter Process for Immobilization of High-Level Wastes in Borosilicate Glass. Adapted from Holton (1980).

combined and filtered through the cell air-filtration system to remove particulates before release to the stack. The resultant contaminated filters would be treated as solid wastes (as discussed in Section B.4). Details of the calciner off-gas treatment processes are given in Holton (1981).

The water condensed from the off-gas would arise principally from the water fraction of the neutralized HLW sludge fed to the calciner. This condensate would be collected in holding tanks for sampling. Based on sample radioanalysis, the contents of the holding tanks, would be treated in the LLW treatment facility and released. Under normal conditions, the estimated activity rate of the condensed process water is estimated to be 5×10^{-5} Ci/h, with a concentration of 2×10^{-6} Ci/L (Holton 1980). Postulated accident scenarios for this type of process are discussed in Section 4.1 of this EIS. There should be no obnoxious noises, odors, or vibrations associated with operation of the waste-vitrification facility.

In a separate vitrification step, prior to treating the neutralized Purex HLW, the acidic Thorex waste would be transferred for immobilization in glass. For this step, the centrifugation and cesium-strontium removal procedures would not be necessary. Otherwise, effluents from the calcining and glass-melting would be similar to those described above.

Liquid-Fed Ceramic Melter

A liquid-fed ceramic melter (LFCM), also called a continuous melter, can be used for vitrifying the HLW instead of spray calcination followed by in-can melting. The LFCM has long been used in the glass industry, and the basic technology is well-known. Its application to vitrifying radioactive wastes has been under development at Pacific Northwest Laboratories for some time, and the method possesses some distinct advantages for processing the West Valley HLW:

- Simpler equipment than the spray calciner/in-can melter system.
- Improved mixing of feed with additives.
- Reduced off-gas volume because no atomizing air is required as for a calciner.

This procedure is the major option for processing the nonseparated salt/sludge HLW; the system details are discussed in Section B.2.2.2. The information presented in that section is equally applicable to the separated salt/sludge option considered in this section except that the considerations associated with high sodium, nitrate/nitrite, and sulfate do not apply here.

Optional Processes

Decantation of the supernate in Tank 8D2 rather than homogenization with sludge is an optional approach. The supernate would be filtered prior to ion-exchange removal of cesium and strontium; centrifugation would not be required. In addition, use of a single, forced-circulation evaporator instead of multiple evaporators is under consideration.

Prior to the decantation, a precipitating agent capable of removing cesium from the supernate could be added. This approach could effect considerable simplification of the waste treatment process. Use of "bifunctional" resins to extract any residual cesium or strontium from this supernate would reduce the complexity of the ion-exchange system required.

Development Needs

Although the base technologies for the above procedures are generally available, there would be a need to adapt them specifically to West Valley conditions. Thus, the following research and development areas are needed:

1. Characterization of the contents of the neutralized-waste tank, based on analysis of the sludge and supernate, allowing better adjustment of the composition of feed for the vitrification. This would also allow the use of nonradioactive, but chemically similar, materials in testing of prototype equipment.

2. Operation of salt/sludge separation equipment.

3. Studies on glass formulations that take into account the very high sodium level in the neutralized-waste tank supernate, as well as the unique features of a high iron content in the sludge and a high thorium content in the acidic waste.

4. Studies to determine (a) the effectiveness of ion exchangers in removing cesium-137, actinides, and other cations in the presence of very high concentrations of sodium; and (b) the performance of the ion exchangers under projected process conditions to establish the validity of the projected immobilization process wherein these species are removed from the supernate and blended with the sludge before the mixture is fed to the vitrification system, while leaving the supernate with a low level of activity for transformation into a salt cake.

5. Engineering studies and testing concerned mainly with design and remote operation of vitrification equipment.

B.2.2.2 Nonseparated Salt/Sludge Option

In the nonseparated salt/sludge option, all the wastes would be immobilized by incorporation into glass. The process selected is the ceramic continuous-melter process (Holton 1981). The liquid-fed ceramic melter process is currently in a state of development both at Pacific Northwest Laboratory (Brouns et al. 1980) and Savannah River Laboratory. It is anticipated that this ceramic melter could be available for plant application in a few years. The ceramic melter is considered here as a means of vitrifying a mix of West Valley HLW with a high sodium content, which may cause scaling problems in a spray calciner.

Liquid-Fed Ceramic Melter

The liquid-fed ceramic melter (LFCM), or continuous melter as it is known in the glass industry, would be essentially a ceramic-lined melting chamber with a feed inlet and an exit drain leading to the canister to be filled with glass. Power is supplied to subsurface electrodes to melt the feed. The basic process consists of mixing the HLW with glass frit, melting the mixture in the melting chamber, and draining the molten glass into a canister. A simplified diagram of such a melter is shown in Figure B.10; a diagram for application of the process to the nonseparated salt/sludge option is presented in Figure B.11. The homogenized slurry from the waste tanks would be transferred to the processing cell, where glass-forming additives would be blended in to produce feed for the ceramic melter. Canisters of molten glass would be filled, welded shut, leak-tested, and decontaminated. These canisters would then be transferred to the onsite temporary storage facility. The off-gas from the melter would be treated before discharge to the atmosphere through a stack. Details of LFCM application to nuclear waste processing can be found in Chapman (1976), Buelt et al. (1979), Barnes et al. (1980), and Wicks (1981), among others.

Because the salt would not be separated out, there would be vitrification of a HLW stream containing high sodium, nitrate/nitrite, and sulfate concentrations. There are a number of technical questions that need to be resolved. The high sodium level in the waste requires that little or no alkali elements be added to the glass-former mixture. The resulting glass-former mixture has a higher melting point (>1400°C) than that in the separated salt/sludge option. Elimination of alkali elements from the glass former mixture reduces this variable for control of the waste-form process, making it more difficult to ensure the production of a high-quality waste form.

The levels of sulfate in the feed could produce difficulties with the borosilicate glass product quality and ceramic melter reliability. Sulfate has a limited solubility in borosilicate glass (less than 1 wt%). At concentrations above this level, a water-soluble sodium sulfate phase can form. Alkali elements such as cesium and rubidium would tend to concentrate in this phase. Glass designed to accommodate the sulfate would produce 3000 canisters. The sulfate could be volatilized from glass as sulfur dioxide by utilizing a strong reducing agent in the glass-former mixture (this has been assumed in this FEIS). A strong reducing agent, however, has the potential for corroding the melter electrodes. Sulfur has also been identified as a potentially corrosive agent in the ceramic melter (Dierks et al. 1980).

Effluents

The sulfate content of the wastes, a value that is now uncertain and will remain so until further chemical analyses are made, could result in the production of large amounts of effluents. Many of the sulfate salts would be decomposed in the melter to form SO_2; studies by PNL (Holton 1980, 1981) incorporate the addition of a reducing agent to the feed to expedite formation of this and other sulfur oxide gases. These would be removed in the off-gas treatment system by scrubbing with calcium carbonate (limestone). As shown in Table B.9, this would result, overall, in the production of 890, 55-gallon drums of by-product calcium sulfate sludge to be disposed as LLW.

Vitrification of the entire contents of Tank 8D2 would result in the production of a large quantity of nitric acid or nitrogen oxides (NOx), formed from the thermal decomposition of nitrate/nitrite which would be evolved from the vitrification process. The nitric acid could be recovered and processed to reduce its level of contamination; however, the residual activity would be

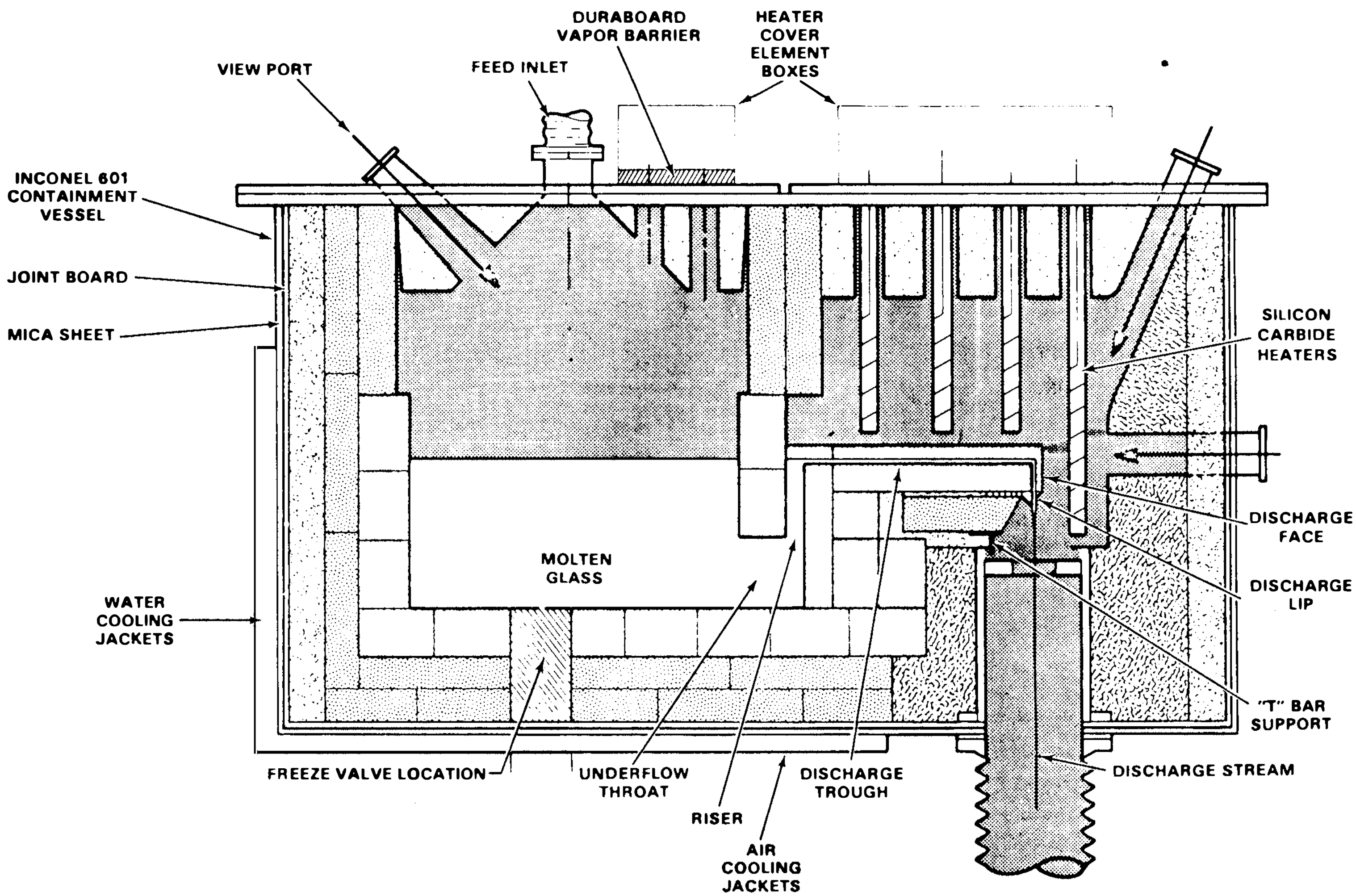

Figure B.10. Diagram of a Continuous Liquid-Fed Ceramic Melter.
Source: Dierks et al. (1980).

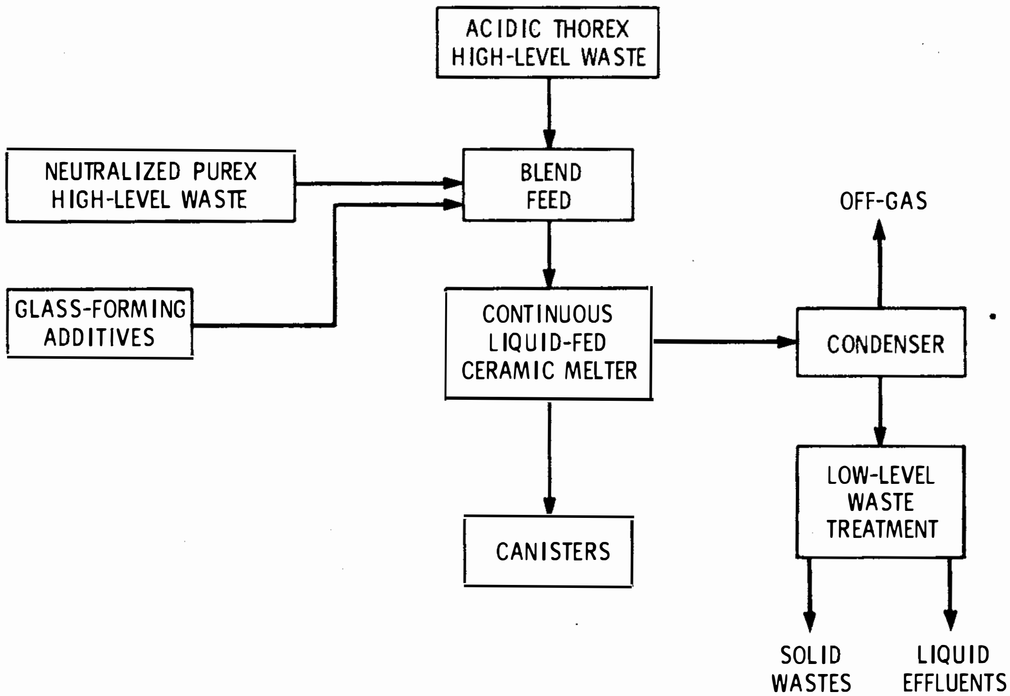

Figure B.11. Schematic of the Continuous Melt Process. Adapted from Holton (1980).

such that it could not be recycled for general use. The second processing option would necessitate dealing with the large volume of NOx gas produced. Destruction of the NOx could be accomplished with the use of an ammonia burner (Pence and Thomas 1974). To date, however, ammonia burners have not been reliably demonstrated for extended periods of time in radioactive environments. The latter option (i.e., use of an NOx destructor) was assumed for purposes of analysis in this EIS.

The water condensed from the off-gas stream (as shown in Figure B.11) would have an estimated activity of 4×10^{-7} Ci/L (Holton 1980). It is projected that after treatment in the LLW treatment facility, the resultant liquids could be released.

Development Needs

The major research and development needs for the nonseparated salt/sludge option are the following:

1. Characterization of the contents of the acidic Thorex waste in Tank 8D4 and of the neutralized waste in Tank 8D2, based on independent analysis of the acidic waste and the neutralized sludge and supernate. This information is critical to the formulation of an optimum glass product and to the prediction of the quantity of process off-gases.

2. Development of the best formulations for the product glasses. In the case of the neutralized waste, uncertainties regarding the maximum quantities of sodium that can be incorporated into the glass without adversely affecting its qualities must be resolved. In the case of the Thorex waste, the quantity of thorium in the glass would be the limiting factor. In both cases, the glass specimens should be tested to ascertain the effects of these limiting species on the properties of the glass, such as resistance to leaching and to physical impacts.

3. Studies of the effectiveness of the methods proposed for the removal of NOx and SOx from the melter off-gas stream.

4. Engineering studies and testing concerned mainly with design and remote operation of vitrification equipment.

B.2.2.3 Comparison of the Separated and Nonseparated Salt/Sludge Options

Glass has been produced from waste compositions representative of the separated salt/sludge and nonseparated salt/sludge options. The glasses were essentially identical when compared on the basis of chemical durability (Holton et al. 1980). Differences between the two options are, therefore, based on the degree of process complexity, state of process development, and volume of glass produced.

The major advantages and disadvantages of the separated and nonseparated salt/sludge options are compared in Table B.10. Because there are technical uncertainties and environmental disadvantages for each option, both were chosen for environmental analysis.

B.2.3 Interim-Form Immobilization

One of the principal advantages that could result from conversion of the West Valley wastes to an interim solid form would be the possibility of carrying out the conversion to a terminal waste form at the same time and place that other high-level wastes were being immobilized for permanent disposal. Another possible advantage might be that less modification of the West Valley facilities would be required for interim waste-form processing than for terminal waste-form processing if the existing facilities were utilized. However, implementation of an interim-form alternative requires the construction and operation of a terminal-form solidification facility. Such a facility does not currently exist.

Development work on methods for producing interim forms for HLW has been limited because such forms have not previously been investigated. A program for the study of interim waste forms was conducted at Argonne National Laboratory (Vogler et al. 1980), primarily in connection with the West Valley wastes. Preliminary analysis has narrowed down the interim form to two options: fused salt and agglomerated (pelletized) calcine. These options are discussed in detail below. For purposes of analysis in alternative 2, the fused-salt option was selected; the rationale for selection is given in Section B.2.3.6.

Table B.10. Comparison of the Major Advantages and Disadvantages of the Two Terminal Waste-Form Options

Advantages	Disadvantages
Separated Salt/Sludge Option	
Much smaller volume of solidified high-level wastes, leading to smaller size of onsite temporary high-level waste storage facility, fewer shipments of high-level wastes, and less space for disposal in Federal repository. Thus, lower costs.	Uncertainties regarding sludge/supernate separation and ion-exchange treatment of supernate. Also higher heat load per canister.
Control of glass composition easier because salt previously separated out.	Large volume of low-level salt cake requiring disposal.
Salt cake probably can be disposed of as low-level waste. Less costly than handling and disposing of as high-level or transuranic waste.	
Radioactive effluent streams, particularly gases, require less treatment. No sulfate sludges from off-gas treatment needing disposal.	
Nonseparated Salt/Sludge Option	
No need for complex separation of salt/sludge and ion-exchange treatment of supernate. Lower heat load per canister.	Larger volume of solidified high-level wastes, leading to larger size of onsite temporary high-level waste storage facility, more shipments of high-level wastes, and more space for disposal in Federal repository. Thus, higher costs.
No salt cake to dispose of. Amount of sludges from off-gas treatment less than amount of salt cake needing disposal.	Lack of experience with HLW.
	Control of glass composition more difficult because of high salt content. Uncertainties regarding high-temperature operation and maintenance of continuous melter under remote conditions.
	Sulfate sludges from off-gas treatment need disposal.
	Off-gas NOx destructor technology needs development

B.2.3.1 Interfacing the Interim Waste Forms with the Terminal Waste Form

The solid, interim waste forms are not designed to meet criteria for final geologic disposal. Interim-form HLW canisters are expected to be transported in certified shielded shipping casks from West Valley to a Federal waste facility where the interim-form wastes would be converted to a terminal waste form. This Federal site is assumed to have facilities for receiving the casks and interim-form canisters, temporarily storing the canisters, and possibly combining the interim-form West Valley wastes with other HLW stored at the site for simultaneous conversion to a terminal-form HLW.

Inclusion of interim-form wastes into the process streams of a Federal waste facility would begin with the removal of the waste from the canisters. Although removal of granulated material (i.e., agglomerated calcine) would require little more than removing canister covers, fused-salt monoliths would require melting prior to removal. There might also be a need to convert the interim-form HLW into another form more amenable to the facility's terminal-form process. Finally, the emptied interim-form HLW canisters would be either decontaminated for possible reuse or disposed.

B.2.3.2 Fused-Salt Process

In the fused-salt process, the West Valley HLW solids would be converted into monolithic, resolidified salt blocks. The feed considered for the fused-salt process is the same as that for the nonseparated salt/sludge vitrification option--that is, the contents of Tanks 8D2 and 8D4 would be mixed and processed at the same time. The feed would first be evaporated to remove the bulk of the water. The resulting solids slurry would then be transferred to a melter and heated to between 320 and 350°C to drive off the rest of the water and melt the solid. The melt would be poured into transport canisters, where it would form a solid monolithic block upon cooling. The canister lid would then be welded in place, and the canister put through leak-testing and decontamination procedures.

Conceptually, the process is straightforward, but it has not been demonstrated with HLW. The sequence of steps involved in the fused-salt process are shown in Figure B.12. The selected process is a modification of a procedure suggested by Cordiner and Hull (1971), with the substitution of wiped-film evaporators for bent-tube evaporators.

The process flow rates shown in Figure B.12 would require construction of a single wiped-film evaporator of considerable size, although well within current manufacturing capabilities. However, three smaller evaporators could be used (Vogler et al. 1980), any two of which together could maintain the desired process flow rate. The third evaporator would add to process reliability. To match this arrangement, two melting furnaces and canister-filling stands would be required.

Effluents

None of the contained radioactive species are expected to be volatile at the low temperatures at which the evaporation and melting steps would be conducted (maximum of 350°C). Thus, it is assumed that all the radioactivity would remain with the salt solution, except for a very small amount entrained in the

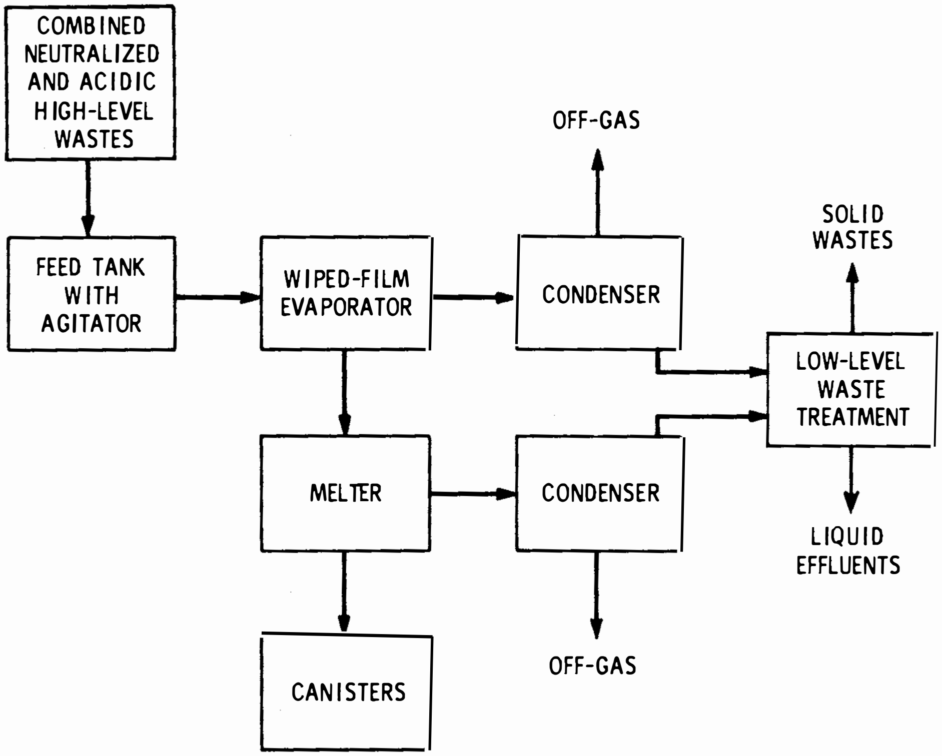

Figure B.12. Schematic of the Fused-Salt Process. Adapted from Vogler et al. (1980).

evaporated water. It has been estimated (Vogler et al. 1980) that this water, when condensed, would have a radioactivity concentration of 1 x 10^{-4} Ci/L. This condensate could be returned to the unused, stainless steel tank at the waste tank farm to be used in the solids-suspending and cleaning work in the neutralized-HLW tank. The contaminated condensate remaining at the end of these operations would be routed to the LLW treatment facility.

The radioactive contamination in the off-gas for the fused-salt process would be much lower than for alternatives 1a and 1b. This would make cleanup of this waste stream easier than for alternatives 1a or 1b.

Development Needs

The major areas needing investigation for the fused-salt option are:

1. Process safety.

2. Leach resistance, with water as the leaching agent.

3. Resistance of fused salt to physical impacts.

4. Stability of fused salt in a high radiation field.

5. Effect of the radiation field on other properties of fused salt--e.g., leach rate, impact resistance, and radiolytic decomposition.

6. Cracking of the fused-salt monolith as a result of stresses developing from differences between the centerline and circumferential temperatures.

7. Production of voids, if any, upon freezing of the melt in the canister and their effect on the stability of the monolith with changing temperature.

8. Effect of suspended sludge on fused-salt characteristics.

9. Modification of wiped-film evaporators for use with radioactive solutions.

10. Development of a salt-melter system.

11. Reliability of the wiped-film evaporator/salt-melter system for remote operation.

12. Development of feed compatibility with existing terminal-form melter.

Experimental work reported by Vogler et al. (1980) has shown that the fused-salt monolith dissolves rapidly in stagnant water at room temperature. Some information on impact resistance is available in the same report.

B.2.3.3 Agglomerated-Calcine Process

The use of agglomerated (pelletized) calcine as an interim waste form for West Valley HLW was also considered by Vogler et al. (1980). Feed to the calcining process (described in Section B.2.2.1 under Spray Calcination) could be either (a) separated neutralized Purex sludge and ion-exchange wastes from the supernate, with the acidic Thorex wastes added, or (b) all of the neutralized waste, including the supernate, with the acidic Thorex wastes added. However, laboratory tests (Vogler et al. 1980) have indicated that a suitable silicate-agglomerate waste form is best produced in the absence of the relatively large amounts of sodium salts in the supernate of the neutralized Purex HLW; hence, it is assumed that this procedure would involve the feed obtained by separating the sludge from the supernate.

The concept of converting the solids produced in a spray calciner to an agglomerated interim waste form containing silicate as a binder is described in this section. Silicate agglomeration was selected for a number of reasons: (1) it promises to decrease the dispersibility and leachability and to increase the thermal conductivity of the interim waste form, (2) the additive has the components of vitrified waste forms and, therefore, could be compatible with the eventual conversion to a vitrified form, (3) soluble silicates have been widely used as binders (Vail 1952), and (4) the properties of the sodium silicate ("water glass") can be adjusted to facilitate process operations and to impart suitable characteristics to the product; the sodium silicate properties are dependent on the proportions of sodium oxide (Na_2O), silica (SiO_2), and water.

The concept described here involves agglomeration of calcine powder into small spheres using a homogenous solution of sodium silicate, followed by firing the spheres at temperatures up to 550°C to remove water and to form hard pellets. The intent is to exploit the adhesive properties of water-glass and the hard, vitreous, intergranular film that remains when it dries. Colloidal silica, an optional binder, does not have the "sticking" quality of a water-glass solution (Vail 1952).

The sequence of operations in the silicate-agglomerated calcine process are shown in Figure B.13. This process is more complex than that for powdered calcine, mainly through the addition of pellet-forming and pellet-drying operations and because the water and entrained solid particles contained in the off-gas from the pellet-forming and -drying operations must be removed. The agglomeration process has been planned to include disc pelletization, because the latter is a well-developed technology that has already been tested on simulated, calcined nuclear wastes (Lukacs et al. 1979).

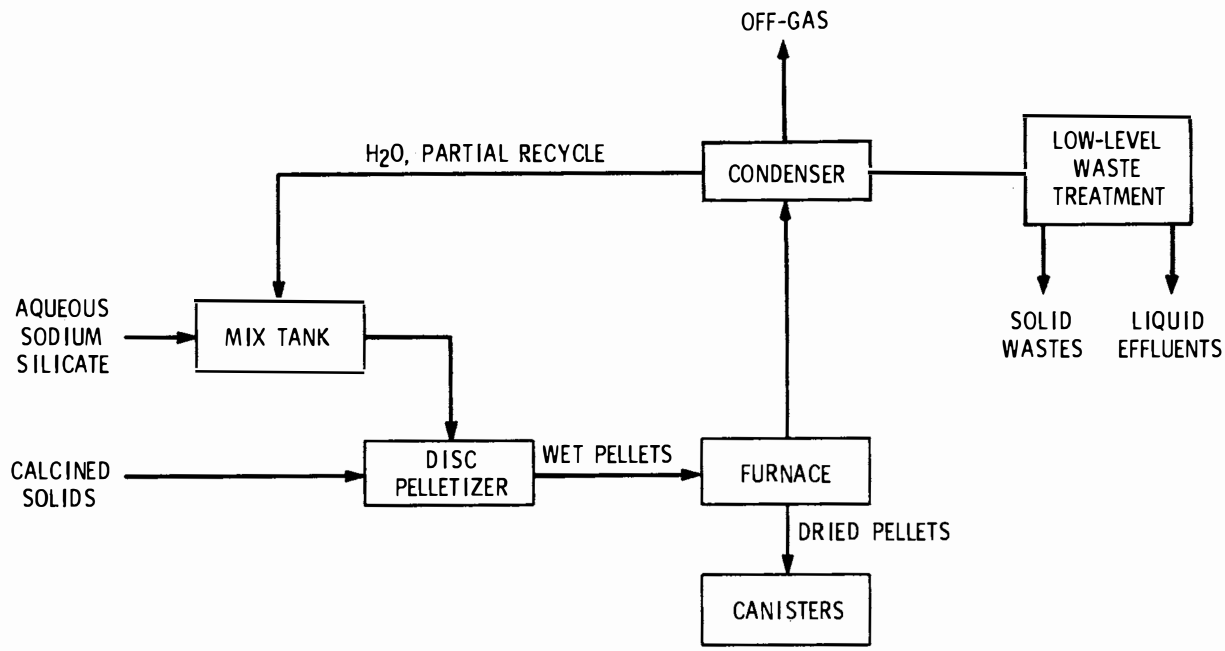

Figure B.13. Schematic of the Agglomerated-Calcine Process. Adapted from Vogler et al. (1980).

Effluents

The major components of the effluent streams are (1) the vessel off-gas--consisting of particulate solids, water vapor, and air, and (2) the cell exhaust, consisting of air and particulate solids. The effluent streams from the calcining process are not expected to differ in composition from those of the calcining part of the borosilicate glass process. The gaseous effluent from agglomeration and pelletizing would only be a small increment to the off-gas from the calcining portion of this process. The off-gas streams would be treated in a manner similar to that for the separated salt/sludge process described in Section B.2.2.1.

Development Needs

The major areas needing investigation for the agglomerated-calcine option are:

1. Leach resistance, with water as the leaching agent.

2. Resistance of agglomerated calcine to physical impacts.

3. Effects of radiation on the physical properties of the agglomerated calcine.

4. Optimum formulation of the water glass and of the agglomerated-calcine waste form.

5. Adaptation of the disc pelletizer to remote operations.

6. Optimum parameters for drying the silicate-agglomerated calcine pellets.

7. Compatibility of the agglomerated-calcine product with processes for conversion to the final vitrified form.

8. Reliability of the calciner/pelletizer for remote operation.

Work on a number of these problems is already under way, including studies on the resistance of the agglomerated calcine to leaching, physical impacts, and radiation. The studies will be carried out with agglomerates of various compositions to establish the optimum composition for this interim waste form (Vogler et al. 1980).

B.2.3.4 Interim-Waste-Form Criteria

In general, a Federal regulation (10 CFR 50) requires that liquid HLW be converted to a dry solid form within five years of generation and prior to offsite shipment; the solid should be chemically, thermally, and radiolytically stable so as not to generate pressures within a sealed shipping container exceeding safe operating pressure. This regulation specifically exempts the West Valley HLW. There currently are no specific regulations that further define desirable procedures or acceptable forms, terminal or interim, for the treatment and shipment of HLW. Accordingly, Vogler et al. (1980) have established their own criteria to be used as general guidelines for interim waste forms. These criteria are divided into two groups, the first dealing with the conversion process and the second with the properties of the product.

For the reasons discussed earlier (Section B.2.1.2), fused salt and agglomerated calcine are the two interim waste forms selected for further analysis. Process and product criteria, methods of production, and a comparison of these two waste forms appear in the following sections.

Interim-Waste Process Criteria

a. Simplicity. The equipment needed should fit into the West Valley or similarly-sized facility and should be simple to install, operate remotely, and decommission.

b. Safety. A properly designed process should be safe to install and operate.

c. Minimal Research and Development Needs. The process should have a reasonable degree of maturity, so that little laboratory-scale research and development is required.

d. Economics. The process could be lower in cost than that for the production of a terminal waste form.

e. Product Volume. The process should not extensively increase the volume of the product to be shipped offsite.

f. Utilization. The process should be adaptable for remote operation and maintenance.

g. Environmental Effects. The installation and operation of the process should have minimal environmental impact.

Interim-Waste Product Criteria

a. Compatibility. The properties of the interim form, including any additives, should be compatible with processes that might be used in producing the terminal waste-form product, e.g., borosilicate glass.

b. Dispersibility. The dispersibility of the waste form should be low to minimize the effects of transportation or other handling accidents.

c. Stability. There must be reasonable chemical and physical stability because the interim-form materials may require storage for long periods of time before terminal processing can be undertaken.

d. Heat transfer. The product should have thermal properties such that the heat generated by the contained radioactivity can be adequately dissipated.

e. Packaging. The waste form should be capable of being packaged so that the waste-canister/cask system can satisfy transportation regulations.

f. Terminal Process Compatibility. The product should be easily removed from its shipping canister.

B.2.3.5 Comparison of the Fused-Salt and Agglomerated-Calcine Processes

In the fused-salt process, all the HLW would be concentrated by evaporation and the concentrated salts would be melted and cast into monolithic forms. In the agglomeration process, the HLW would be calcined, mixed with sodium silicate, and formed into pellets. The interim-form product of the agglomerated-calcine processing of acidic Thorex and separated sludge is compared in Table B.11 to that of fused-salt processing of all the West Valley HLW. It should be noted that this is a comparison of extreme cases in terms of volume of product, wherein the fused-salt procedure would result in roughly six times the HLW product volume generated by the agglomerated-calcine procedure. If the use of identical waste canisters is assumed in both cases, the radioactivity and self-heating of the agglomerated-calcine canisters would be roughly six times larger than that of the fused-salt canisters.

Table B.11. Comparison of Properties of Interim-Form Products

Property	Agglomerated Calcine†1	Fused Salt†2
Number of canisters	165	1040
Fission products/canister (curies)†3	2.1×10^5	3.3×10^4
Actinides/canister (curies)†4	610	96
Surface radiation (rem/hour)	3.0×10^4	1200
Self-heating (watts/canister)	600	94
Centerline temperature (°C)	190	30

†1 Calcination of acidic Thorex waste and neutralized Purex sludge, with supernate removed prior to calcination. For the number of containers and properties of salt cake, see Table B.9.

†2 Solidification of all the high-level wastes, including the acidic Thorex waste and both the neutralized sludge and supernate in Tank 8D2.

†3 Based on a total West Valley HLW fission-product content of 3.4×10^7 curies.

†4 Based on a total West Valley HLW actinide content of 1.0×10^5 curies.

Criteria for interim waste-form processes and products were presented in Section B.2.3.4. These criteria are used below as a basis for comparing the fused-salt process (total HLW feed) with the agglomerated-calcine process (feed comprising separated sludge, ion-exchange waste, and acidic waste from the Thorex process).

Interim-Waste Process Criteria

a. Simplicity--Fused Salt Favored. The agglomerated-calcine process would involve more unit operations than the fused-salt process, principally an additional pelletization step. Further, although the fused-salt process would involve evaporating the water from the HLW, the agglomerated calcine process would involve evaporating not only the water from the HLW (calcination) but also the water added as a component of the silicate pellet binder. This second evaporation step would require additional furnaces, piping, and instrumentation. Since the neutralized supernate must be separated from the sludge and subsequently decontaminated, the agglomerated calcine process would have the added complexity of the centrifugation, filtration, ion-exchange, and evaporation operations and the arrangements for storing the separated salt cake as LLW.

b. Safety--Fused Salt Favored. The higher temperatures required for calcination (750-800°C) and the additional operations associated with agglomeration introduce additional possibilities for operational problems that might lead to adverse consequences; thus the fused-salt process appears to be relatively safer. However, the safety of storing fused salt is more questionable than storing agglomerated calcine because of possible container pressurization and corrosion.

c. Research and Development Needs--Agglomerated Calcine Favored. Spray calcination has been extensively demonstrated at Pacific Northwest Laboratory (Larson 1980; Holton 1980) on both simulated and actual HLW. The agglomeration of powders and subsequent firing to dried pellets is a routine industrial operation that has also been demonstrated on a small scale on simulated HLW. The performance of the fused-salt process has not been demonstrated as extensively as that for the calcination and agglomeration operations (Holton 1980).

d. Economics--Difference Not Obvious. The agglomerated calcine process would require not only the large capital costs for the calciner and its complex vessel off-gas system but also the cost of the agglomeration equipment (disc pelletizer and furnace systems for converting wet pellets to dried pellets). In addition, the agglomerated-calcine process would require separation of the neutralized supernate from the sludge in Tank 8D2. However, in treating the total volume of HLW, the fused-salt process would incur greater expense in terms of more waste canisters, a larger number of offsite shipments and related handling activities, and storage and processing requirements at the Federal waste facility. In light of the above, careful consideration will have to be given to the economics of both procedures before a judgment is made on their relative merit.

e. High-Level-Waste Volume--Agglomerated Calcine Favored. The volume of HLW would be much larger in the fused-salt alternative since the supernate is included in the processing.

Interim-Waste Product Criteria

a. Compatibility With Terminal Waste Form--Agglomerated Calcine Favored. If the terminal waste form is to be borosilicate glass, agglomerated calcine is considered to be more compatible with the vitrification process than fused salt. Conversion of fused salt would require the addition of very large amounts of glass-forming additives because of the much larger volume of waste and because the sodium content in the fused salt would require the waste loading of the glass to be less than that with agglomerated calcine.

b. Dispersibility--Difference Not Obvious. The concern of dispersibility generally hinges on how readily the waste form could be converted to an aerosol and how widely scattered contaminated solid particles might become on impact or breach of containment. In the light of qualitative observations, neither waste form seems to have a decided advantage over the other.

c. Chemical and Physical Stability--Agglomerated Calcine Favored. The agglomerated calcine is expected to be more resistant to leaching by water and also less susceptible to degradation by radiolysis.

d. Thermal Conductivity--Difference Not Obvious. In the absence of quantitative observations and with the knowledge that the thermal conductivity of some solid salts is not greatly different than that of some ceramics, it is not obvious that either waste form offers an advantage with respect to this criterion.

e. Compatibility with Packaging and Transportation Requirements--Agglomerated Calcine Favored. Since the agglomerate considered here would not contain the salt of the neutralized supernate, the volume of agglomerated-calcine HLW to be shipped would be smaller than the volume of fused-salt HLW. Agglomerated calcine is favored, based on the assumption that the number of HLW shipments is of more concern than the number of LLW shipments.

B.2.3.6 Rationale for Selecting the Interim Waste Form (Alternative 2) for Environmental Analysis

Two interim waste forms--agglomerated calcine and fused salt--were considered for inclusion in the alternative strategies. The environmental impacts associated with the fused salt and agglomerated calcine were analyzed and compared. The major differences in impacts between these two waste forms would result from waste handling and transportation. However, the differences in impacts for all the steps comprising the two alternatives were well within the accuracy of the estimates. The fused-salt option was selected for environmental analysis because it is a simpler process than agglomerated calcine, which is essentially as complex as the terminal-form alternatives 1a and 1b. The advantages inherent in the agglomerated-calcine process are such that, if a decision is made to immobilize the West Valley liquid HLW as an interim waste form, the agglomerated calcine process would be reevaluated during the waste-form selection.

B.2.4 In-Tank Solidification

In-tank solidification of the West Valley HLW was considered in a safety analysis report issued in 1973 (Nucl. Fuel Serv. 1973). Although no process details were given in the analysis, it can be inferred that the intent was to blend the contents of the neutralized Purex and acidic Thorex tanks and to reduce the volume by evaporation. This volume reduction would allow the blended wastes to be transferred into the other, unused carbon-steel tank, along with suitable additives for forming cement. The resulting monolith would have to be cooled for about 10 years before natural convective cooling would maintain the temperature in the concrete at an acceptable low level. At the end of this time, cooling would not be required and the space between the vault wall and the tank could be backfilled with silty till or cement to provide against future soil subsidence. The process that was proposed is described in some detail in the U.S. Department of Energy (1978) report and is presented as a simplified process schematic in Figure B.14.

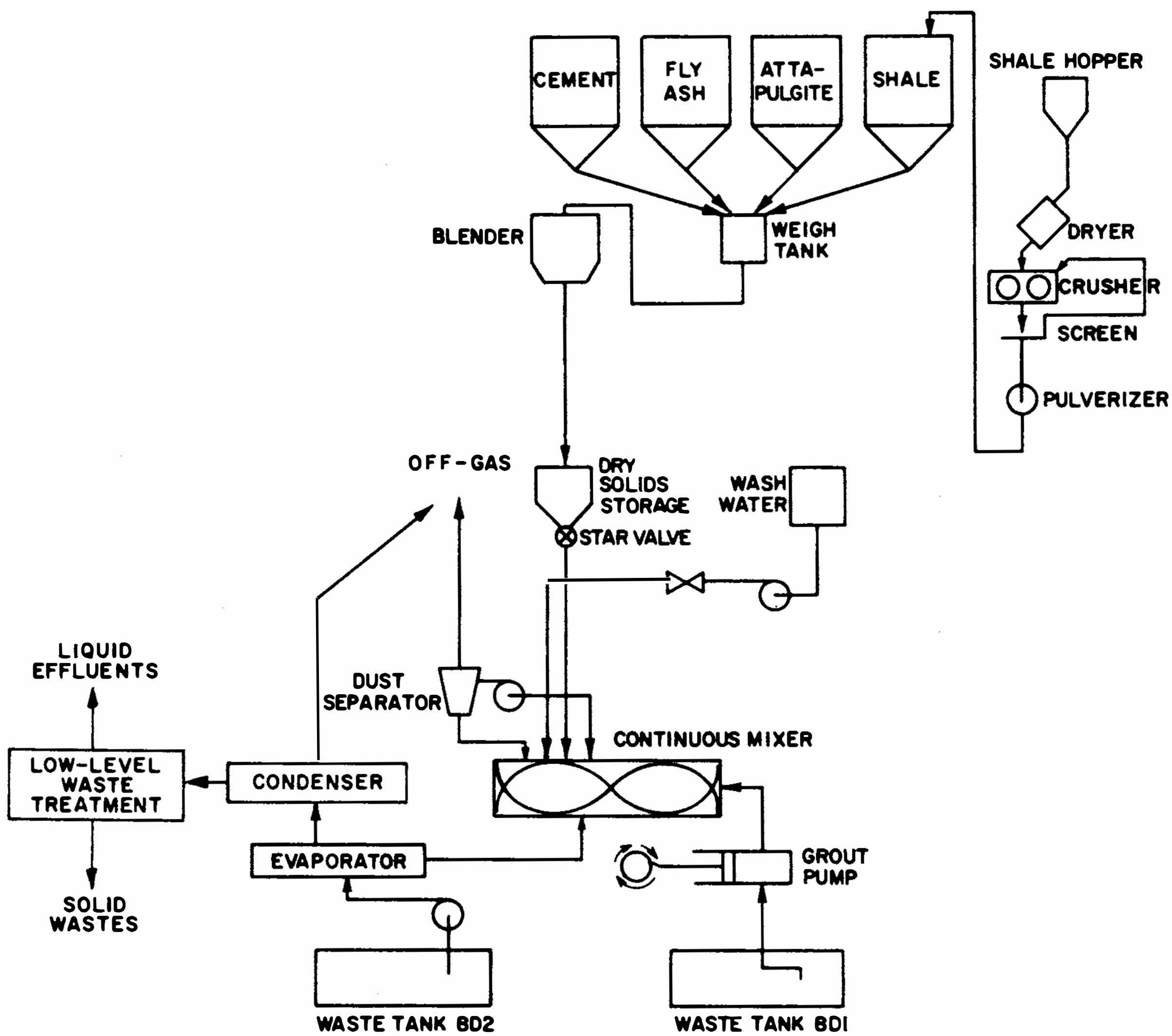

Figure B.14. Schematic of the In-Tank Solidification Process. Adapted from U.S. Department of Energy (1978).

The neutralized-HLW tank would be modified to accept waste-retrieval equipment as described in Section B.1.3. The wastes would be homogenized to the extent possible. The contents of the acidic-HLW tank would be added to the neutralized HLW during the solids suspension operation. The combined HLW would be fed to an evaporator in the existing reprocessing building and subjected to a volume reduction of approximately 10%. The resulting solids-liquid suspension would be pumped to a continuous mixer where the material would be blended with a metered flow of cement mix. The mix would consist of portland cement, attapulgus clay, fly ash, and ground shale--all additives that have been demonstrated to improve either radioisotope or excess water retention (U.S. Dep. Energy 1978).

Flow rates of the combined neutralized-waste/acidic-waste slurry would be 23,000 L/h. The mixer would mix the dry solids at a rate of up to 25,000 kg/h. The operation would be conducted as a series of "campaigns," each of which would involve processing 115,000 L of slurry to an estimated 160,000 L of cement mix. It would be necessary to devise a suitable slurry-distribution mechanism so that each pour could extend over the entire tank area. One week would elapse between campaigns, allowing the cement to set and cure. Seventeen campaigns would be required to process the 2 million L of slurry, yielding 2.6 million L of solidified wastes. It is estimated that the in-tank solidification procedure would take about two years.

Removal of the wastes from the neutralized-HLW tank would be completed with minimal tank washing so as not to exceed the capacity of the standby tank to accept the cement mix. The waste remaining in the HLW tank would be immobilized by filling the tank and vault with cement. The two acidic-waste tanks and their shared vault would be filled with cement (see Section B.6).

B.2.4.1 Effluents

If cement were to be produced by an onsite cement plant, there would be the normal nonradiological effluents associated with that operation: smoke, dust, high solids-content wastewater, and noise. The same conditions would be expected for the shale-crushing operation. In the continuous mixing of liquid HLW with cement and other dry additives, some amount of dusting would likely occur. However, the design of the dust separation and backup off-gas treatment capabilities would be such that the concentration of radioactive particulates in the off-gas stream would be acceptable for discharge to the atmosphere. Airborne effluents associated with evaporation of the HLW prior to cement solidification would be treated in the off-gas system. The water condensed from the off-gas would be treated in the LLW treatment facility and released.

B.2.4.2 Development Needs

The principal research and development needs for in-tank solidification of HLW are:

1. Structural analysis of the standby Purex tank in which the cement monolith is to be formed.

2. Formulation of optimum cement/HLW mix composition regarding the desired physical properties and radioisotope retention.

3. Stability studies on monolithic in-tank HLW cement.

4. Determination of the maximum loading in cement of HLW with high ionic salt content, compatible with the desired properties of the final mix.

5. Facility design for cement mixing and systems designs for dust elimination and cooling of monolith during the pre-entombment phase.

6. Development of equipment to ensure proper distribution of cement in the standby Purex tank and to monitor temperatures throughout the finished monolith.

B.2.4.3 Advantages and Disadvantages of In-Tank Solidification

In-tank cement solidification is a relatively straightforward process that could be carried out in the existing reprocessing facility, using a minimum amount of complex processing equipment. The simplicity of the required technology would allow the work to be undertaken comparatively quickly, and actual operations could be completed relatively rapidly (estimated to be about two years). Use of an evaporator to reduce the volume of HLW would require that these off-gases be treated prior to discharge. In addition, careful attention would have to be given to cement dust control. The cement solidification option would reduce costs and short-term risks of developing and applying a more complex solidification process and of transporting the wastes offsite either as an interim or terminal form.

The principal disadvantage of the in-tank solidification alternative would be the long period of time required for site surveillance and monitoring and the resulting long-term risk. This may not conform to the philosophy that HLW-disposal systems should not depend upon long-term institutional and societal stability for the security of waste isolation after disposal (Interagency Review Group 1979). Preferred disposal systems are those that do not need human supervision since they reduce the uncertainties inherent in long-term surveillance efforts (Bishop et al. 1978). In addition, the solidification alternative cannot be reconciled with the activities mandated by the West Valley Demonstration Project Act of 1980 (Public Law 96-368), which stipulates that the West Valley HLW are to be prepared for shipment to a Federal repository for permanent disposal. Once the wastes underwent solidification in the underground tanks at West Valley, shipment offsite would be permanently precluded. Further, the Advisory Panel on NFS High-Level Waste Forms (1980) recommended that development of in-tank waste forms would be justified only in the unlikely event that it proves impossible to empty and decontaminate the West Valley tanks.

B.2.5 Environmental Impacts

B.2.5.1 Radiological Impacts

The radiological impacts associated with processing the HLW consist of the occupational dose to perform this activity and the radiological risk to the population in the vicinity of the processing site, which is associated with the possible release of airborne radionuclides through the ventilation system as a result of the processing. The impacts associated with processing the interim-form HLW to a terminal form at a Federal waste facility for alternative 2 is added to the impacts of the processing activities at West Valley for this alternative.

The occupational dose is estimated from the work effort (person-years) required along with an average occupational dose rate based on experience in fuel reprocessing facilities at the Savannah River Plant (SRP). The average occupational dose to workers at SRP was 0.54 rem/year for the years 1965 through 1975 (U.S. Dep. Energy 1979b). It is anticipated that the occupational dose incurred as a result of processing the HLW could be kept at this level provided operational procedures were modified and improved, as necessary, to maintain exposures as low as reasonably achievable (ALARA).

The work force estimate from PNL for alternative 1a is that 127 workers would be directly involved in the solidification process for three years, exclusive of any increased work effort due to plant startup activities. In this EIS, it was assumed that an additional 27 workers would be required in an analytical capacity or to perform miscellaneous functions during the three-year processing period. Moreover, a fourth year would be required for tank flushing and decontamination. Assuming that the total number of workers required during tank flushing activities would be 30 for a period of one year, a total of 492 person-years of effort would be required for alternative 1a. In this EIS, it was assumed that this amount of effort would also be required for alternatives 1b and 2. In addition to the processing requirement at West Valley, the interim waste for alternative 2 must be processed to the terminal form at a Federal waste facility. Assuming that this would require an additional one year of effort, with the same work force as at West Valley, the total effort required for alternative 2 would be 646 person-years. For alternative 3, it is assumed to take two years for solidification of the HLW in the existing tank; assuming 154 workers per year, 308 person-years would be required.

The occupational doses associated with HLW solidification are summarized in Table B.12. These doses range from 170 person-rem for alternative 3 to 350 person-rem for alternative 2. The dose for alternative 2 is the largest due to the necessity of processing the HLW twice.

Table B.12. Occupational Doses from High-Level-Waste Processing

Alternative	Work Effort (person-years)	Average Dose (rem/year)	Occupational Dose (person-rem)
1a	492	0.54	270
1b	492	0.54	270
2	646	0.54	350
3	308	0.54	170

The risk to the population in the vicinity of West Valley (and the Federal waste facility) resulting from routine releases and potential accidents is given in Table B.13. The major contributor to this population risk would be

Table B.13. Population Risks from High-Level-Waste Processing

Alternative	Population Risk (person-rem)
1a	4
1b	3
2	3
3	3

the release of tritium from operation of the LLW treatment facility. The risk from alternative 1a would be slightly larger than from the other alternatives due to the additional processing requirement for the salt cake. However, considering the assumptions involved, this difference is not significant.

B.2.5.2 Nonradiological Impacts

The immobilization procedures associated with alternative 1a would produce no significant nonradiological environmental impacts. The LLW treatment facility would be designed so that the effluents would meet the appropriate State and Federal standards. Releases of effluents would not be expected to have a significant impact. Existing electrical, water, and natural gas services to the site are expected to be sufficient. The risks of worker injuries/deaths would be small (4.2 injuries and 0.05 deaths) and about the same as those associated with any industrial operation.

For alternative 1b, some gases of sulfur oxides (SOx) and nitrogen oxides (NOx) would be released to the atmosphere in addition to water vapor. The SOx gases would be treated as necessary to meet Environmental Protection Agency emission or air concentration limits. Releases of SOx and NOx are not expected to have a significant impact. The risks of worker injuries/deaths during operations would be the same as alternative 1a.

The nonradiological impacts associated with alternative 2 would be about the same as for alternative 1a. If the agglomerated-calcine option were chosen, the nonradiological impacts would be about the same as those associated with the fused-salt option. Nonradiological impacts at an offsite Federal waste facility would be about the same as if the processing was carried out at West Valley (alternatives 1a and 1b) and would add only a small increment to the defense waste-processing impacts.

The impacts for alternative 3 would also be about the same as for alternative 1a; the only difference is that for alternative 3, large amounts of cement would be used. Although cement dust can never be entirely eliminated, appropriate controls would minimize the impacts to workers and nearby ecosystems. Since the amount of activity would be much less than for alternative 1a, risks of worker injuries/deaths would also be much less (0.8 injuries and 0.01 deaths).

B.3 FACILITIES USED FOR SOLIDIFICATION AND TEMPORARY STORAGE OF HIGH-LEVEL, TRANSURANIC, AND LOW-LEVEL WASTES

The use of facilities for solidifying and storing the high-level, transuranic, and low-level wastes are discussed in this section. For illustrative purposes, it was assumed in this EIS that the existing reprocessing building would be decontaminated and modified to incorporate the necessary features to process the HLW. A study of the existing building has shown that the equipment needed for waste solidification can be installed in various cells of this building (Holton 1981). The use of the existing building for illustrative purposes is not meant to preclude the possible decision to construct a new building for this program. If a new building were constructed, it could incorporate features that might aid in reducing occupational exposure from processing and decommissioning. In this statement, differences between the utilization of the existing versus a new facility will be noted.

The separated salt/sludge terminal-form process (alternative 1a) has been selected for detailed discussion of facility requirements because the technology for processing HLW into this form is more fully developed than that for the nonseparated terminal form (alternative 1b). However, if the final decision is to use an interim form, a design study similar to that currently being carried out for the terminal form would be required and the options for facility use for interim-form solidification would have to be reevaluated.

In addition to modifying the existing reprocessing facility for the solidification program, it is assumed that new temporary storage facilities for HLW, LLW, and TRU wastes would be needed, because it is likely that a Federal repository for HLW and TRU wastes will not be available until 1997 or later and it is assumed that a regional burial ground for LLW will not be available until 1990 or later. Construction of two facilities for temporary storage of these wastes (HLW in one and low-level and TRU wastes in the other) is included in alternatives 1a and 1b so that the lack of disposal facilities would not delay solidifying the HLW (see Section B.3.2).

If the interim-form alternative 2 were chosen, there would be no need for an onsite temporary HLW storage facility but there would be a need for a new HLW facility at an offsite Federal waste facility. This facility would accommodate receiving, handling, and temporary storage of the interim-form waste canisters, as well as equipment for opening the canisters, removing the contained HLW, and transferring the wastes for incorporation with other high-level wastes for processing into the terminal form. Finally, this facility would have to provide for both the decontamination of and preparation for disposal of the canisters. There would still be a need for a new temporary storage facility for low-level and TRU wastes at West Valley.

For alternative 3, there would be no need for temporary waste storage facilities.

Modification of the existing LLW treatment system or construction of a new one for treating the solids, liquids, and gases resulting under any of the action alternatives (1a, 1b, 2, or 3) is discussed in Section B.3.2.1.

B.3.1 High-Level Wastes

B.3.1.1 Use and Modification of Existing Reprocessing Facilities for Solidification

Seismic and Meteorological Considerations

Before discussing utilization of the current facilities, it is appropriate to discuss the seismic design of the reprocessing building. When the building was designed and constructed in the 1960s, no specific seismic standards for nuclear fuel reprocessing facilities existed. Hence, it was designed to the requirements of the Uniform Building Code for reinforced concrete structures in a Zone III seismic damage area, an area of possible but infrequent and not intensive earthquakes.

As part of a license application for planned modifications of the building to increase nuclear fuel reprocessing capabilities in the early 1970s, Nuclear Fuel Services (NFS), using input assumptions directed by the Atomic Energy Commission (now the Nuclear Regulatory Commission), applied seismic design and geologic criteria developed for nuclear reactors (Appendix A of 10 CFR 100). NFS concluded that 0.12 g (12% of gravity) was a conservative estimate of the peak horizontal acceleration for a safe-shutdown earthquake (the event producing the maximum vibratory ground motion for which the facility could be safely shut down). However, in December 1975, the Nuclear Regulatory Commission imposed more stringent seismic criteria for the modifications and new construction. In particular, the Commission concluded that the new design should be based on a peak horizontal acceleration of 0.2 g at the site. In September 1976, the facility operator, Nuclear Fuel Services, Inc., concluded that modification of the building to meet these new criteria was not financially viable and announced its intention to withdraw from the nuclear fuel reprocessing business.

It should be noted that the seismic ground acceleration requirement of 0.2 g was imposed on a plant that would reprocess substantial amounts of commercial nuclear fuel. For the project proposed in this EIS, the facility would be used for solidification of HLW, which may make less stringent seismic requirements more appropriate. It has been suggested (Burns and Roe Indus. Serv. Corp. 1981, Task 3) that use of the facility for waste solidification should lead to seismic requirements comparable to those for radwaste facilities within the purview of 10 CFR 50 and 100. The seismic ground acceleration requirement for such facilities would be 0.1 g at West Valley.

For this EIS, a preliminary risk analysis was made. The results of this analysis indicate that if the wastes were solidified in the modified processing facility, no unacceptable hazard to the offsite population would occur as the result of an earthquake. However, since uncertainties remain, a more detailed seismic and tornadic hazard assessment--taking into account specific structures, systems, amounts of radioactivity available for release at any one time, as well as assessment of the consequences to the public--will have to be made based on the specific design when such information becomes available. Such analyses will be performed in conjunction with the Safety Analysis Report to be prepared for the solidification project.

Modifications

Design studies (Vogler et al. 1980; Holton 1981) have shown that it is possible to carry out HLW solidification to either the terminal form (Section B.2.3) or the interim form (Section B.2.4) in the chemical process cell of the existing reprocessing building. The following discussion focuses on alternative 1a, i.e., immobilization in borosilicate glass using the separated salt/sludge option. For illustrative purposes, the spray calciner/in-can melter was used; this process is considered to be a limiting case in terms of space availability because more unit processes and more equipment would be used than in the other immobilization options. This assumption is not meant to favor this process or to preclude the other solidification techniques. If a liquid-fed ceramic melter were substituted for the spray calciner/in-can melter, the requirements would be similar.

It is proposed to use the chemical process cell to house most of the equipment since preliminary design studies indicate that most of the process operations could be carried out in this cell. The equipment would include centrifuges, ion-exchange columns, spray calciners, and in-can melters or liquid-fed ceramic melters. The scrap removal room could be used for the preparation and packaging of the salt cake, and the equipment decontamination room could be used for the decontamination and temporary storage of the sealed HLW canisters.

Decontamination of Cells. Prior to use, extensive decontamination of the cell interiors of the chemical process cell, scrap removal room, and equipment decontamination room would be necessary. The decontamination is assumed to reduce the radiation levels within the cells to levels no greater than about 10 mrem/h (Burns and Roe Indus. Serv. Corp. 1981, Task 1A), which would allow personnel to enter and install the process equipment while adhering to the as low as reasonably achievable (ALARA) philosophy. Included in the cleanup would be decontamination and removal of all existing reprocessing equipment, piping, tanks, and any other obstructions and/or radioactive material within the cells. This decontamination would be performed in a manner that would minimize the impact on the structural integrity of the cells.

Although use of only a few cells directly used in fuel reprocessing is projected, it may be advantageous to remove the equipment from the other cells and perform some decontamination since this would advance the goal of final plant decommissioning, while allowing greater operational flexibility during processing. Some of these cells could be decontaminated while the wastes were being solidified, but for this EIS it is assumed that the entire decontamination would be completed before solidification began.

Most of the decontamination work would be done remotely to minimize the radiation doses to the workers. However, since many of the cells are not equipped with cranes or remote manipulators, it appears at this time that some of the decontamination activities would require contact (i.e., hands-on) procedures. The following description is based on the more detailed assessment given by Burns and Roe Industrial Services Corporation (1981, Task 1A).

For cells equipped with cranes and/or remote manipulators, cell decontamination would consist of remote decontamination and removal of equipment and remote decontamination of internal walls and floors. Cranes and manipulators, along with air tools and plasma torches, would be used to dismantle and remove equipment. A final spray decontamination of internal cell walls and floors would be carried out using a high-pressure water lance. Surface contamination could be removed from portions of the exposed concrete cell walls by scraping, or, if radiation levels were low, the radiation could be fixed to the walls by painting. Painting would reduce the possibility of personnel exposure to loose particulates, but would do little to reduce or mask the sources of gamma radiation.

The removed equipment would be remotely packaged in the equipment decontamination room or mechanical crane room and transported to a new onsite facility for temporary storage. The packaged equipment volumes from these cells are given in Section B.4, along with volumes for equipment from the other cells and for other radioactive wastes that would require temporary onsite storage. It should be noted that there is uncertainty regarding the level of decontamination of the equipment and the volume of wastes that would have to be classified as TRU wastes.

The remote decontamination techniques that could be used are (1) dry vacuuming of equipment, floors, and walls, (2) high-pressure aqueous chemical spraying (water lances) of equipment and structures, with wet vacuuming of cell walls and floors, and (3) chemical decontamination of component internals. The water lances would be mounted on the power manipulators. Vacuums would be adapted for use with cell power manipulators. Remote-operated rotating wet scrub brushes would be used on resistant surface contamination.

The basic decontamination techniques for the seven cells lacking remote manipulators would be the same as for the primary cells. However, some contact work would be necessary. First, the piping and other components would be decontaminated remotely, by flushing, to reduce gamma radiation. Since there are no cranes or manipulators, manual removal of the piping and components and manual decontamination of the cell walls and floors might be necessary. Because it is always desirable to avoid as much contact work as possible to minimize the exposure of workers to radioactivity, state-of-the-art decontamination procedures would be employed whenever these cells were to be decontaminated.

Chemical Process Cell Modifications and Equipment. The chemical process cell would house most of the equipment for immobilization of the HLW. The following description applies to the separated salt/sludge option (alternative 1a).

Existing features of the chemical process cell that are important to the solidification work include: (1) the cell is large and has thick concrete walls, (2) it is serviced by a remote-operated crane and an electromechanical power manipulator, (3) viewing necessary for remote operation is provided by oil-filled shielding windows in the west and north walls, and (4) a door is provided in the north wall for remotely moving equipment between the chemical process cell and the equipment decontamination room.

The chemical process cell would house the equipment for separating the sludge from the supernate, the ion-exchange systems, the process-solution evaporators, the spray calciner/in-can melter or liquid-fed ceramic melter, the canister-cover welder and test station, and the vitrification process off-gas treatment system. At least twice as many pieces of equipment would be required for this process as are currently installed in the chemical process cell, and many additional service lines to the cell would be required. Also, one or more process lines between the cell and the existing HLW storage tanks would be needed to transfer the stored HLW to the preconditioning equipment. Many of the streams that require sampling would contain solids; thus, the existing samplers might not be satisfactory, and some modifications could be required.

As currently envisioned, the spray calciner/in-can melter or liquid-fed ceramic melter would be placed close to the west wall, near the south end of the chemical process cell. Two new shielded viewing windows would be required in this location for operation and maintenance of the spray calciner/in-can melter or liquid-fed ceramic melter. New master slave manipulators would be required at each of these windows and at one other existing window where closures would be welded on the filled waste canisters. Some modifications to the floor and west wall of the chemical viewing aisle would be required for accommodating the new windows and for removal of the manipulator.

Electrical leads would be required through the west wall to service the equipment. A shielded cubicle and a wall penetration would be needed at the south end of the chemical process cell to house the frit addition airlock valves and associated equipment.

The equipment door in the north end would be used for moving empty waste canisters into and full canisters out of the chemical process cell. A new transfer cart would be required for moving the canisters. Two or three periscopes would be needed in the west wall to view change-out and maintenance of the spray-calciner feed nozzles, vibrators, and filters.

If the interim-form alternative were selected, the equipment would be housed in the chemical processing cell and would consist of three wiped-film evaporators, a melter, an evaporator feed tank, and a venturi scrubber system for initial off-gas treatment. Maintenance on the fused-salt and feed modules would be performed using the crane with two mounted television cameras. Routine operations would be performed from the gallery and control room with the crane or remote controls (Hill 1981).

Scrap Removal Room. The scrap removal room would be used for the preparation of the salt cake. It does not contain installed fuel reprocessing equipment. The room is serviced by a remote-operated crane and viewing is provided by one shielded viewing window. For remote operation of the salt-cake equipment, an additional viewing window and two sets of manipulator sleeves would be required. Maintenance of this equipment would be done both by contact and by remote means. A minimum of four process lines would be required between the chemical process cell and this room for transfer of process solutions and effluents.

General Considerations. All modifications would be designed to equal or exceed the shielding provided by the existing structures. The new facilities and equipment would be designed to facilitate decontamination and decommissioning. It is expected that the equipment to be installed would be on skids and of modular design. The present facility, after some renovation and refurbishing, is also expected to supply the basic laboratory and support services for the solidification project.

B.3.1.2 Use of a New Facility for Solidification

An alternative to modifying the existing facility is construction of a new facility. Basically, the same seismic and tornadic considerations would apply to the new facility as to the existing facility (see Section B.3.1.1). The new facility could, of course, be designed to meet whatever seismic criteria are determined to be appropriate for a solidification facility. However, a detailed seismic and tornadic hazard analysis--taking into account specific structures, systems, amounts of radioactivity available for release at any one time, as well as assessment of the consequences of a release to the public--would be required for a new facility when a more detailed design became available.

In the final decommissioning of the new facility, the same decontamination procedures would apply as those discussed for the existing building, which also would eventually be decontaminated and decommissioned.

The new facility could be a stand-alone structure located close to the existing reprocessing facility and tank farm (preliminary engineering work is not detailed enough at present to allow selection of an exact location). It would house all the equipment for processing and packaging the HLW. The bulk of the solidification equipment might be housed in two separate cells: (1) a pretreatment cell for centrifuges, filters, ion exchangers, evaporators, feed/holdup tanks, and salt-packaging equipment, and (2) a waste-vitrification cell for the spray calciner/in-can melter or liquid-fed ceramic melter, canister sealing equipment, and racks for lag storage of canisters. Each of these cells would be served by a maintenance and decontamination cell. Shielded viewing windows, cranes, and master slave manipulators would allow all operation and maintenance activities to be performed remotely.

Additional cells might include an off-gas treatment cell, a glass frit feed cell, a cell for housing the services and controls of the melter, a cell with areas for transferring empty and full canisters into and out of the waste-vitrification cell, and a decontamination cell for filled canisters.

An important design feature of the new facility would be its capability to be decontaminated and decommissioned remotely. For example, the two main cells would have adjacent decontamination/maintenance cells which could be used for remote decontamination and decommissioning of equipment. The process cell walls would be lined with either stainless steel or covered with a strippable coating to facilitate the removal of surface contamination. These cells would also be equipped with spray headers with complete cell coverage and hose connections for remote high-pressure water/steam hookups.

Transfer of filled canisters to a temporary, onsite HLW storage facility (Section B.3.4) could be accomplished either via a canister decontamination cell and loadout station or via an underground tunnel.

B.3.1.3 Qualitative Comparison of Using the Existing Facility or Using a New Facility

Solidification of the liquid HLW is a complex operation involving not only the solidification process itself, but also the pretreatment equipment needed to make the wastes amenable to solidification, off-gas treatment equipment, LLW treatment, HLW and LLW storage, and various support facilities required to keep the project operating in a safe and proper manner. Preliminary design studies (Vogler et al. 1980; Holton 1981) indicate that the existing facility may be modified to house the solidification process, but additional facilities would have to be constructed to house the other operations.

The major advantages of using a new facility for the solidification process are that it could be designed and constructed to (1) conform to whatever seismic criteria are determined to be appropriate, and (2) include certain features of remote operation, remote maintenance, and remote decontamination and decommissioning that would be difficult to incorporate into an existing structure not specifically designed for HLW solidification. Construction of such a facility would eliminate the uncertainties of decontaminating the existing facility to acceptable levels for worker exposure and the concomitant problems of accurately estimating project schedules and costs.

Construction of this facility could begin earlier than modification of the existing facility and could proceed without radiological/health physics support. This might shorten the schedule as currently envisioned, leading to an earlier date for the start of solidification.

Once removed from the critical pathway for project scheduling, decontamination of the existing facility could proceed in a less labor-intensive manner and to an exposure level higher than required for contact (hands-on) labor (i.e., if this facility were used for solidified HLW storage, decontamination need not be to the 10 mrem/h levels previously assumed. Final decontamination and decommissioning of this facility would be performed according to criteria developed by the Nuclear Regulatory Commission.

If the existing facility were to be used for the solidification process, it would have to be decontaminated twice: once before installation of the solidification equipment and again upon completion of the solidification campaign. Total costs for this option might be less; however, uncertainties of decontamination and of the building being able to meet suitable seismic criteria make costs difficult to project.

All these advantages and disadvantages are well within the present uncertainties regarding earthquake design criteria, engineering design and construction, and radiological exposure estimates. For this EIS, based on the work of PNL (Holton 1980), there was much more information available on the use of a modified existing facility, and it was therefore decided to use a modified processing facility for illustrative purposes. Also, since the existing building must eventually be decontaminated and decommissioned, the total impacts of a given alternative would not be significantly different for using the modified facility than for using a new facility. This choice would be evaluated during development of the project design. The Department will decontaminate and decommission the existing reprocessing facilities and any new facilities used in the solidification of the wastes in accordance with such requirements as NRC may prescribe.

B.3.1.4 Temporary Storage of Solidified High-Level Wastes

For alternatives 1a and 1b, there will be a need for temporary storage of the solidified HLW at West Valley until a Federal repository becomes available.

Currently, plans call for commencing the processing of the HLW in 1987 and completing the processing in 1990. However, a Federal repository will not be available until 1997, hence the need for temporary onsite storage. The number of canisters needing storage would be 300 for alternative 1a and 1300 for alternative 1b. The radioactivity content, heat generation, and number of canisters are given in Table B.9.

Use of Existing Facilities

A conceptual study (Burns and Roe Indus. Serv. Corp. 1981, Task 2) examined the feasibility of using existing facilities--i.e. the three primary cells or the spent fuel storage pool--for temporary storage of the solidified wastes. With respect to utilizing the cells for storage of the HLW canisters, it was found that two cells could accommodate only 128 canisters. If the largest cell, the chemical processing cell, were used to accommodate 300 canisters, it could not be used for solidification of the HLW. The study also concluded that the spent fuel pool, 70% of which is currently occupied with spent fuel assemblies, could accommodate 300 canisters in addition to the spent fuel if the spent fuel pool were reracked to store both HLW and spent fuel in a more efficient manner. However, neither the cells nor the spent fuel pool could accommodate the 1300 canisters expected from the nonseparated salt/sludge option.

Use of a New Facility

For this statement, a new storage facility for terminal-form HLW was assumed (the spent fuel pool is attached to the main process building and, for purposes of analysis, it was considered to be dismantled along with the processing building). However, during development of the project design, other options--including use of the spent fuel pool for temporary storage--would be reevaluated. No temporary storage, except perhaps lag storage, is contemplated for the interim-waste form because these wastes are assumed to be shipped offsite as they are processed.

The following description of a new storage facility for HLW is based on a conceptual design developed by Burns and Roe Industrial Services Corporation (1981, Task 7). Belowgrade vault storage was selected for this study because (1) it allows easy placement in storage and retrieval of canisters, (2) it lends itself to remote handling of canisters and minimizes exposures, and (3) it provides for easy interfaces with the offsite transportation system.

Two storage facilities were analyzed based on storage needs: (1) a small facility that could accommodate the 300 canisters from the separated salt/sludge process, and (2) a large facility that could accommodate the 1300 canisters from the nonseparated process. These facilities are based on the same design (shown in Figure B.15), the fundamental difference being the size of the storage vaults. It is assumed that support services for the storage facilities would be supplied from the solidification building. However, such services could be readily supplied if the solidification building were immediately dismantled after waste processing was completed. It is also assumed that the building codes, standards, and guides would be consistent with those that are used for government plutonium facilities (U.S. Energy Res. Dev. Admin., undated).

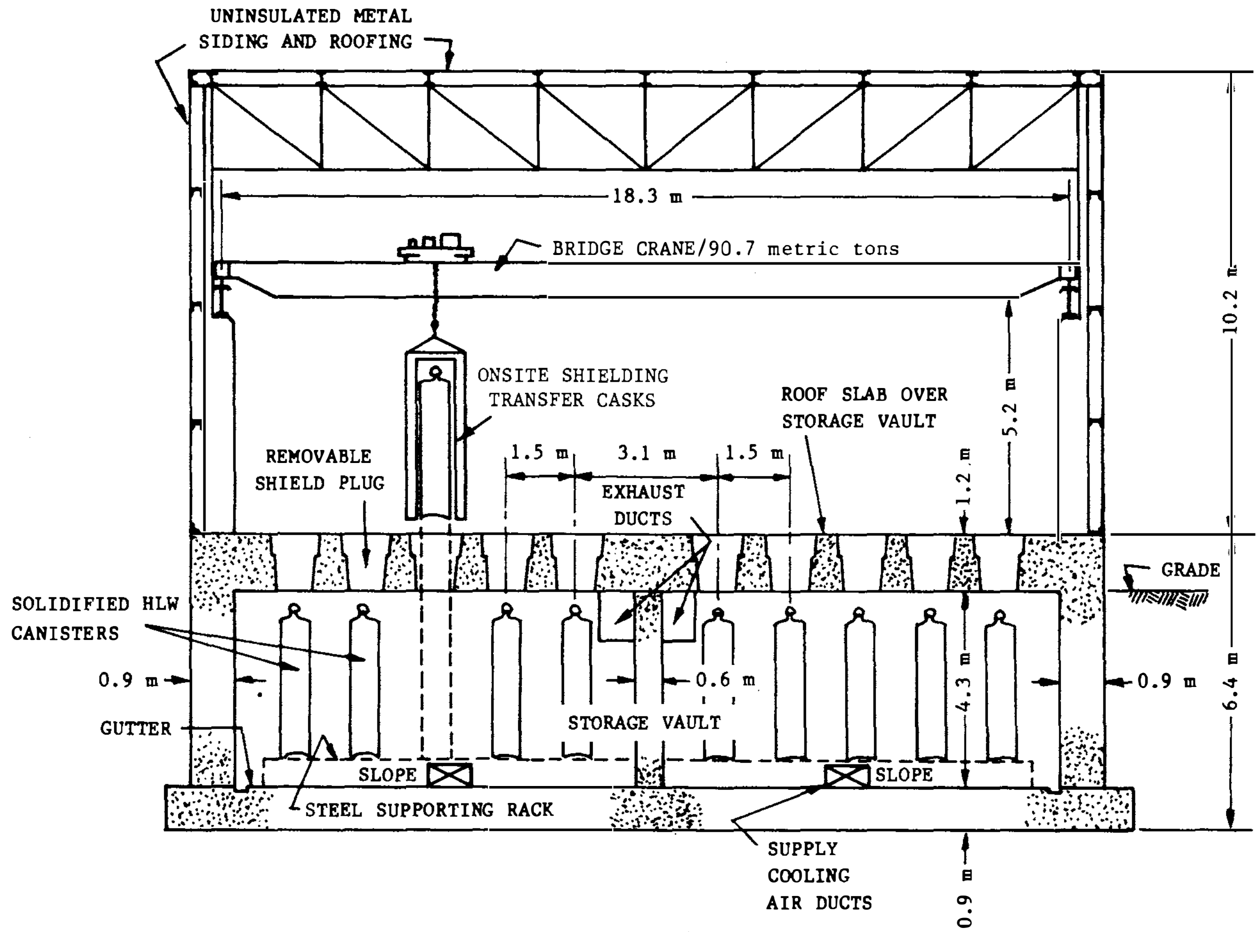

Figure B.15. A Conceptual Design for the High-Level-Waste Storage Facility. Source: Burns and Roe Industrial Services Corporation (1981, Task 7).

Both storage facilities would consist of a partially belowgrade, reinforced-concrete structure or vault. A steel rack structure for supporting the canisters and restraining their movement would be installed on the floor of the vault. The vault would have a thick roof slab. Built into this slab would be removable shielding plugs over holes for the individual canisters. A light metal building would be constructed over the vault to provide for an enclosed work space. Housed in and supported from this building's superstructure would be a bridge crane for the placement and removal of canisters. The waste canisters would give off heat, so cooling would be effected by a combination of convective cooling and circulation of the air in the vault. An onsite transfer cask would be used to move the canisters from the process building to the storage facility.

In the smaller waste storage facility, the vitrified-waste canisters would be stored, standing upright, in a single tier array, arranged in 30 rows of 10 canisters each. One end of the facility would serve as a loading/unloading area, which would consist of a railroad car loading area and an adjacent free space to be used for upending the empty cylindrical steel shipping casks from their horizontal shipping position to a vertical position and vice versa. In addition, a belowgrade loading cell would be provided for vertical loading of the canisters into shipping casks.

The larger facility would include two identical reinforced concrete storage vaults, almost entirely belowgrade, and a loading/unloading area in the center of the facility. The canisters in each vault would be stored in a single tier array of 65 rows of 10 canisters each.

B.3.2 Transuranic and Low-Level Wastes

B.3.2.1 Low-Level-Waste Treatment Facility

Since the current LLW treatment facility at West Valley is expected to be inadequate for treating the large volume of solids, gases, and liquids generated in solidification-related activities, the existing LLW treatment facility would be modified or a new facility constructed for treatment of these wastes. Such a LLW treatment facility would have shielded cells and would allow remote operation to minimize personnel exposure to radiation. The facility would be equipped with suitable radiation monitoring and alarm systems. Appropriate filter systems and ion-exchange resins would be installed to remove radioactivity.

Sampling of the liquid LLW in the collection tanks would be carried out first to determine what treatment is required. The liquid wastes would be treated, as appropriate, by filters to remove suspended solids, by evaporators to concentrate dissolved solids and reduce waste volume, and by ion-exchange resins to remove solutes at low concentrations. The concentrated solutions, sludges from filters, and spent ion-exchange resins would be mixed with a suitable binder to immobilize the radioactive species, and the mixture would be allowed to solidify in monolithic form in 55-gallon drums. The TRU wastes would be segregated from the other wastes.

Dry contaminated wastes--such as trash, filters, and failed equipment--would be separated into compactible and noncompactible wastes. The former would be reduced in volume by compactors and loaded into drums. The compacted wastes could be further immobilized by adding a binder. Reduction of volume by incineration of flammable compactible wastes is not considered to be economical because the quantity of such wastes would not be large. Noncompactible wastes, such as metallic items, would be cut to fit into standard package sizes. The environmental impacts associated with treatment of low-level radioactive liquids and processing the resultant filters, sludges, and resins to a solid form are included with the impacts from HLW processing given in Section B.2.

If the LLW treatment facility were not operational prior to initiation of the presolidification decontamination activities, it is assumed that the decontamination liquids could be stored in the existing HLW tanks or in new tanks prior to treatment. Solid wastes could be stored in the existing reprocessing facility.

B.3.2.2 Temporary Storage of Transuranic and Low-Level Wastes

If the project LLW are not disposed onsite, it may be necessary to store these wastes onsite until a regional burial ground is available. It may also be necessary to store the TRU wastes onsite until a Federal repository becomes available. Several concepts for temporary storage of transuranic low-level radioactive wastes have been investigated (U.S. Dep. Energy 1979e). These wastes could be stored aboveground in a facility designed to provide protection from the environment or belowgrade in a concrete-lined bunker. In this EIS, it is assumed that the temporary storage would be in belowgrade bunkers. The decision on what type of temporary storage facility to use will be made at a later date.

The storage bunkers would be designed to accommodate the TRU and low-level wastes generated by the solidification alternative chosen. Sufficient space is available near the existing reprocessing plant to accommodate either aboveground or belowgrade storage facilities.

Operational considerations may dictate that two separated bunkers, rather than one, be preferred for the temporary storage of these wastes. One bunker (45 × 129 × 25 ft deep) would be used to store those wastes with radiation levels below about 200 mrem/h and the other (46 × 113 × 25 ft deep) would be to store wastes with radiation levels greater than about 200 mrem/h. Both bunkers would be constructed belowgrade of asphaltic-coated reinforced concrete, with the upper surface nearly flush with the ground level. The structures would meet seismic and tornadic criteria and would conform to Department of Energy regulations relevant to the storage of TRU and low-level wastes.

B.3.3 Environmental Impacts

The environmental impacts associated with modification and construction of facilities are discussed in this section. The environmental impacts of the reprocessing facility modifications are applicable to all of the action alternatives (1a, 1b, 2, and 3) because the HLW are assumed to be processed in the existing facility for all these alternatives. A new or modified LLW treatment facility could also be constructed for all the action alternatives. A new temporary storage facility for HLW would be required only for alternatives 1a and 1b. A new temporary storage facility for TRU and low-level wastes would be required for alternatives 1a, 1b, and 2. A temporary storage facility would not be required for alternative 3 because it has been assumed that if the HLW were left onsite permanently, it would be reasonable to also bury the TRU and low-level wastes onsite in the existing NRC-licensed burial ground.

B.3.3.1 Radiological Impacts

The radiological impacts associated with modifying the existing reprocessing facility and installing waste solidification equipment consist of an occupational dose and the risk to the population in the vicinity of West Valley from offsite release of radioactivity. There would be no radiological impacts associated with the construction of the waste treatment or storage facilities.

The occupational dose resulting from decontaminating the current fuel reprocessing plant and removing the existing equipment would apply to all of the action alternatives (1a, 1b, 2, and 3). This dose is estimated to be 740 person-rem, based on a detailed study of the procedures required to decontaminate and remove the existing fuel reprocessing equipment and to decontaminate the cells required for waste solidification (Burns and Roe Indus. Serv. Corp. 1981, Task 1A). This estimate of 740 person-rem was increased from that given in the Burns and Roe study to take into consideration the additional requirements of decontaminating the remaining areas of the fuel reprocessing building. It is assumed in this EIS that most of this building would be decontaminated prior to installation of the solidification equipment. This occupational dose estimate assumes that maximum use would be made of appropriate shielding, remote manipulators, and cranes to achieve ALARA radiation doses. However, since some of the cells contain equipment that cannot be removed remotely, manual removal of piping and equipment in these cells and additional hands-on decontamination of the cell walls and floors would be required. The large occupational dose estimate is the result of this need to work in close proximity to highly contaminated areas.

The occupational dose from installing the solidification equipment is dependent upon the solidification option chosen. It is assumed that the radiation field within the cells following decontamination and equipment removal would be about 10 mrem/h or less (Burns and Roe Indus. Serv. Corp. 1981, Task 1A). The work effort estimates for installation of the solidification equipment, based on estimates provided by PNL, are 5000 person-hours for alternative 1a and 4000 person-hours for alternative 1b (Knowlton 1980). The requirements for alternatives 2 and 3 were conservatively estimated to be 4000 person-hours and 2000 person-hours, respectively. The occupational doses from installing the equipment for these alternatives are summarized in Table B.14, based on these assumptions.

Table B.14. Occupational Doses from Decontamination of the Existing Plant and Installation of the Solidification Equipment

	Occupational Dose (person-rem)		
Alternative	Presolidification Decontamination	Equipment Installation	Total
1a	740	50	790
1b	740	40	780
2	740	40	780
3	740	20	760

The occupational dose from decontaminating the existing reprocessing facility and installing the HLW solidification equipment does not vary greatly between alternatives because the major component of this dose is from decontaminating the facility prior to installing the solidification equipment, and this activity is common to all of the action alternatives.

The risk to the population in the vicinity of West Valley is estimated to be 0.1 person-rem for all action alternatives (1a, 1b, 2, and 3). This risk results from the release of radioactivity from decontamination activities.

There would be minimal release of radioactivity associated with installation of the solidification equipment.

If a new facility were built to solidify the HLW, there would be no radiological impacts related to decontamination of the existing fuel reprocessing facility prior to solidification.. However, since it would be necessary to eventually decontaminate and decommission the existing reprocessing facility as well as the new facility, the radiological impact associated with decontamination of the existing fuel reprocessing facility would undoubtedly occur sometime in the future. The occupational dose associated with equipment installation would not occur if a new waste solidification facility were built.

B.3.3.2 Nonradiological Impacts

At West Valley, the construction/modification activities would occur near the existing building on about 4 hectares (10 acres) of land that is currently maintained in grass and gravel. Construction impacts--such as increased traffic, noise, fugitive dust, loss of habitat, and preclusion of other land uses--would be largely confined to the existing cleared, developed portion of the site and would last only a few years. As with any construction project, there would be some risk of worker injury/fatality. It is anticipated that the total modification/construction activities would result in about 19 injuries and 0.19 deaths for alternative 1a. Alternative 2 would be the highest (25 injuries and 0.26 deaths), whereas alternative 3 would be the lowest (9.5 injuries and 0.1 deaths).

The impacts related to construction of the receiving/handling building at a Federal waste facility for alternative 2 would be relatively small and insignificant compared to the construction impacts that would occur during construction of solidification facilities at that site.

B.4 ONSITE AND OFFSITE MANAGEMENT OF SOLIDIFIED HIGH-LEVEL, TRANSURANIC, AND LOW-LEVEL WASTES

An integral component of any of the alternatives for the West Valley HLW solidification program is the management, in an acceptable manner, of all radioactive wastes produced. In this section, procedures and environmental impacts resulting from the handling, storage, and disposal of the high-level, transuranic, and low-level radioactive wastes are given.

B.4.1 Description of the Solidified Wastes

B.4.1.1 High-Level Wastes

The two types of high-level wastes (HLW) stored in tanks at West Valley--neutralized Purex waste and acidic Thorex waste--are described in Section B.1.2. The optional processes for immobilizing these wastes are described in Section B.2. Upon completion of HLW immobilization, it would be necessary to dispose of the immobilized HLW. It is assumed that the HLW resulting from alternatives 1a and 1b would be stored onsite until a Federal repository became available. The HLW from alternative 2 would first be transported to an offsite Federal waste facility for storage and additional processing, and then eventually to a Federal repository. The HLW from alternative 3 would remain at West Valley.

Although the acidic and neutralized wastes would be processed separately in alternative 1a, the environmental impacts for handling, transportation, and disposal for this alternative were obtained by treating the wastes as a composite waste. This procedure simplifies the analysis but does not alter the overall environmental conclusions.

B.4.1.2 Transuranic and Low-Level Wastes

In addition to the HLW, a large volume of TRU and low-level wastes would be generated in activities related to this program. If the existing reprocessing facility were modified and used for the solidification process, TRU and low-level wastes would be generated from decontamination of the cells prior to solidification. These wastes would also be generated during the solidification process and in the decontamination and decommissioning of the facilities after processing. If a new facility were built for the solidification process, no such wastes would be generated before processing since cleanup of the existing facility would not be needed. However, TRU and low-level wastes would be generated later when both existing and new facilities were decommissioned. The largest volume of LLW from the solidification process would accrue if a salt cake were generated, as in the immobilization of HLW using the separated salt/sludge process to produce borosilicate glass as the terminal waste form (alternative 1a).

The radioactive wastes currently produced from maintenance activities at West Valley are being buried onsite in the NRC-licensed burial ground. In addition to this burial ground, which was originally intended for disposal of high-activity wastes resulting from reprocessing activities, there is a State-licensed waste burial area (not operating at present) for disposal of LLW. There are no offsite wastes being buried at West Valley at this time.

B.4.2 Regulatory Considerations

B.4.2.1 High-Level Wastes

Two Federal agencies have responsibilities to ensure safe handling and disposal of radioactive wastes, including HLW from fuel reprocessing. The U.S. Environmental Protection Agency is responsible for formulating environmental standards, and the U.S. Nuclear Regulatory Commission has facility licensing and regulatory authority.

In 1970, the Environmental Protection Agency was created and given authority to set general environmental standards on radioactive exposure outside the sites of nuclear activities. This authority includes establishing the overall performance objectives for disposal of radioactive wastes (i.e., establishing standards for the maximum allowable release of radionuclides to the biosphere). The central objective of the Agency's HLW program is to develop generally applicable environmental standards for the management and disposal of high-level radioactive wastes. The Environmenal Protection Agency plans to propose these standards in 1982, and this will be followed by an extensive public comment period involving several public hearings. The Department of Energy participates in discussions regarding these standards and is sharing data with the Environmental Protection Agency for its use in formulating standards.

In the Energy Reorganization Act of 1974, the Nuclear Regulatory Commission was formed and given regulatory and licensing authority over facilities used for the handling of commercial high-level radioactive wastes. Such facilities include those used for retrievable surface storage and others authorized for the express purpose of long-term storage of HLW. The Commission is also responsible for providing and implementing regulations and criteria to meet the Environmental Protection Agency's overall performance objectives for safe, terminal waste disposal. The Commission's program is intended to assure the public that all Department of Energy repositories accepting commercial HLW materials are properly designed, constructed, operated, and decommissioned so as to protect the environment and human health and safety.

The Department of Energy has responsibility for developing the technology for the safe, terminal disposal of radioactive wastes. In its West Valley demonstration project, the Department will consult with the Nuclear Regulatory Commission regarding the waste form to be produced from liquid HLW and will provide the Commission with information necessary to identify any danger to public health and safety from the West Valley project (U.S. Dep. Energy 1981). The Department will also consult with the Environmental Protection Agency and other appropriate Federal and state agencies.

If the Department of Energy decides to solidify the West Valley wastes into a terminal waste form suitable for disposal in a Federal repository, this form will be required to meet criteria of the Nuclear Regulatory Commission's developing regulation (proposed 10 CFR 60). A draft of this regulation, which includes technical criteria for a solid waste form suitable for disposal in a repository, has been issued for public comment (U.S. Nucl. Reg. Comm. 1981a). It is anticipated that the regulation will be published as a final rule in 1982. However, if the Department chooses the option to convert the liquid HLW at West Valley into an interim solid form suitable for offsite shipment and later conversion into the final form for repository disposal, the criteria of proposed 10 CFR 60 would not apply to the process at West Valley, but would apply to the later conversion. For purposes of environmental analysis in this EIS, it is assumed that a repository will be licensed and operating by 1997.

B.4.2.2 Transuranic and Low-Level Wastes

In addition to the commercial LLW disposal grounds at West Valley (the State-licensed burial area), there are five commercial facilities for disposal of LLW. Of these five, three are currently operational and are located in South Carolina, Nevada, and Washington--which are Agreement States* and are licensed by the appropriate state agencies. These licenses dictate the physical and chemical form of wastes that are acceptable for disposal by shallow land burial. The criteria of waste acceptability are periodically updated to incorporate technological improvements in waste treatment and packaging, as well as regulatory changes owing to public concerns about the hazards of radioactive waste-disposal facilities. Currently, TRU wastes are not acceptable for disposal by shallow land burial. In this statement, it is assumed

*Agreement States are those states that have entered into agreements with the Nuclear Regulatory Commission on transfer of the regulatory authority of nuclear activities from the Commission to the State. To date, 26 states have entered into such agreements.

that TRU wastes would be disposed in a Federal repository for alternatives 1a, 1b, and 2. In alternative 3, the TRU wastes are assumed to be disposed onsite in the existing NRC-licensed burial ground. This burial is deemed reasonable because the HLW are also disposed by near-surface burial in this alternative.

The Department of Energy also maintains disposal facilities for low-level radioactive wastes at several sites owned by the Federal government. These Department facilities are not licensed by the Nuclear Regulatory Commission because they are owned and operated by the Federal government. However, the modes of operation of these sites are similar to those at commercial facilities.

In addition to these current regulations for LLW disposal, the Nuclear Regulatory Commission has drafted comprehensive regulations for the management of LLW. A draft of these regulations (proposed 10 CFR 61) was made available for public comment on July 24, 1981 (U.S. Nucl. Reg. Comm. 1981b). These regulations, which are scheduled to be issued in 1982, will address shallow land burial for the disposal of specific LLW, the method currently used at commercial sites. Management of the West Valley low-level wastes would be in accordance with the Nuclear Regulatory Commission regulations as well as those promulgated by the Environmental Protection Agency for disposal of wastes if buried in a licensed commercial disposal facility. If the LLW are disposed onsite in the NRC-licensed burial ground, such burial would be in accordance with Department of Energy criteria.

The facilities for treatment and temporary storage of TRU and low-level wastes would be designed to conform to existing regulations for such facilities. If future changes in regulations dictated changes in either of these facilities, such changes would be incorporated into the design of the facilities.

Congress has requested that the Department of Energy, as the lead Federal agency for nuclear waste, assess the need for development of regionally distributed sites for LLW. The Department has estimated that five to seven sites will be needed in the next ten years and that the northeast and midwest sectors of the country are the regions with the greatest near-term need for disposal facilities. However, no new land burial sites are in the development stages, and it is unlikely that new disposal facilities will be available in the next few years. For conservatism, in this EIS it is assumed that it will be necessary to store the LLW onsite for 15 years prior to disposal at a regional LLW disposal site. Impacts associated with such storage will be reduced or eliminated if the LLW are disposed onsite or a regional burial ground is available sooner.

B.4.3 Sources of High-Level, Transuranic, and Low-Level Wastes

B.4.3.1 High-Level Wastes

The amounts of HLW that must be handled and eventually disposed at a Federal repository for alternatives 1a, 1b, and 2 are given in Table B.15. For alternative 2, it is assumed that the interim form would be processed by the nonseparated salt/sludge process at an offsite Federal waste facility. Thus, the amount of HLW that would eventually be disposed in a Federal repository for alternative 2 is the same as that given for alternative 1b. There is no HLW to handle for alternative 3 because the waste is solidified in the existing tanks as a part of the processing activities.

Table B.15. Types of High-Level Wastes Requiring Onsite and Offsite Management and Disposal

High-Level-Waste Processing Option	Alternative	Number of Canisters	Surface Radiation†[1] (rem/hour) from Unshielded Canisters
Terminal Form			
Separated salt/sludge	1a	300	2.0×10^4
Nonseparated salt/sludge	1b	1300	4.5×10^3
Interim Form			
Fused salt†[2]	2	1040	1.2×10^3

†[1] Based on a composite of the wastes in Tank 8D2 (neutralized Purex HLW) and Tank 8D4 (acidic Thorex HLW).

†[2] It is assumed in this EIS that the interim form would be processed to a terminal form in a manner similar to alternative 1b at a Federal waste facility.

B.4.3.2 Transuranic and Low-Level Wastes

The various sources of TRU and low-level wastes are identified in Table B.16. The wastes arise primarily from three major activities: presolidification decontamination, processing, and final decontamination and decommissioning. The estimated volumes of each source from these activities, the treatment received, the package surface radiation level, and the percentage of each kind of waste treated as TRU waste are also given in the Table B.16. The waste volumes given in Table B.16 are based on detailed studies of the current West Valley reprocessing facility (United Nucl. Indus. 1978; Burns and Roe Indus. Serv. Corp. 1981, Task 1A), estimates of the amount of equipment required to perform the solidification of the HLW (Burns and Roe Indus. Serv. Corp. 1981, Task 1B), and an overview study of TRU and low-level wastes related to this program (Burns and Roe Indus. Serv. Corp. 1981, Task 4). Even though the waste volumes given in Table B.16 were developed with considerable investigation and study, these estimates might be subject to change based upon future advances in decontamination technology as well as improvements in HLW solidification techniques. The area of most uncertainty at this time is the amount of waste that will be classified as TRU wastes. As shown in Table B.16, approximately 25% is assumed to be TRU wastes. Depending upon the actual processing conditions and decontamination techniques used, as well as changes in regulatory classification, the amount of TRU wastes could vary significantly from this value.

The data in Table B.16 may be used to obtain estimates of the total volumes of TRU and low-level wastes that would be generated by the various alternatives. It is not possible at this time to identify many specific characteristics of the TRU and low-level wastes shown in Table B.16. These will be dictated by

Table B.16. Transuranic and Low-Level Wastes Resulting from the Solidification Project

Waste Form	Packaged Volume (ft^3)	Assumed Waste Treatment Process	Package Type	Package Volume (ft^3)	Package Number†1	Unshielded Maximum Surface Radiation	Unshielded Average Surface Radiation	Percent Treated as TRU†2
Presolidification Decontamination								
Rubbish and trash	4,000	Compact†3	55-gal drums	7.35	540	50 mrem/h	10 mrem/h	50
Spent filters and resins	810	Solidify in binder	55-gal drums	7.35	110	50 rem/h	20 rem/h	25
Solidified decontamination solution	24,000	Solidify in binder	55-gal drums	7.35	3,200	40 rem/h	10 rem/h	25
Contaminated equipment and hardware	58,000	Dismantle and cut	Liner	200	290	10 rem/h	500 mrem/h	25
Processing HLW†4 (General)								
Rubbish and trash	11,000	Compact†3	55-gal drums	7.35	1,500	50 mrem/h	10 mrem/h	50
Spent filters and resins	2,100	Solidify in binder	55-gal drums	7.35	290	50 rem/h	20 rem/h	25
Solidified decontamination solution	740	Solidify in binder	55-gal drums	7.35	100	15 rem/h	6 rem/h	25
Failed equipment	2,000	Dismantle and cut	Liner	200	10	10 rem/h	500 mrem/h	25
Processing HLW (Specific)								
Supernate salt cake†5	37,000	Evaporate and dry	55-gal drums	7.35	5,100	8 mrem/h	5 mrem/h	0
Sulfate sludge†6	6,500	Evaporate and dry	55-gal drums	7.35	890	Negligible	Negligible	0
Final D&D (Dismantlement)†7								
Rubbish and trash	8,100	Compact†3	55-gal drums	7.35	1,100	50 mrem/h	10 mrem/h	50
Spent filters and resins	810	Solidify in binder	55-gal drums	7.35	110	50 rem/h	20 rem/h	25
Solidified decontamination solutions	31,000	Solidify in binder	55-gal drums	7.35	4,200	15 rem/h	6 rem/h	25

Table B.16. Continued

Waste Form	Packaged Volume (ft^3)	Assumed Waste Treatment Process	Package			Unshielded		Percent Treated as TRU†2
			Type	Volume (ft^3)	Number†1	Maximum Surface Radiation	Average Surface Radiation	
Final D&D (Dismantlement) (contd.)†7								
Contaminated equipment and hardware	64,000	Dismantle and cut	Liner	200	320	10 rem/h	500 mrem/h	25
Waste retrieval equipment	5,000	Dismantle and cut	Liner	200	25	10 rem/h	500 mrem/h	50
Fuel storage racks†8	24,000	Dismantle and cut	4x4x8-ft box	128	190	50 mrem/h	10 mrem/h	0
Contaminated rubble†9	23,000	None	4x4x4-ft box	64	360	10 mrem/h	1 mrem/h	50
Final D&D (Entombment)								
Rubbish and trash	6,800	Compact†3	55-gal drums	7.35	920	50 mrem/h	10 mrem/h	50
Spent filters and resins	810	Solidify in binder	55-gal drums	7.35	110	50 rem/h	20 rem/h	25
Solidified decontamination solutions	29,000	Solidify in binder	55-gal drums	7.35	4,000	15 rem/h	6 rem/h	25

†1 Rounded to two significant figures.

†2 Percent of specified volume treated as TRU waste.

†3 A volume reduction factor of three is assumed.

†4 The volumes of LLW given for HLW processing (with the exception of the salt cake and sulfate sludge) are based on the separated salt/sludge option which is projected to produce the maximum volume of LLW. For the nonseparated salt/sludge and in-tank solidification options, less processing LLW would be produced.

†5 From separated salt/sludge process.

†6 From nonseparated salt/sludge process.

†7 D&D = decontamination and decommissioning. If a new facility is used, the additional volume of LLW due to demolition of the new building would be about 20,000 ft^3 of contaminated rubble.

†8 Based on present storage rack configuration.

†9 Includes contaminated concrete from decontamination of processing building, LLW treatment facility, and interim storage facilities.

the procedures used to implement this program. However, care must be taken to ensure stability of the waste form over the length of time it is hazardous. For example, certain organic binders (such as asphalt) are not appropriate for wastes with relatively high radiation levels (greater than 50 rem/h). In addition, use of chelating agents in decontamination solutions will result in radioactive wastes that may contain significant levels of these chelating compounds. Proposed regulation 10 CFR 61 specifies that wastes containing more than 0.1% chelating agents require NRC approval prior to disposal. These specific concerns will be addressed during the design phase of this project to ensure compliance with Department of Energy regulations. To use the data in Table B.16, it is important to note that not all forms of wastes apply to all alternatives. For example, the process to immobilize the HLW as borosilicate glass using the separated salt/sludge option would include the supernate salt cake volume, but not the sulfate sludge volume; the nonseparated salt/sludge option for borosilicate glass formation would include the sulfate sludge volume, but not the salt cake volume. Similar adjustments are required for estimating the volumes of TRU and low-level wastes generated by decontamination and decommissioning for the various alternatives. The types of wastes included in each alternative are shown in Table B.17.

Table B.17. Matrix Showing the Activities During Which Transuranic and Low-Level Wastes are Generated for the Various Alternatives†[1]

		Processing High-Level Wastes			Final Decontamination and Decommissioning	
			Specific			
Alternative	Presolidification Decontamination	General	Supernate Salt Cake	Sulfate Sludge	Dismantlement	Entombment
1a	X	X	X	-	X	-
1b	X	X	-	X	X	-
2	X	X	-	-	X	-
3	X	X	-	-	-	X

†[1] The symbol "X" indicates that transuranic and low-level wastes are generated; the symbol "-" indicates that these wastes are not generated.

Information regarding the surface radiation levels of the wastes is needed to estimate the occupational radiation doses during packaging, handling, and disposal. The radiation levels in Table B.16 are considered to be typical for the types of wastes listed. However, some packages could have higher levels than the values assumed to be typical. Thus, the actual radiation levels of the packaged wastes would be measured so that proper precautions could be taken to ensure worker safety. The estimation of radiological impacts associated with management of the TRU and low-level wastes is based on the maximum surface radiation levels given in Table B.16.

For alternatives 1a, 1b, and 2, the solidification facility is assumed to be dismantled and the resultant wastes transported offsite for burial. In alternative 3, the solidification facility is assumed to be decontaminated and entombed. Details on these options are given in Section B.6. The wastes resulting from these decommissioning options are shown in Table B.16. Note that if a new facility were constructed for waste solidification, the amount of contaminated rubble requiring disposal would be approximately twice as large, provided the existing reprocessing facility were also dismantled.

B.4.4 Environmental Impacts

In this section, the environmental impacts associated with onsite (i.e., either placement in a waste storage facility or onsite disposal) and offsite management (handling, storage, and/or disposal) of high-level, transuranic, and low-level wastes are discussed. The impacts associated with offsite transportation of these wastes are given in Section B.5.

B.4.4.1 High-Level Wastes

The environmental impacts associated with temporary onsite storage of the terminal-form HLW (alternatives 1a and 1b); temporary offsite storage of the interim-form HLW (alternative 2); disposal of the terminal-form wastes from alternatives 1a, 1b, and 2 in a Federal repository, and permanent onsite disposal at West Valley (in-tank solidification alternative 3) are given in this section.

Radiological Impacts

The radiological impacts associated with handling, storage, and disposal of the HLW would consist of the occupational dose from handling the wastes, the short-term dose to the population in the vicinity of the site from accidents related to onsite storage of the wastes prior to disposal, and the long-term risk from disposal of the wastes in a Federal repository.

Occupational Dose. The occupational dose from handling the HLW is dependent upon the alternative used. For alternatives 1a and 1b, the occupational dose would consist of the following four waste-handling activities:

1. Placing the waste canisters in the HLW solidification cell onto a motorized vehicle for onsite movement to the HLW storage facility.

2. Unloading the canisters from this vehicle and placing them in the temporary onsite HLW storage facility.

3. Retrieving the canisters from storage and loading them onto a transport vehicle for shipment offsite.

4. Unloading the canisters from the transport vehicle and disposing of them in a Federal repository.

Under optimal conditions, the handling activities would be similar to the above for alternative 2 because the interim-form HLW would be transported to a storage facility at a Federal waste facility, unloaded and placed in storage, retrieved and processed to the terminal form, and transported to a Federal repository for disposal. However, it may be necessary to handle the HLW more than four times depending upon the availability of a Federal waste facility and the specific details of coordinating the solidification of the West Valley interim-form HLW with the HLW at a Federal facility. Since these details will not be known until such a program is better defined, it has been assumed in this EIS that the HLW will be handled four times--twice as the interim form and twice as the terminal form. The terminal-form processing at a Federal waste facility is assumed to be production of a borosilicate glass by a process similar to the nonseparated salt/sludge option (alternative 1b). For alternative 3, there would be no occupational dose from HLW handling (the occupational dose is all accounted for under the waste processing step).

The occupational doses from handling the waste packages are estimated from unit-dose factors, which depend upon the physical package characteristics, the external surface radiation levels, and the specific handling activity. The unit-dose factors used in this EIS to estimate the occupational dose for each handling activity for HLW are shown in Table B.18. These factors are based on occupational dose experience for handling spent fuel assemblies. There would be minimal risk to the population from handling HLW because such activities would occur either at West Valley or at other waste processing and disposal sites that are fairly long distances from the general population. The unit-dose factors are different for the various waste forms due to the variations in surface radiation of the canisters.

Table B.18. Unit-Dose Factors for Handling the High-Level Wastes

High-Level-Waste Processing Option	Alternative	Surface Radiation Level†[1] (rem/hour)	Unit Occupational Dose†[2] (person-mrem/canister)
Terminal Form			
Separated salt/sludge	1a	2.0×10^4	250
Nonseparated salt/sludge	1b	4.5×10^3	120
Interim Form			
Fused salt	2	1.2×10^3	120

†[1] Based on a composite of the wastes in Tank 8D2 (neutralized Purex HLW) and Tank 8D4 (acidic Thorex HLW).

†[2] This occupational dose is for one handling activity, either loading onto a transport vehicle or unloading at a storage or disposal site.

The occupational doses for handling the HLW are estimated by multiplying the unit-dose factors by the numbers of canisters to be handled. The number of HLW canisters that would be handled for the various alternatives and the associated radiation levels are given in Table B.15. It should be recalled that the canisters are assumed to be handled four times for the applicable alternatives (1a, 1b, and 2). The occupational doses for handling the HLW are given in Table B.19. The occupational dose would be smallest for alternative 1a because this alternative has the fewest number of canisters to be handled.

Table B.19. Occupational Doses for Handling the High-Level Wastes

Alternative	Occupational Dose (person-rem)
1a	260
1b	620
2	560

Population Risk. The cumulative risk to the population from handling, storage, and disposal of HLW includes the risk to the population in the vicinity of West Valley for the three action alternatives, and to the population in the vicinity of a Federal repository for alternatives 1a, 1b, and 2. A 15-year storage period is assumed for storage of the HLW for alternatives 1a, 1b, and 2. The population risk associated with this interim-storage period and during the first 100 years following disposal would be small. Scenarios leading to the release of radionuclides during the interim-storage period were investigated and were determined to contribute less than 0.1% to the total short-term population risk for this project. For the 100-year period, it is assumed that monitoring, corrective actions, and other institutional controls would serve to prevent, control, or minimize any potential releases to the environment. Thus, only the long-term population risk has been quantified.

The long-term population risk from disposal of the HLW in a Federal repository for alternatives 1a, 1b, and 2, and the risk from onsite disposal of the HLW for alternative 3 through 10,000 years are given in Table B.20. The population risks were estimated by examining the potential pathways that would result in the movement of radionuclides to the area surrounding the disposal site. The long-term risk for alternative 3 is much larger than for the other alternatives considered, due to easier access (intrusion) to the solidified HLW. The long-term population risk associated with HLW disposal in a Federal repository is low due to the low probability of human contact.

Nonradiological Impacts

A minor nonradiological impact of HLW disposal would be the dedication of land to nuclear use. For alternatives 1a, 1b, and 2, disposal of the high-level and TRU wastes in an underground Federal repository would account for less than 1% of the wastes in the repository. Thus, the aboveground incremental land-use impacts (preclusion of other uses) from disposal of the West Valley

Table B.20. Cumulative Population Risk from Handling, Storage, and Disposal of High-Level Wastes

Alternative	10,000-year Risk (person-rem)
1a	61
1b	61
2	61
3	5200

wastes would be insignificant. Worker injuries/deaths during disposal of all wastes are combined and are given in Section B.4.4.2.

For alternatives 3 and 4b, there would be a potential for water to carry chemicals from the HLW for the long term when there were no institutional controls. Using the same groundwater model that was used for the radiological analysis (Nucl. Safety Assoc. 1980), it was found that concentrations of nitrate, chromium, uranium, and plutonium in nearby streams would be at least one-thousand times less than drinking water limits of potentially toxic levels.

B.4.4.2 Transuranic and Low-Level Wastes

The environmental impacts associated with onsite storage and offsite disposal of the TRU and low-level wastes resulting from solidification of the HLW are dependent upon the solidification alternative. For alternatives 1a, 1b, and 2, the LLW are assumed to be disposed offsite in a regional disposal site whereas the TRU wastes are assumed to be disposed in a Federal repository; in alternatives 3 and 4, the TRU and low-level wastes are assumed to be disposed in the onsite NRC-licensed burial ground. In alternatives 1a, 1b, and 2, the TRU and low-level wastes resulting from the presolidification decontamination of the existing reprocessing plant and those from HLW solidification are assumed to be stored onsite in a new storage facility for TRU and low-level wastes prior to offsite shipment.

Radiological Impacts

The radiological impacts associated with handling and storage of the TRU and low-level wastes consist of the occupational dose from handling the wastes, the dose to the population in the vicinity of West Valley from accidents related to onsite storage of the wastes, and the risk associated with disposal of the wastes.

Occupational Dose. The occupational dose from handling the wastes is dependent upon the alternative. For alternatives 1a, 1b, and 2, the occupational dose would consist of the following four waste-handling activities for TRU and low-level wastes resulting from presolidification decontamination and HLW processing:

1. Placing the waste packages in the LLW treatment facility onto a motorized vehicle for onsite movement to the storage facility.

2. Unloading the packages from this vehicle and placing them in the temporary onsite storage facility.

3. Retrieving the packages from storage and loading them onto a transport vehicle for shipment offsite.

4. Unloading the packages from the transport vehicle and disposing of them in the burial ground.

The TRU and low-level wastes resulting from the final decontamination and decommissioning would only be handled twice since it has been assumed in this EIS that final decontamination and decommissioning would not occur until there was an offsite storage or disposal facility for these wastes.

For alternative 3, only two waste-handling activities would occur for all TRU and low-level wastes because they would be disposed onsite in the NRC-licensed burial ground rather than placed into onsite storage. Because the number of handling activities would be less for onsite disposal of wastes, the effect would be to decrease the occupational dose associated with waste handling.

The occupational doses from handling the waste packages are estimated from unit-dose factors, which depend upon the physical package characteristics, the external surface radiation levels, and the specific handling activity. Three types of packages have been selected in this EIS to be used for the storage and disposal of TRU and low-level wastes: 55-gallon drums, large metal boxes for wastes that can be transported unshielded, and cylindrical liners that can be placed in shielded overpacks for transportation (see Table B.16).

The unit-dose factors used in this EIS to estimate the occupational dose for each handling activity for TRU and low-level wastes are shown in Table B.21 for the radiation levels of these wastes that are projected to occur in the program. There would be minimal risk to the population from handling these wastes because such activities would occur either at West Valley or at other waste processing and disposal sites that are fairly long distances from the general population. The unit-dose factors depend on the radiation levels of the wastes because different handling techniques would be required to ensure compliance with ALARA. The waste packages with high surface radiation levels (i.e., greater than about 0.2 rem/h) would be handled remotely whereas those with low radiation levels (i.e., less than 0.2 rem/h) could be handled directly. The handling procedures that will be utilized will be defined more thoroughly as the project progresses.

These unit-dose factors were obtained by examining the necessary activities related to loading and unloading radioactive waste packages on transport vehicles and the radiation field associated with these activities; the radiation levels are consistent with field experience (Mullarkey et al. 1976; U.S. Nucl. Reg. Comm. 1981d). The unit-dose factors for TRU and low-level wastes are assumed to be the same because the major component of this exposure

Table B.21. Unit-Dose Factors for Handling Transuranic and Low-Level Wastes

Package Type	Surface Radiation Level (rem/hour)	Unit Occupational Dose (person-mrem/package)†[1]
55-gal drum	<0.2	0.2
55-gal drum	>10	2
Liners	1 to 10	10
Boxes (4x4x4 ft)	<0.2	10
Boxes (4x4x8 ft)	<0.2	10

†[1] This occupational dose is for one handling activity, either loading onto a transport vehicle or unloading at a storage or disposal site.

would be from radiation penetrating the waste packages and any waste-handling shields or overpacks. The penetrating radiation would be similar for TRU and low-level wastes because the transuranic elements are basically alpha-emitters, and alpha particles would not penetrate any waste package. The unit-dose factors for boxes are higher than for 55-gallon drums with equivalent radiation levels, due to the bulkiness of these boxes.

The occupational doses for handling TRU and low-level wastes are estimated by multiplying the unit-dose factors by the number of packages to be handled. Table B.22 gives the number of waste packages to be handled for the various alternatives. It should be recalled that the waste packages would be handled four times for alternatives 1a, 1b, and 2, and two times for alternative 3. The occupational doses for handling the TRU and low-level wastes, which are assumed to be the same, are given in Table B.23. The occupational dose for alternative 3 is lower than for the other alternatives because the wastes would be handled fewer times. Onsite disposal of LLW for alternatives 1a, 1b, and 2 would reduce the occupational doses for handling the TRU and low-level wastes by about 20%.

Population Risk. The cumulative risk to the population shown in Table B.24 includes the risk to the population in the vicinity of West Valley for alternatives 1a, 1b, 2, and 3, and to the population in the vicinity of the regional disposal site for alternatives 1a, 1b, and 2. A 15-year storage period is assumed for onsite storage of the TRU and low-level wastes for alternatives 1a, 1b, and 2. The short-term (through 100 years) risks given in Table B.24 are solely those associated with accidents related to temporary onsite storage of wastes followed by disposal in a regional burial ground (alternatives 1a, 1b, and 2) or immediate disposal in the NRC-licensed burial ground (alternative 3) with resultant airborne release of radionuclides. It is assumed that there would be no release of radionuclides from these wastes due to offsite migration

Table B.22. Number of Transuranic and Low-Level Waste Packages for the Various Alternatives

Alternative	Package Type	Radiation Level (rem/hour)	Number of Packages TRU	LLW
1a	55-gal drums	<0.2	1570	6670
	55-gal drums	>10.0	2003	6007
	Liners	1.0 to 10	168	477
	Boxes (4x4x4 ft)	<0.2	0	360
	Boxes (4x4x8 ft)	<0.2	0	190
1b	55-gal drums	<0.2	1570	2460
	55-gal drums	>10.0	2003	6007
	Liners	1.0 to 10	168	477
	Boxes (4x4x4 ft)	<0.2	0	360
	Boxes (4x4x8 ft)	<0.2	0	190
2	55-gal drums	<0.2	1570	1570
	55-gal drums	>10.0	2003	6007
	Liners	1.0 to 10	168	477
	Boxes (4x4x4 ft)	<0.2	0	360
	Boxes (4x4x8 ft)	<0.2	0	190
3	55-gal drums	<0.2	1480	1480
	55-gal drums	>10.0	1953	5857
	Liners	1.0 to 10	75	225
	Boxes (4x4x4 ft)	<0.2	0	0
	Boxes (4x4x8 ft)	<0.2	0	0

Table B.23. Occupational Doses for Handling Transuranic and Low-Level Wastes

Alternative	Occupational Dose (person-rem)
1a	83
1b	80
2	79
3	38

Table B.24. Cumulative Population Risk from Handling, Storage, and Disposal of Low-Level Wastes

Alternative	Risk (person-rem)	
	100-year	10,000-year
1a	0.13	140
1b	0.13	4
2	0.13	4
3	0.09	4

within the first 100 years after implementation of this program, except those releases resulting from accidents. The risk would be low due to the very low probability that events causing the release of radionuclides would occur. The risk from alternative 1a is largest as a result of the salt cake.

Also given in Table B.24 are the long-term (through 10,000 years) population risks from (a) disposal of LLW in a regional burial ground and TRU wastes in a Federal repository for alternatives 1a, 1b, and 2, and (b) onsite disposal of the LLW and TRU wastes for alternative 3. These risks were estimated by examining the potential pathways that would result in the movement of radionuclides to the area surrounding the disposal site. The long-term risk for alternative 1a is much larger than for the other alternatives considered, due to the large amount of salt cake containing technetium-99 in the burial ground and the movement of this technetium in groundwater. The major pathways for radionuclide migration for alternative 1a would be groundwater contamination and human intrusion; for the other alternatives, human intrusion would be the dominant exposure pathway.

Nonradiological Impacts

For any of the alternatives, less than 1 hectare (2.5 acres) in a burial ground would be dedicated to disposal of the wastes generated during the project (LLW only for alternatives 1a, 1b, and 2; LLW plus TRU wastes for alternative 3). The construction-type impacts associated with this disposal would be insignificant. Of the action alternatives, alternative 3 would present the highest risk of worker injuries and deaths during disposal (9.8 and 0.11, respectively) because of the continued need for workers at the West Valley site during the 100 years of institutional controls.

For alternative 1a, the disposal of large amounts of salt cake in the regional burial ground would have to be carefully controlled since nitrates can be hazardous (U.S. Environ. Prot. Agency 1978). In addition, during the long term when there were no institutional controls, it must be assumed that eventually the steel drums containing the salt cake would rust and that water might enter the burial trenches and dissolve the salt. The nitrate salts are very soluble in water and can become toxic under conditions in which they are reduced to nitrites. Domestic drinking water criteria for nitrates are 10 mg/L (as nitrogen) (U.S. Environ. Prot. Agency 1976). Using the same groundwater model that was used for determining potential releases of radioactive elements from the burial ground (Nucl. Safety Assoc. 1980), it is estimated that concentrations of nitrate in the stream would be one-thousand times less than the EPA limit.

B.5 TRANSPORTATION

Implementation of the West Valley HLW demonstration project would require that the solidified HLW be transported offsite to approved disposal facilities for all alternatives except 3 and 4 (in which the wastes would be disposed onsite). The West Valley legislation also requires that low-level and TRU wastes produced by the project be disposed in accordance with applicable licensing requirements. If the LLW are not disposed onsite, transportion of the wastes to a disposal facility would be required. The TRU wastes would be transported offsite for alternatives 1a, 1b, and 2. For alternatives 1a and 1b, it is assumed that both the HLW after solidification and the TRU and low-level wastes resulting from the various activities involved in the solidification program would be stored onsite until disposal facilities became available, at which time the wastes would be transported offsite. For alternative 2, the interim-form HLW is assumed to be transported offsite shortly after processing at West Valley, but the resultant TRU and low-level wastes would be temporarily stored onsite. In this section, various options available for transporting all of these wastes are discussed, along with the applicable regulations and environmental impacts as they relate to the HLW solidification program.

B.5.1 Methods of Shipment

The available methods for shipment of the high-level, transuranic, and low-level wastes are:

- Truck shipment from West Valley to a processing or disposal site.
- Rail shipment from West Valley to a processing or disposal site.
- Intermodal rail and truck shipment (rail shipment for the entire route might not be possible because some disposal or storage facilities do not have rail spurs).

B.5.1.1 Transporting High-Level Wastes

Currently, no casks have been specifically designed and constructed for transporting HLW. However, the extensive experience gained in design of spent-fuel casks is now being employed in design efforts for HLW casks; the technological base for spent-fuel casks is directly applicable to the technology required for HLW casks.

A reference design concept has been completed for both truck and rail casks. The concept is referred to as a convertible cask because the casks will have interchangeable aluminum baskets. A drawing of a convertible cask is shown in Figure B.16. In rail transport, these baskets--which will fit within the cask

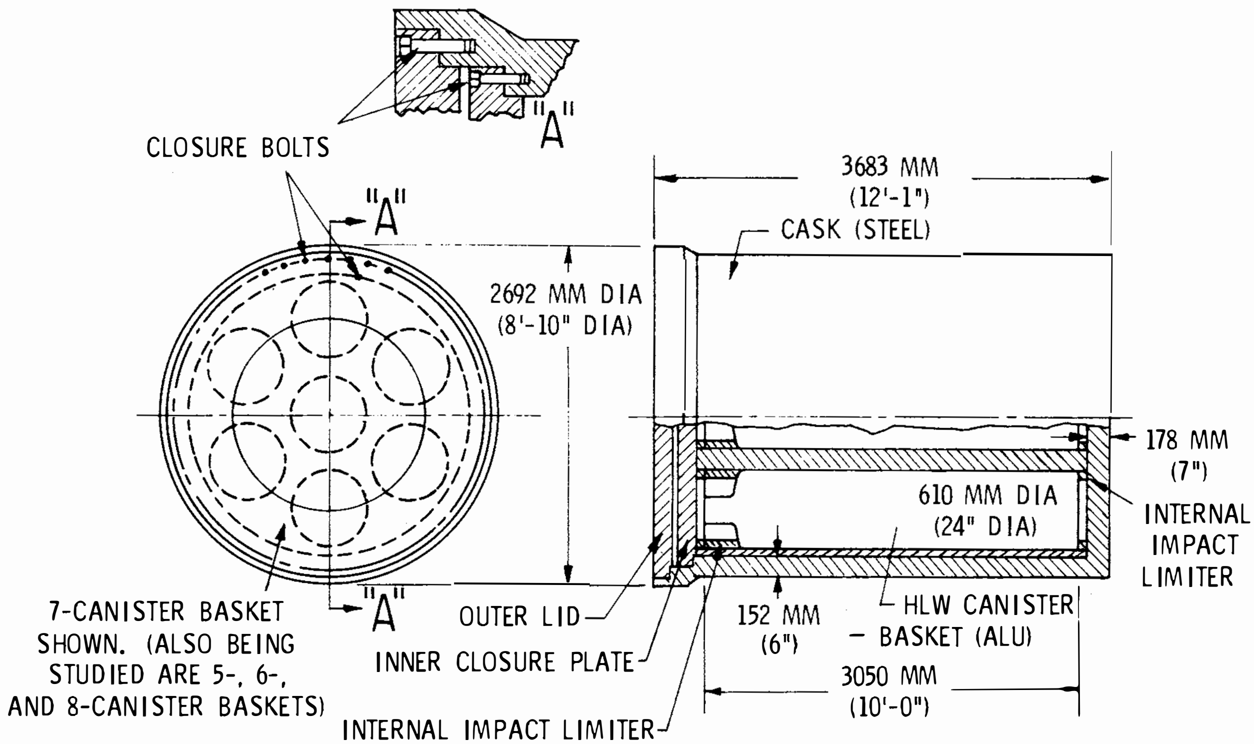

Figure B.16. Diagram of a Convertible Cask.

shell--are cylinders having five to eight channels, with each channel accommodating a single canister. In truck transport, a smaller cask would be used, which could accommodate only one canister per truck because of highway size and weight restrictions. It has been assumed in this EIS that the HLW would be transported exclusively by rail. This assumption, however, should not be interpreted as a recommendation against truck transport of HLW. The differences in radiological impacts between transporting the solidified HLW by truck as opposed to rail is given in Section B.5.5.1. The number of canisters per rail cask used for analyzing the environmental impacts of HLW transportation is shown in Table B.25.

Casks for the West Valley HLW are not being designed specifically for this program, but rather are being designed to support the overall defense HLW processing program. The quantity of HLW at West Valley is very small relative to the quantities of HLW at other sites, so the number of casks required specifically for West Valley is only a small fraction of the number required for the overall program. If the separated salt/sludge option is selected, only one or two rail casks plus a spare would be required to ship all canisters of HLW produced within about two years. The current estimate of the maximum number of casks required to support the overall defense HLW program is 26, a number that is probably unaffected by the requirements for West Valley.

Table B.25. Number of High-Level-Waste Shipments by Rail

High-Level-Waste Processing Option	Alternative	Number of Canisters†[1]	Number of Canisters per Shipment	Number of Shipments
Terminal Form				
Separated salt/sludge	1a	300	7	43
Nonseparated salt/sludge	1b	1300	8	162
Interim Form				
Fused salt	2	1040	8	130

†[1] Includes the wastes from both Tank 8D2 (neutralized Purex HLW) and Tank 8D4 (acidic Thorex HLW).

B.5.1.2 Transporting Transuranic and Low-Level Wastes

Low-level radioactive wastes are currently shipped principally by truck. In this EIS, all shipments of TRU and low-level wastes are assumed to be by truck, rather than by rail, because this is consistent with current practice and because some disposal sites do not currently have rail spurs. However, use of rail transport for these wastes remains a viable option because the number of shipments would be decreased significantly, thereby reducing the environmental impacts associated with transportation.

Under an old proposed rule (U.S. Atomic Energy Comm. 1974), commercially generated TRU wastes are to be sent to Federal repositories for interim storage or permanent disposal. All TRU wastes that are shipped to a Federal repository are assumed to be in overpacks because of the regulations that consider toxicity of transuranic nuclides--which include neptunium, plutonium, americium, and curium. In addition, some individual waste packages of LLW may exceed the 0.001-Ci limitation for Group I radionuclides, as currently given in 49 CFR 173,* and it may also be necessary to transport some of these wastes in overpacks.

Prior to shipment, the TRU and low-level wastes would be packaged in disposable containers. Three types of waste containers are considered in this EIS: 55-gallon drums, large metal boxes, and cylindrical liners made as inserts to available casks. Whenever possible, the wastes would be packaged in 55-gallon drums. Wastes that are too unwieldy would be packaged in boxes and liners; boxes would be used for unshielded shipments and liners for shielded shipments.

*Radioactive materials are classified, for transportation purposes, into one of seven transport groups according to their potential hazard if released to the environment; plutonium and other transuranic elements are classified in Transport Group I, which is the most restrictive (U.S. Dep. Energy 1979a).

If necessary, the waste containers would then be placed in overpacks; as required by Department of Energy regulations, wastes with dose rates at the surface of less than 200 mrem/h would be shipped in unshielded overpacks, whereas those with dose rates at the surface greater than 200 mrem/h would be shipped in shielded overpacks. All TRU wastes would be shipped in overpacks. The capacity of the overpack decreases as the amount of shielding increases; therefore, the overpacks would be of various sizes, based on the amount of shielding they must provide. For the purposes of this EIS, an overpack volume was selected for use in calculating impacts. The overpacks used in this analysis are shown in Table B.26; the capacities of the overpacks are presented in Table B.27. The overpack capacities are dependent upon the radiation levels of the wastes.

B.5.2 Regulations Affecting Transport of Radioactive Materials

An extensive array of regulations and jurisdictions apply to transport of the various radioactive wastes that would be generated during the waste solidification project. Four Federal agencies are currently charged with responsibility for regulations that apply to the transportation of radioactive waste in the United States: The Department of Transportation, the Nuclear Regulatory Commission, the Department of Energy, and the Interstate Commerce Commission (ICC). Where overlapping responsibilities exist, memoranda of understanding have been issued between agencies to define areas of responsibility. In addition, Federal and state laws define the limits of authority.

The ICC is the principal authority for regulating rates, charges, and conditions of truck and rail services operating in interstate commerce. Since most regulations of the ICC are related to the economics of transportation, the regulatory function of the ICC will not be discussed further because the primary concern of this document is related to the environmental impacts of transport and assurance that this transportation will be safe.

Both the Department of Transportation and the Nuclear Regulatory Commission regulate safety in transportation of radioactive materials. Under a Memorandum of Understanding, they partition their regulatory responsibilities. The Department of Transportation regulates safety in transporting all hazardous materials--including high-level, transuranic, and low-level wastes--and is primarily concerned with the conditions of carriage and with Type A packages of Type A (smaller) quantities of these wastes. The Nuclear Regulatory Commission regulates receipt, possession, use, and transfer of source, by-product, and special nuclear material, including such licensed materials as these wastes. The Commission is primarily concerned with reviewing designs of Type B packagings that would be used by licensed commercial shippers to ship Type B quantities (large quantities) of HLW and high-activity TRU and low-level wastes. The Department of Energy has the authority to certify that its own packagings for government or government-contractor shippers meet the requirements of the Department of Transportation. In accordance with the Memorandum of Understanding for this project, the Deparment of Energy will consult with the Nuclear Regulatory Commission on transportation of radioactive materials.

Providing for adequate control of radiation is a requirement that must be met when transporting radioactive material. Radiation control limits are met by providing the necessary shielding to reduce external radiation levels to within the allowable limits. Because the West Valley wastes would probably be

Table B.26. Overpacks Used to Transport Transuranic and Low-Level Wastes

Overpack Identification†[1]	Cask Type	Equivalent Shielded Thickness (cm)	Empty Weight (kg)	Company
Super Tiger™†[2]	End Load	1.3 Steel	6,800	U.S. Ecology†[3]
CNS-14-190	Top Load	7.0 Lead	27,400	Chem-Nuclear
CNS-4-85	Top Load	8.6 Lead	19,100	Chem-Nuclear
S3-208	Top Load	7.6 Steel	19,100	U.S. Ecology
CNS-14-195H	Top Load	7.0 Lead	18,000	Chem-Nuclear

†[1] The overpacks given in this table are not meant to indicate preference for specific companies, but were used to analyze the impacts associated with transportation of these wastes.

†[2] The Super Tiger is not likely to be recertified.

†[3] Formerly Nuclear Engineering Company (NECO).

Table B.27. Shipment Parameters for Transuranic and Low-Level Wastes†[1]

Type of Waste	Surface Radiation Level	Overpack	Packages per Shipment†[2]: Number of Drums	Liner Capacity (ft^3)	Number of Low-Specific-Activity Boxes: 4x4x8 ft	4x4x4 ft
LLW	<200 mrem/h	None	120†[3]	-	11	13
TRU	<200 mrem/h	Super Tiger	42	-	-	3
TRU or LLW	1 to 10 rem/h	S3-208 or CNS-14-195H	-	200	-	-
TRU or LLW	>10 rem/h	CNS-14-190	14	-	-	-
TRU or LLW	>10 rem/h	CNS-4-85	4	-	-	-

†[1] Includes only the categories of transuranic and low-level wastes projected to be transported for this program and analyzed in this EIS.

†[2] Only one package type per type of waste shipment--i.e., for low-level wastes with a surface radiation level <200 mrem/h, either 120 drums or 11 4x4x8-ft boxes or 13 4x4x4-ft boxes are shipped per truckload.

†[3] Two exceptions for this category (low-level wastes <200 mrem/h) are: (1) 52 drums of sulfate sludge per shipment due to weight restrictions, and (2) 42 drums of salt cake per shipment because Type B packaging (e.g., Super Tigers) might be required.

shipped in vehicles consigned for exclusive use, the following dose limits specified in 49 CFR Part 173.393 apply:

- 1000 mrem/h at 3 ft from the external surface of the package (closed transport vehicle only).
- 200 mrem/h at any point on the external surface of the vehicle (closed transport vehicle only).
- 10 mrem/h at 6 ft from the external surface of the vehicle.
- 2 mrem/h in any normally occupied position in the vehicle.

Based on these constraints, certain of the waste packages could be shipped unshielded whereas others would require additional shielding.

In addition to the Federal agency regulations, states and local governing bodies have prohibited or restricted transport of radioactive materials through their jurisdictions. The impacts of such regulations on the West Valley program cannot be assessed at this time but are not anticipated to present insurmountable obstacles.

A major consideration in evaluating the environmental impacts and costs associated with transporting the wastes from West Valley is the total weight of the shipment. For truck transportation, the gross vehicle weight of shipments is limited by state laws to about 80,000 lb. This limitation is more stringent in many states, and shipments in excess of 80,000 lb may require special permission. In this EIS, it is assumed that all efforts would be taken to limit the total weight of shipments to about 80,000 lb or less. However, since some shipments would require heavy overpacks to reduce the surface radiation to allowable levels, a few shipments in excess of 80,000 lb might occur.

B.5.3 Routes

Potential truck and rail routes will be discussed only for the area in the vicinity of West Valley. Discussion of specific routes that are a long distance away from West Valley becomes difficult, if not impossible, because of the very large number of potential routes and because the destination of the West Valley wastes has not been decided.

B.5.3.1 Truck Routes

The U.S. Department of Transportation (1981) has recently adopted regulations regarding routing requirements for highway shipment of radioactive wastes. These regulations require that shipments be made on preferred highways, which are defined as interstate highways not specifically disapproved by states and state and local highways designated by the states. The only deviations from preferred highway routes are for emergencies, necessary stops, and for routes that are the only existing ones between a given origin and destination. In accordance with these regulations, truck shipments from West Valley would be routed as quickly as possible to a preferred highway selected by the State of New York or to an interstate highway not specifically disapproved. Possible routes that may be considered from West Valley are shown in Figure B.17.

B.5.3.2 Rail Routes

The Department of Transportation has no similar routing regulations proposed for rail shipments; however, rail routes are more restricted owing to the existing track locations. The track servicing the West Valley site is a spur off of the Chessie System (Baltimore and Ohio) (Figure B.18). The poor condition of this spur warrants consideration prior to its use in this program. If the wastes were to be shipped southward, the Chessie track could be used to carry the wastes into Pennsylvania. If the wastes were to be shipped west, the Chessie System could interchange with Conrail at Salamanca. It would also be possible to move the wastes north and interchange with Conrail at Buffalo.

B.5.4 Sabotage

The possibility that terrorists might sabotage a shipment of high-level radioactive wastes for the purpose of either dispersing or threatening the dispersal of the wastes has been given increasing attention from the government, news media, and public. Part of this attention probably stems from fear concerning the word "nuclear." Only the threat to disperse radioactive wastes for contamination is considered a viable action by terrorists. Theft of the radioactive wastes in itself, without intent to disperse, is not considered a viable option because the wastes have neither monetary value nor sufficient fissile material content for even a crude nuclear bomb.

Unauthorized penetration of the HLW casks will probably require energy-intensive techniques, such as the use of explosives or some mechanical devices, because special tools and heavy equipment are normally required to safely handle and open these casks. Because of the massive size of the packages and the probable uncertainty of the saboteurs in properly placing the explosives (detailed knowledge of the design features of the package, access to it, and other logistical considerations), the likelihood of successful sabotage is extremely low. The use of hands-on mechanical techniques (e.g., gas cutting torches, power saws, burn-bars) would also be unattractive because the levels of external penetrating radiation near the exposed wastes would kill the terrorists but would not disperse the contents.

The uncertainties of success would probably cause a terrorist to select another means of expressing his demands other than the dispersal of HLW. Furthermore, if a terrorist tries to break open a cask with energy-intensive devices, the immediate nonradiological effects of a sabotage attack in a densely populated area would be as significant or more significant than the radiological effects (U.S. Nucl. Reg. Comm. 1980).

B.5.5 Environmental Impacts

Transporting the wastes from West Valley would produce environmental impacts, resulting from both the radiological character of the wastes and the non-radiological aspects of transportation such as injuries from traffic accidents and latent effects from pollutants caused by the combustion of diesel fuel. The impacts discussed in this section incorporate those resulting from both normal transport and accidents. These transportation impacts are based on assumed distances from West Valley to locations for disposal or further processing. If the actual distances were substantially different from those used in this analysis, the impacts would be increased or decreased by the amount of

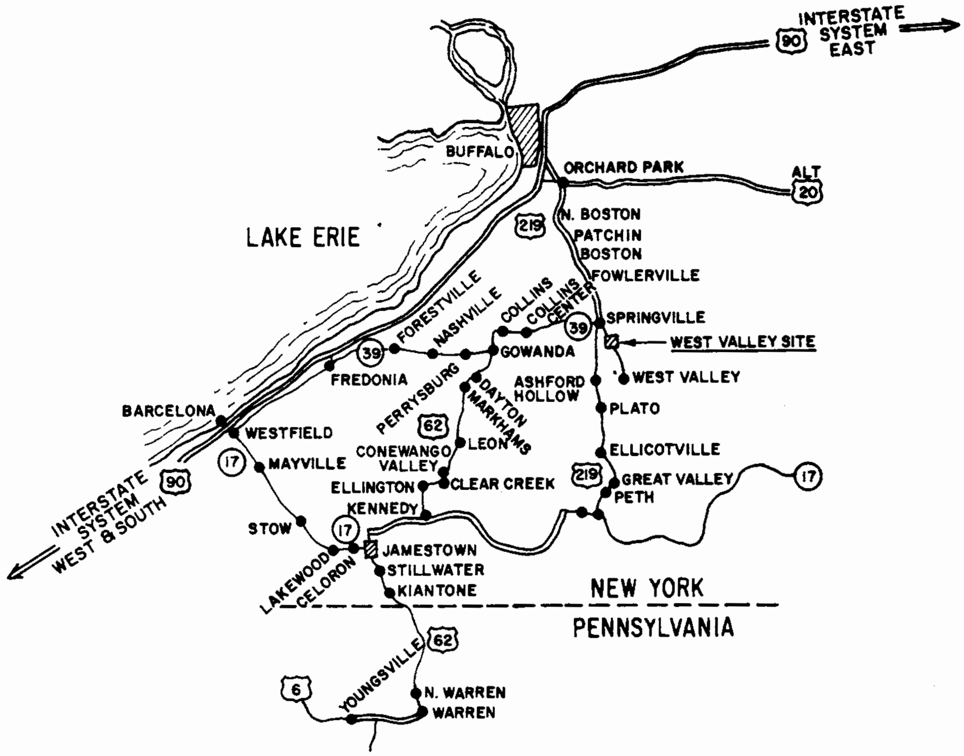

Figure B.17. Possible Routes for Truck Shipment of West Valley Wastes.

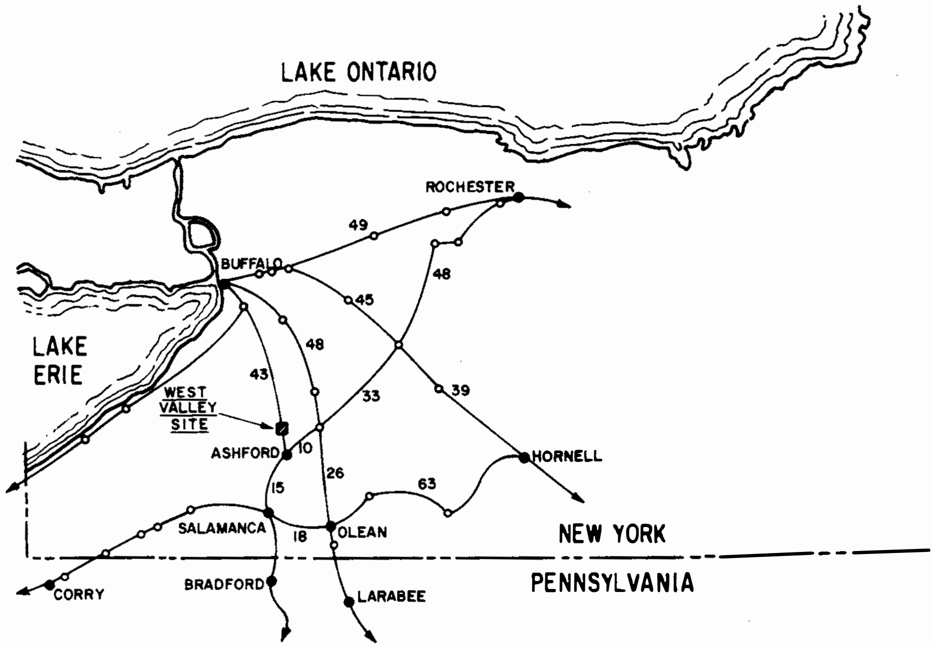

Figure B.18. Possible Routes for Rail Shipment of West Valley Wastes.

this deviation--for example, doubling the distances would double most of the impacts. The assumed distances are: (a) 640 km from West Valley to a regional burial ground, (b) 1600 km from West Valley to an offsite Federal waste facility (for alternative 2), and (c) 4800 km from West Valley to a Federal repository. Use of the burial grounds at West Valley would eliminate the impacts associated with transporting LLW.

B.5.5.1 Radiological Impacts

Radiological impacts would result from movement of radioactive materials through areas occupied by people because low levels of radiation would penetrate the waste containers and overpacks and expose the nearby surrounding populations. In this EIS, radiological impacts are divided into the occupational dose received by transport crews and the short-term population dose received by the general population living near the routes or traveling on the routes used for transporting the wastes. Impacts are further divided into those resulting from normal transport and those resulting from accidents.

The radiological impacts from transportation were calculated using the unit-dose factors shown in Table B.28 for transportation of the HLW by rail and Table B.29 for transportation of the TRU wastes and LLW by truck. The unit-dose factors are the radiological doses associated with transporting the radioactive material one kilometer or the dose per hour resulting from stopping during transit. Separate unit-dose factors were calculated for normal transport and for accidents.

The unit-dose factors for the TRU wastes and LLW are nearly the same because the major component of this exposure is from radiation that penetrates the waste packages and any overpacks or casks. The penetrating radiation would be similar for the TRU and low-level wastes because both TRU and low-level wastes are assumed to have similar concentrations of gamma-emitting nuclides. These unit-dose factors were obtained with the aid of a comprehensive computer code (RADTRAN-II) (Taylor and Daniel 1980), which considers all aspects of transportation and evaluates radiological impacts to all population groups affected by the shipment of radioactive material. The unit-dose factors were calculated using specific details pertaining to the types of waste at West Valley, such as estimated surface exposure rates of various waste forms and associated radionuclide inventories. Many of the parameters such as population densities, velocities of travel, and meteorological data were based on recommendations of the U.S. Nuclear Regulatory Commission (1977a) and the RADTRAN-II user's manual (Taylor and Daniel 1980).

For normal transport, the critical parameter in determination of the unit-risk factor is the radiation exposure at 6 feet from the edge of a vehicle. For example, the exposure at 6 feet from the vehicle used to haul the HLW, both terminal and interim forms, is dependent on the solidification alternative chosen. The exposure from the separated salt/sludge glass is assumed to be the regulatory limit of 10 mrem/h at 6 feet. The nonseparated salt/sludge glass and fused salt are estimated to produce exposures one-half of this regulatory limit. The exposure at 6 feet for TRU and low-level wastes is dependent upon the exposure at the surface of the waste packages and on the possible use of shielding during transportation. Radiation levels consistent with experience for transportation of radioactive wastes were used in this analysis (Mullarkey et al. 1976; U.S. Nucl. Reg. Comm. 1981d). The radiation

Table B.28. Unit-Dose Factors for Transport of High-Level Wastes by Rail

High-Level Waste Processing Option†[2]	Normal Transport: Occupational (person-rem/km)	Normal Transport: Population†[1] Offlink (person-rem/km)	Normal Transport: Population†[1] Onlink (person-rem/km)	Normal Transport: Population†[1] Stops (person-rem/h)†[3]	Accidents: Loss of Shielding (person-rem/km)	Accidents: Loss of Contents (person-rem/km)
Terminal Form						
Separated salt/sludge	~0†[4]	1.7×10^{-5}	6.0×10^{-7}	0.12	1.0×10^{-12}	2.1×10^{-9}
Nonseparated salt/sludge	~0	8.3×10^{-6}	3.0×10^{-7}	0.06	2.8×10^{-13}	6.6×10^{-10}
Interim Form						
Fused salt	~0	8.3×10^{-6}	3.0×10^{-7}	0.06	2.6×10^{-13}	1.7×10^{-10}

†[1] Terminology: Offlink refers to people residing near the transport routes, onlink to people traveling on the routes, and stops to people exposed while the transporting vehicle is stopped.

†[2] The unit-dose factors are based on a composite of the wastes in Tank 8D2 (neutralized Purex HLW) and Tank 8D4 (acidic Thorex HLW).

†[3] Eight hours of stopping assumed for every 3200 km of travel.

†[4] The occupational dose for rail shipment is extremely low due to the distance between the rail crew and the HLW cask.

Table B.29. Unit-Dose Factors for Transport of Transuranic and Low-Level Wastes by Truck

Low-Level Waste Form	Normal Transport: Occupational (person-rem/km)	Normal Transport: Population†[1] Offlink (person-rem/km)	Normal Transport: Population†[1] Onlink (person-rem/km)	Normal Transport: Population†[1] Stops (person-rem/h)†[2]	Accidents: Loss of Shielding (person-rem/km)	Accidents: Loss of Contents†[3] (person-rem/km) LLW	Accidents: Loss of Contents†[3] (person-rem/km) TRU
Salt cake	5.4×10^{-5}	2.7×10^{-5}	1.3×10^{-5}	1.8×10^{-2}	1.1×10^{-9}	5.8×10^{-8}	NA
Other TRU or LLW:							
<0.2 rem/h	5.4×10^{-5}	6.8×10^{-5}	3.2×10^{-5}	4.5×10^{-2}	2.8×10^{-12}	1.4×10^{-9}	2.0×10^{-9}
0.2 to 1.0 rem/h	5.4×10^{-5}	6.9×10^{-6}	3.3×10^{-6}	4.5×10^{-3}	4.6×10^{-12}	1.8×10^{-9}	2.6×10^{-9}
1.0 to 10.0 rem/h	5.4×10^{-5}	1.1×10^{-5}	5.2×10^{-6}	7.2×10^{-3}	2.2×10^{-16}	2.7×10^{-9}	3.3×10^{-9}
>10 rem/h	5.4×10^{-5}	1.1×10^{-5}	5.2×10^{-6}	7.2×10^{-3}	3.7×10^{-16}	3.0×10^{-9}	3.5×10^{-9}

†[1] Terminology: Offlink refers to people residing near the transport routes, onlink to people traveling on the routes, and stops to people exposed while the transporting vehicle is stopped.

†[2] Eight hours of stopping assumed for every 3200 km of travel.

†[3] Impacts are different for transuranic and low-level wastes due to the transuranic elements. NA = not applicable.

levels for all shipments of radioactive materials would be in compliance with the regulatory limit of 10 mrem/h at 6 feet from the edge of the vehicle.

There are generally two types of accidents that could occur to the radioactive material package during transportation: (1) accidents involving the loss and dispersal of some of the contents and (2) accidents resulting in a loss of shielding provided by the package and overpack. The radiation risk from accidents can be estimated by multiplying the radiation effects from the various accidents by the probability that these accidents will occur.

To calculate the unit-dose factors for accidents, assumptions had to be made regarding the amount of material that might be released in an accident. The TRU and low-level waste releases are based on a report of the U.S. Nuclear Regulatory Commission (1977a), but the releases for HLW are estimated from experimental data. Tests at Sandia Laboratories have indicated that casks will sustain considerable impacts without releasing their contents (Jefferson and Yoshimura 1978). The immobilized form of HLW also precludes significant release of material. These two facts, coupled with the fact that it is difficult to suspend any released material, provide justification for assuming a small release of material for analysis of accidents. The unit-dose factor for an accident in which only shielding of the cask is lost is calculated using the same methodology as that given in the 1977 NRC report. The probabilities for accidents used in this analysis are given in Clarke et al. (1976).

High-level wastes have not been shipped in the United States. However, spent fuel has been shipped in casks similar to those projected to be used for transporting the HLW from West Valley. Although there have been several serious accidents involving spent fuel casks, these accidents have never involved a release of radioactivity to the environment. This provides additional support to the assumed low probabilities for accidents involving HLW that would release radioactivity.

The environmental impacts associated with transportation are obtained by multiplying the unit-dose factors by the total kilometers traveled. To calculate the impacts associated with implementing a specific alternative, the associated waste volumes must be identified and the impacts summed. The number of shipments of HLW for each alternative are given in Table B.25; the corresponding number of shipments of TRU wastes and LLW can be obtained by combining the number of waste packages for each alternative in Table B.22 with the shipment parameters in Table B.27.

The radiological impacts for alternatives 1a, 1b, and 2 for normal transport conditions and accidents are summarized in Table B.30. A breakdown of the radiological impacts for the different waste forms (HLW, LLW, and TRU wastes) are given for normal transport conditions in Table B.31 and for accidents in Table B.32.

If the HLW were transported by truck rather than by rail, the radiological impacts for alternatives 1a, 1b, and 2 would increase because more shipments would be required. Population doses for normal transport would increase in proportion to the increase in number of shipments required. Population doses associated with truck transport of HLW are estimated to be 460 person-rem for alternative 1a (300 shipments), 960 person-rem for alternative 1b (1300 shipments), and 1200 person-rem for alternative 2 (1040 shipments). This compares

Table B.30. Summary of the Radiological Impacts from Transportation†[1]

Alternative	Occupational Dose (person-rem)	Population Dose (person-rem)	
		Normal	Accident
1a	210	290	2×10^{-2}
1b	200	340	1×10^{-2}
2	200	370	1×10^{-2}

†[1] Includes both the radiological impacts from normal (nonaccident) and accident transport conditions.

with 66 person-rem for alternative 1a, 120 person-rem for alternative 1b, and 153 person-rem for alternative 2 for rail transport of HLW. The occupational doses would also increase. The occupational doses for truck transport of HLW are estimated to be 60 person-rem for alternative 1a, 260 person-rem for alternative 1b, and 330 person-rem for alternative 2. This compares with an occupational dose of less than 1 person-rem for HLW transport by rail for these alternatives.

The radiological impacts associated with HLW transport accidents would not vary significantly because the increase in the likelihood of an accident to occur (due to more shipments) is offset by the lower consequences (due to less HLW per shipment).

The radiological impacts from waste transportation do not vary greatly among the alternatives. Most of the shipments are of TRU wastes and LLW, which are nearly the same for all the alternatives because the majority of these wastes results from activities that are common to all alternatives--i.e., the decontamination of the existing reprocessing plant prior to installation of the solidification equipment and the final decontamination and decommissioning. It should also be noted that the cumulative radiological impacts from transportation are dominated by the TRU wastes due to the number of shipments and the distances assumed.

The population dose is smallest for alternative 1a because a major contributor to the dose is from the transportation of HLW and the number of shipments of HLW is significantly lower for alternative 1a than for alternatives 1b and 2. The population dose for alternative 2 is greater than for alternatives 1a and 1b because use of the interim waste-form alternative requires the HLW to be shipped twice: from West Valley to a Federal waste facility site and from the waste facility to a Federal repository assumed to be 4800 km away. The amount of radioactive wastes produced at a Federal waste facility in processing the HLW from the interim form to the terminal form would not significantly increase the volume of TRU and low-level wastes over that predicted to occur at West Valley for alternative 2. It has been assumed in this EIS that the TRU and low-level wastes resulting from processing the interim HLW to a terminal form would be handled along with the other wastes generated at a

Table B.31. Radiological Impacts from Normal Transporation

Alternative	Waste Form	Number of Shipments†[1]	Distance (km)	Dose (person-rem) Occupation	Dose (person-rem) Population
1a	HLW	43 R	4800	<1†[2]	66
	TRU	573 T	4800	150	180
	LLW	1576 T	640	55	43
1b	HLW	162 R	4800	<1	120
	TRU	573 T	4800	150	180
	LLW	1471 T	640	51	39
2†[3]	HLW	130 R (162)	1600 (4800)	<1 (<1)	33 (120)
	TRU	573 T	4800	150	180
	LLW	1454 T	640	50	37

†[1] R refers to railcar loads, T to truckloads.

†[2] The occupational dose during transportation is low due to the distance between the HLW and the train crew.

†[3] The radiological impacts for alternative 2 are for shipping the interim-form HLW 1600 km to a Federal waste facility for final processing, followed by shipping the terminal form 4800 km to a Federal repository; the impacts for the transuranic and low-level wastes generated at West Valley are for shipping these wastes to appropriate disposal sites.

Table B.32. Radiological Impacts from Accidents During Transportation

Alternative	Waste Form	Number of Shipments†[1]	Distance (km)	Dose (person-rem) Loss of Shielding	Dose (person-rem) Loss of Contents
1a	HLW	43 R	4800	2×10^{-7}	4×10^{-4}
	TRU	573 T	4800	1×10^{-6}	9×10^{-3}
	LLW	1576 T	640	9×10^{-5}	7×10^{-3}
1b	HLW	162 R	4800	2×10^{-7}	5×10^{-4}
	TRU	573 T	4800	1×10^{-6}	9×10^{-3}
	LLW	1471 T	640	1×10^{-7}	3×10^{-3}
2†[2]	HLW	130 R (162)	1600 (4800)	5×10^{-8} (2×10^{-7})	4×10^{-5} (5×10^{-4})
	TRU	573 T	4800	1×10^{-6}	9×10^{-3}
	LLW	1454 T	640	8×10^{-8}	3×10^{-3}

†[1] R refers to railcar loads, T to truckloads.

†[2] The radiological impacts for alternative 2 are for shipping the interim-form HLW 1600 km to a Federal waste facility for final processing, followed by shipping the terminal form 4800 km to a Federal repository; the impacts for the transuranic and low-level wastes generated at West Valley are for shipping these wastes to appropriate disposal sites.

Federal waste facility. For perspective, the population exposed to the radiation from transport of these radioactive wastes would receive in excess of 1×10^8 person-rem from natural background radiation.

The maximum dose to a member of the general public resulting from a transportation accident is predicted to be 0.6 rem for alternative 1a and 0.2 rem for alternatives 1b and 2. This dose results from a very severe accident involving the transport of solidified HLW. This estimate is based on the assumption that the individual would be exposed for a total of one hour as a result of this accident; 0.25 hours at 5 m, 0.25 hours at 10 m, and 0.5 hours at 15 m. These times and distances are believed to be conservative. Alternative 1a would have a higher dose than the other two alternatives since each canister has a higher concentration of radioactivity. Corresponding population doses from this accident would be 6 person-rem for alternative 1a and 2 person-rem for alternatives 1b and 2, assuming that this accident would cause 10 people to be exposed to the same extent as the maximum individual. Perspective on the maximum individual doses resulting from transportation accidents can be gained by the following two facts. The annual dose in the United States from natural background sources is about 100 mrem, and a chest X-ray delivers a dose of about 25 mrem.

If such an accident occurred while the rail cars were crossing a river, the cask could fall into the river causing contamination to be spread to the surrounding area. The radiation exposures from this accident would be similar to those given above except for the population dose for alternative 2. The population dose for alternative 2 is estimated to be 40 person-rem. This estimate was obtained using the assumptions given in the 1977 report of the U.S. Energy Research and Development Administration, supplemented with data from Smith and Ross (1975). The amount of activity released to the river in a 24-hour period is assumed to be 1×10^{-4} of the contents of the cask carrying fused salt. The river is assumed to have a flow of 600 m^3/s (2000 ft^3/s) and to supply drinking water to 200,000 people. These are considered to be conservative assumptions. The population doses resulting from this accident for alternatives 1a and 1b via the water pathway would be less than those from direct irradiation which were given previously.

The probability for such a severe accident is estimated to be less than 9×10^{-10} per kilometer. The conditional probability that this accident would occur while crossing a river is estimated to be 2×10^{-6} (Clarke et al. 1976). Thus, these severe transportation accidents involving HLW would have a negligible contribution to the overall risk of transporting radioactive materials.

B.5.5.2 Nonradiological Impacts

The nonradiological impacts of transporting the wastes are not related to the radioactive nature of the wastes but are those impacts that would occur from the transport of any type of cargo. Such impacts result from vehicular emissions and accidents.

To compare vehicular emissions to current pollution standards, the emissions resulting from the hourly passing of one diesel-powered truck or one railcar pulled by a diesel locomotive were used to calculate an average air pollution concentration (Table B.33). Current estimates of the total number of truckloads required for each of the three alternatives involving the transport of wastes (1a, 1b, 2) are about 2000-2200 (Table B.34) and the period of time during which these wastes would be transported is in excess of three years; therefore, it is doubtful that the assumption of one truck per hour would be exceeded. Emissions related to train transport of the wastes would be about the same. Although the emissions resulting from diesel fuel combustion, per railcar, exceed those of a diesel truck, the number of railcar loads involved would be comparably smaller (see Table B.34). Thus, the time between trains would be greater and the concentrations should not exceed those associated with trucks. In addition, trains produce less fugitive dust because their wheels travel on rails.

The concentrations of all pollutants shown in Table B.33 are below current air quality standards (U.S. Environ. Prot. Agency 1977), and the pollutants are therefore assumed to cause no harmful effects. Although it is recognized that the trucks and trains transporting West Valley wastes would use a portion of the allowable air quality increment, it is not feasible here to calculate the effects of other vehicles using the same routes. On the basis of the impacts from these pollutants, it is also not possible to clearly choose an environmentally preferred alternative from among the alternatives involving the transport of wastes. The pollution impacts would be in proportion to the distances traveled. As can be seen in Table B.34, the distances associated with each of these alternatives would not differ greatly. The impacts associated with the terminal-form alternative 1b (nonseparated salt/sludge) would be somewhat more than those associated with the reference alternative 1a. The impacts associated with the interim-form alternative 2 would be slightly greater than those associated with alternatives 1a and 1b because it would be necessary to transport the HLW twice--the interim form from West Valley to a Federal waste facility and the terminal form to a Federal repository.

The nonradiological impacts of accidents during transport of the wastes are more easily defined in terms of deaths and injuries. If it is assumed that the potential for transportation accidents involving shipments of radioactive wastes is comparable to that for general truck and rail transportation in the United States, 1.1 truck accidents for every million kilometers and 9.3 railcar accidents for every ten million kilometers traveled would occur (Table B.35) (Clarke et al. 1976; U.S. Atomic Energy Comm. 1972). Each truck accident would result in about one injury and no deaths, and each railcar accident would result in about three injuries and no deaths (see Table B.35). Based on these rates, about six injuries for every ten million kilometers and about three deaths for every hundred million kilometers traveled would occur if the wastes were shipped by truck, and about three injuries for every million kilometers and about two deaths for every 10 million kilometers traveled would occur if they were shipped by railcar.

A comparison of the risks for each of the alternatives is shown in Table B.34. No fatalities are likely to result from any of the alternatives, but a few injuries would be expected. The impacts from accidents would be somewhat higher for alternative 1b than for the reference alternative 1a because there would be a large increase in the number of HLW shipments and only a slight decrease in LLW shipments. For alternative 2, the impacts would be slightly larger than those for alternatives 1a and 1b because the HLW would be transported twice. For perspective, about 50,000 people die each year as a result of transportation accidents on the nation's highways, and 100 times as many are injured.

Table B.33. Comparison of Calculated Vehicular Pollutant Concentrations and Air Quality Standards

	Pollutant Concentration†[1] (μg/m³)		Primary Standard†[2] (μg/m³)
	Truck	Rail	
Particulates†[3]	0.63	0.09	260 (24-hour)
SO_2	0.02	0.05	365 (24-hour)
NO_2	0.06	0.3	100 (annual mean)
Hydrocarbons	0.02	0.09	160 (3-hour)
CO	0.1	0.1	40,000 (1-hour)

†[1] Calculated assuming that a diesel-powered truck or train would pass once an hour and that, of the total distances traveled, 90% would be through a low population zone, 5% through a medium population zone, and 5% through a high population zone.

†[2] Primary standards of the U.S. Environmental Protection Agency (1977).

†[3] Including fugitive dust.

Table B.34. Risk of Injuries and Deaths from Transport Accidents

Alternative	Waste Form	Number and Type of Shipments†[1]	Round-trip Distance (km)	Total Travel (10^6 km)		Accident Injuries/Deaths for All Shipments†[3]	
				Truck	Railcar	Injuries	Deaths
1a	HLW	43 R	9600		0.4	1.0	0.08
	TRU	573 T	9600	5.5		3.1	0.17
	LLW	1576 T	1280	2.0		1.1	0.06
				7.5	0.4	5.2	0.31
1b	HLW	162 R	9600		1.6	3.9	0.3
	TRU	573 T	9600	5.5		3.1	0.17
	LLW	1471 T	1280	1.9		1.1	0.06
				7.4	1.6	8.1	0.53
2†[2]	HLW	130 R (162)	3200 (9600)		0.4 (1.6)	1.0 (3.9)	0.08 (0.3)
	TRU	573 T	9600	5.5		3.1	0.17
	LLW	1454 T	1280	1.9		1.0	0.06
				7.4	2.0	9.0	0.61

†[1] R refers to railcar loads, T to truckloads.

†[2] The radiological impacts for alternative 2 are for shipping the interim-form HLW 1600 km to a Federal waste facility for final processing, followed by shipping the terminal form 4800 km to a Federal repository; the impacts for the transuranic and low-level wastes generated at West Valley are for shipping these wastes to appropriate disposal sites.

†[3] Both workers and the general population would be affected, but it was not possible to separate out the occupational component.

Table B.35. Projected Accidents, Injuries, and Deaths from Transportation of Radioactive Wastes

Vehicle	Accident Rate (number/kilometer)	Injuries (number/ accident)	Injuries (number/ kilometer)	Deaths (number/ accident)	Deaths (number/ kilometer)
Truck	1.1×10^{-6}	0.51	5.6×10^{-7}	0.03	3.1×10^{-8}
Railcar	9.3×10^{-7}	2.7	2.5×10^{-6}	0.2	1.9×10^{-7}

Transport of HLW by truck would increase the nonradiological impacts. The total highway distance traversed for transport of HLW would be 2.9×10^6 km for alternative 1a, 12.5×10^6 km for alternative 1b, and 15.8×10^6 km for alternative 2. Thus, the total number of injuries and deaths would increase in proportion to the increased mileage (due to shipping only one HLW canister per truckload), taking into account the different accident rate estimates for truck and rail shipments given in Table B.35. The number of injuries and deaths associated with transporting the HLW by truck rather than rail are summarized in Table B.36. The contribution to local air quality would not change significantly for truck transport of HLW.

Table B.36. Total Number of Injuries and Deaths Projected to Result from Transportation of High-Level Wastes by Truck

Alternative	Injuries	Deaths
1a	1.6	0.09
1b	7.0	0.39
2	8.8	0.49

B.6 DECONTAMINATION AND DECOMMISSIONING

Following completion of the immobilization of the liquid HLW, the facilities used in this program would be decontaminated and decommissioned to protect the public from any residual radioactivity or other potential hazards extant in these facilities. Due to other facilities at the site that may not be included in this program, it may not be feasible to return the entire site to unrestricted use in the near term. In any event, actions would be taken to minimize the potential for release of radioactivity. Prior to undertaking a final decommissioning program, another environmental review would be performed.

The HLW solidification process could be performed either within the existing reprocessing building or within a new structure built specifically for this purpose. The use of the existing reprocessing building has the advantage of utilizing an existing facility that, in any event, must eventually be decontaminated and decommissioned. On the other hand, if a new facility were to be constructed specifically for the solidification program, its design could incorporate features that would be more helpful in decontamination and decommissioning than would modification of the existing facility. In the discussion of environmental impacts in this section, those impacts that are associated with decommissioning of the existing facility and other facilities built on the West Valley site specifically for this project are given.

A specific program for decommissioning the solidification facilities and HLW tanks has not been developed at this time. Such a program will be developed by the end of the solidification campaign, currently expected to be 1990. The environmental impacts of decommissioning can therefore best be analyzed by evaluating those from possible decommissioning options. The possible decommissioning options considered for retired nuclear facilities (U.S. Nucl. Reg. Comm. 1981c) are: (1) safe storage, (2) entombment, and (3) immediate dismantlement.

The decommissioning alternatives for the waste solidification facilities are considered separately from those for the HLW tanks. The two decommissioning options for waste solidification facilities addressed in this EIS are: (1) decontamination followed by dismantlement (alternatives 1a, 1b, and 2), and (2) decontamination followed by entombment by filling with cement (alternative 3). The third option, safe storage, is not considered to be a reasonable alternative for final decommissioning because it is not consistent with NRC's draft criteria for decommissioning nuclear facilities (U.S. Nucl. Reg. Comm. 1981c).

The waste tanks are considered to be decommissioned by in-situ stabilization (entombment) with cement. Dismantlement of the waste tanks, is an option; however, a recent study indicates that this procedure, although feasible, would substantially increase the occupational dose (United Nucl. Indus. 1978).

The decommissioning options considered in this EIS are not meant as recommendations. Since the proper decommissioning option to be implemented is dependent upon the future use of the West Valley site, which has not yet been determined, it is not possible to analyze in detail the environmental impacts associated with decommissioning. The procedures used to decontaminate and decommission these facilities and the associated environmental impacts given in this section are meant to be indicative of those that would occur in the future.

B.6.1 Solidification Facilities

The facilities to be decontaminated and decommissioned are the solidification equipment; the solidification building; the LLW treatment facility; the storage facilities for high-level, transuranic, and low-level wastes; and any additional supporting facilities.

B.6.1.1 Immediate Dismantlement

In the immediate-dismantlement option, the facilities would be decontaminated and disassembled and the resultant radioactive materials would be disposed. After demolition of the facilities had been completed, a radiation survey would be conducted.

The general types of activities required for immediate dismantlement consist of chemical decontamination, equipment removal, mechanical decontamination, demolition, and site restoration (U.S. Dep. Energy 1979e). Chemical decontamination would be carried out to reduce radiation levels and remove any relatively mobile contamination. The applicability of chemical decontamination would depend largely on the nature and location of the contamination and the level of the radioactivity. Decontamination solutions used could include caustic and acidic solutions, detergents, and high-pressure water or steam. These solutions could be applied remotely using installed equipment, manually, or with portable equipment. These radioactive solutions would be treated in the LLW treatment facility and released (see Section B.3).

Mechanical decontamination would be used to remove significant amounts of radioactive contamination. Contaminated equipment and piping would generally be removed using remote techniques. Contaminated sections of concrete could be removed either with hand tools and jackhammers or by drilling and rock splitting.

Most of the radioactivity would have been removed from the contaminated material during the chemical and mechanical decontamination procedures. The radioactive wastes would consist of filters (wet and dry), ion-exchange resins, combustible wastes, and liquid wastes (e.g., evaporator bottoms and concentrated chemical decontamination solutions). The combustible and wet wastes would be treated onsite (i.e., partially converted to noncombustible solids) and placed in nonflammable containers. All packaged wastes are assumed to be shipped to an offsite disposal facility. The volumes of wastes requiring disposal are given in Section B.4.

During decommissioning, routine airborne radioactive effluents would consist of gases and particulates. A variety of operations could cause the radioactive materials to become airborne, including: agitating and spraying of chemical decontamination solutions in process vessels; high- and low-pressure decontamination solution spraying; jackhammering, drilling and rock splitting, and explosive removal of concrete; and plasma-torch cutting of stainless steel equipment. Procedures would be followed to reduce the amount of these airborne materials that reach the ventilation system. Mist eliminators could be installed to remove airborne decontamination solutions, and water sprays could be used to reduce dust generation during drilling, jackhammering, rock splitting, or explosive blasting of concrete. Portable fume hoods could be positioned over equipment being cut with plasma torches. Nevertheless, a small fraction of the airborne radioactive material could be expected to be released to the atmosphere through the facility stack after passing through the off-gas treatment system. All releases would be within prescribed limits.

All contaminated equipment would be removed from its installed location, perhaps reduced in size, packaged, and transported to an approved disposal site. The techniques used to remove the equipment would depend on the equipment location, construction material, and radiation levels near the equipment. Stainless steel equipment could be removed using plasma torches, arc saws, power hack saws, or explosive cutting equipment. Remote removal techniques--including long-handled tools, portable shielding, or specially constructed remote equipment--would be employed in high radiation areas. Installed remote maintenance equipment would be used where available. Normal maintenance techniques and demolition techniques, adapted as necessary for radiation areas, could be used in low-level radiation areas.

To ensure that all radioactivity is removed, it might be necessary to remove portions of the structures, including radioactive surface layers as well as some noncontaminated materials. After removal, contaminated or activated structural materials would be packaged and shipped offsite for disposal.

Stainless steel structural components could be removed by sectioning in place with plasma torches, arc saws, or explosives. Contaminated concrete could be removed with explosives, by drilling and rock splitting, or by jackhammering. Explosives are usually preferred for large concrete surfaces, jackhammers or hand tools for small areas of concrete, and rock splitters for moderately sized areas or on large areas where explosives are not desirable. These techniques would be used either remotely or manually, depending on radiation levels in the area being decontaminated.

Demolition of noncontaminated facility structures would not be required from a radiological safety standpoint. Building demolition might be carried out because the structural integrity of a building had been degraded by the mechanical decontamination procedures or because the site was to be used for other purposes. Generally, unless site-specific conditions restricted their use, conventional demolition techniques such as explosives and impact balls would be employed. Concrete rubble could be used as backfill at the site or removed for commercial disposal. Building components would be salvaged when economically feasible.

Site restoration activities would include a final site radiation survey, backfilling of excavations, grading and contouring of the soil, and planting of soil-stabilizing vegetation. The extent of these activities would depend on the anticipated use of the site after decommissioning was completed.

B.6.1.2 Immediate Entombment

Entombment of the solidification facility is considered only for alternative 3 because the amount of radioactivity remaining within the entombed facilities would be much less than that in the waste tanks containing the solidified HLW. Entombment involves sealing the radioactive materials by filling contaminated areas with cement or similar materials. The integrity of the resulting monolith would preclude the release of radioactivity or limit its release to very low levels.

For the entombment option, cell cleanup would probably be limited to chemical decontamination as previously described for dismantlement. Initial activities would consist of structural shoring, shielding-window reinforcement, cell ventilation-duct reinforcement or replacement, sealing or plugging of minor openings (e.g., manipulator, telescope/periscope, and sampling equipment penetrations), coating of floors and walls with binders or sealants such as asphalt, and blocking of major openings such as the channel to the fuel storage pool and the various air-locks (if necessary). Also included would be the erection of cement-handling equipment.

The pouring of grout is a well-established technology and would be a straightforward operation. The cement would be poured in batches, each batch creating a 1-m deep layer in the area being filled. Each batch would be allowed to set and cure for about one week before adding another. If it was decided to also fill areas outside the cells, these areas would be filled so as to match the concrete levels inside the cells. A ventilation control system would be designed to clean the cell ventilation air while compensating for decreasing volumes of cell atmosphere. This system would protect against releases of dust caused by pouring cement into the cells. Upon completion of the cement-filling operations, the cement-handling equipment would be dismantled and removed.

B.6.2 Emptied High-Level-Waste Storage Tanks

The HLW storage tanks would be decommissioned after the liquid wastes had been removed and the tanks cleaned to the fullest extent possible. The procedures discussed in this section, in-situ cement entombment, assume a separate operation for HLW removal, but it is likely that tank decommissioning would be an extension of the removal activity (Section B.1.3). The emptied waste tanks would be decommissioned by entombment only for alternatives 1a, 1b, and 2. For alternative 3, in-tank solidification, the HLW would be solidified (Section B.2.4) and the resultant monolith left in the tanks. Any empty tanks for alternative 3 would also be filled with cement.

Entombment would involve the introduction of a cement slurry into the tanks and vaults, with adequate setting and curing time allowed between the pouring of fresh batches. Preparation for cement pouring would consist of creating openings in the HLW tanks and in the concrete vaults, followed by installation of cement-slurry distribution and injection systems.

It is assumed that openings would have been made in the large neutralized-HLW tank (8D2) as part of the liquid HLW-removal project. If current HLW-removal concepts were followed, there would be an adequate number of penetrations through the top of 8D2, which is equipped with steel-pipe risers extending through the vault roof and up to ground level, to allow simple injection of wet concrete into the tank. Additional work, however, would be required to give access to the interior of the concrete vault. It is envisioned that three or four penetrations would have to be made at the extreme periphery of the vault roof by sinking, for example, 25-cm-diam pipes down to the vault, augering out the soil, and boring through the vault roof with core drills. The pouring of cement into the vault-tank annulus would be concurrent with cement injection into the HLW tank.

The other large, carbon-steel tank (8D1) would not have the benefit of waste-removal preparation. Two large (30.5- and 61-cm-diam) central tank penetrations and risers do exist, but for uniform distribution of injected cement, peripheral penetrations into the tanks and into the vault-tank annulus would have to be made using the same technique described above for the vault containing Tank 8D2.

Waste removal preparations for the smaller acidic-HLW tanks (8D3 and 8D4) would also serve for cement injection into the tanks after they were emptied. There is a large enough opening (manway) for pouring cement in the 8D3/8D4 tank vault. Conduits would be inserted into the penetrations and connected to an aboveground cement-distribution system fed by a central charge hopper. This hopper would be kept supplied with commercial ready-mix cement trucked onsite. Cement would be added to the tank and annulus in batches, each taking about seven hours to pour, to form layers of equal height (about 1 m). The layers would be allowed to set and cure for about one week before another batch would be added.

B.6.3 Environmental Impacts

B.6.3.1 Solidification Facilities

Immediate Dismantlement

The environmental impacts from immediate dismantlement for the applicable alternatives (1a, 1b, and 2) are assumed to be the same because the facility requirements are similar.

Radiological Impacts. The radiological impacts associated with immediate dismantlement of the solidification facility would consist of an occupational dose and a radiological risk to the population in the vicinity of West Valley from the release of radioactivity.

The occupational dose would result from decontaminating the facility to allow for dismantlement using conventional demolition procedures. The occupational dose is estimated to be 140 person-rem, based on a study of occupational doses from decontaminating the equipment and cells used for waste solidification (Burns and Roe Indus. Serv. Corp. 1981, Task 1B). It was assumed that maximum use would be made of appropriate shielding, remote manipulators, and cranes to achieve as low as reasonably achievable (ALARA) radiation exposures. In preparing these estimates, it was necessary to make assumptions on the radiation fields within the cells following waste solidification. Since the procedures to solidify the HLW are not well defined at this time, these estimates should be viewed as preliminary. The occupational exposure estimate is considered to be realistic, but conservative.

The population risk would result from airborne and liquid releases of radioactive effluents from the site to the surrounding area during decontamination procedures. The risk to the population in the vicinity of the site is estimated to be 2 person-rem. As with the calculation of occupational exposures, it was necessary to make broad assumptions on these releases because the radionuclide inventory within the facility following waste solidification is dependent upon the procedures used to solidify the HLW.

Nonradiological Impacts. Water taken from existing lagoons would be used for decontamination, but the amounts would be no more than those used during previous plant operations. Thus, there would be no impacts to the aquatic environment, and only small amounts of water vapor would be released to the atmosphere during normal operations. Noise and dust associated with equipment removal and mechanical decontamination would be largely confined within the buildings. The greatest decontamination impact would be the risks of worker injuries, particularly during the handling of caustic cleaning chemicals and mechanical equipment.

The major nonradiological impacts associated with dismantlement would be the noise and dust resulting from the use of drills, jackhammers, rock splitters, other power machines, and explosives. However, because of the already disturbed nature of nearby onsite land and the absence of any nearby residences, the noise impact to terrestrial communities and to the public would be minimal. Fugitive dust generated during demolition and site restoration would be confined to the immediate vicinity of the work activity. Most of the rubble from demolition would be used onsite as backfill. There would be some loss of terrestrial habitat if soil were taken from some other place to spread over the backfilled and graded area to facilitate revegetation. As with any demolition project, there would be some risk of accidental worker injuries/deaths. The combined risk associated with the decontamination and dismantlement phases would result in 24 injuries and 0.24 deaths.

Immediate Entombment

Radiological Impacts. The radiological impacts associated with entombment of the solidification facility would consist of an occupational dose, a radiological risk to the population in the vicinity of West Valley resulting from release of radioactivity from the site during entombment, and a long-term risk to the general population following entombment. As with immediate dismantlement, it was necessary to make assumptions on the radionuclide inventory within the facility following the solidification program. Thus, these estimates of radiation doses are preliminary at this time.

The occupational dose would result from decontaminating the facility prior to and during entombment. The occupational dose is estimated to be 100 person-rem, based on a study of the occupational doses associated with decontamination of the equipment and cells used for this project prior to entombment (Burns and Roe Indus. Serv. Corp. 1981, Task 1B). It was assumed that maximum use would be made of appropriate shielding, remote manipulators, and cranes to achieve ALARA radiation exposures.

The short-term population risk would result primarily from the release of radioactive materials from the site during decontamination prior to entombment. The dose to the population in the vicinity of the site is estimated to be 2 person-rem. This exposure is estimated to be the same as for the immediate dismantlement option since the major source of the population risk would be from the release of radioactive effluents during decontamination activities.

The long-term risk to the population from the entombed facility is estimated to be 0.5 person-rem through 10,000 years. The dominant pathway for this exposure would be from possible human intrusion into the entombed facility. The long-term risk for entombment of the solidification facility is conservatively estimated to be 0.01% of that associated with solidifying the HLW in the tanks.

Nonradiological Impacts. Immediate entombment would result in less noise than dismantlement, but there would be more dust from cement preparation. The combined risk of worker injuries/deaths associated with decontamination and entombment would be 4.8 injuries and 0.05 deaths, which is much less than that associated with dismantlement.

B.6.3.2 Emptied High-Level-Waste Tanks

Radiological Impacts

The radiological impacts associated with entombment of the empty waste tanks would consist of an occupational dose, a short-term risk to the population, and a long-term risk to the general population from the entombed tanks.

The occupational dose would result from entombment activities. The occupational dose is estimated to be about 13 person-rem, based on an assumed work force of 20 people for one year. This estimate assumes that maximum use would be made of localized shielding and that ALARA principles would be followed. An average annual occupational dose of about 0.65 rem per person is used in this estimate, based on data from the waste tank farm at Hanford (Janicek 1980).

The short-term population risk would result from the airborne release of radioactivity from the site during entombment activities; this risk would be small because protective measures would be used to limit the release of radionuclides offsite. The risk to the population in the vicinity of the site is conservatively estimated to be 0.3 person-rem, based on the conservative assumption that the dose from entombing the tanks is 10% of that from entombing the solidification facility.

The long-term risk to the population from the entombed tanks is estimated to be 5 person-rem through 10,000 years. The dominant pathway for this exposure would be from possible human intrusion into the entombment tanks. The long-term risk from tank entombment is conservatively estimated to be 0.1% of that associated with solidifying the HLW in the tanks.

Instead of entombment, the decontaminated empty waste tanks could be dismantled. This would eliminate the long-term risk at West Valley because the tanks would be dismantled and disposed in a Federal repository. However, the occupational dose from dismantling the HLW tanks would be large; it has been estimated to be 230 person-rem (U.S. Dep. Energy 1978). This occupational dose could be reduced by design and use of more remotely operated tank-dismantlement equipment.

Nonradiological Impacts

The major nonradiological impact during entombment of the tanks would be the release of cement dust. With proper controls, this impact would be minimal and confined to the immediate work area.

B.7 CONTINUED STORAGE IN TANKS (NO ACTION)

The Council on Environmental Quality (1978) regulations for environmental impact statements, require that, when discussing alternative actions a "no action" alternative be considered in order to provide a base case for comparison. This EIS is for the proposed Department of Energy action with respect to the HLW at West Valley, i.e., solidification of the wastes. If the Department were to take no action, the current method of storage of the wastes as a liquid in steel tanks would continue. For purposes of analysis in this EIS, the no-action alternatives were defined as: alternative 4a, which would entail delaying action for 10 years (continued storage in the tanks for 10 years and then reconsideration of solidification alternatives) and alternative 4b, which would entail continued storage in tanks for 100 years, with transfers to new tanks as necessary, followed by removal of any institutional controls.

B.7.1 Delay Action for 10 Years (Alternative 4a)

If action for solidification of the HLW were to be delayed for 10 years, the question of the current condition of the tanks and the risk of releases of radioactivity from the tanks becomes more important than in the action alternatives (where the wastes would be solidified by the end of the 10 years). As discussed in Section B.2, in 1977 the U.S. Nuclear Regulatory Commission (1977b) stated that there was no danger to public health and safety at this time. However, several questions have been raised about the actual construction of the tanks and vaults and about the defect in the pan under Tank 8D2 (U.S. Nucl. Reg. Comm. 1979). These issues take on increased importance for alternative 4a.

The major advantages to delaying solidification for 10 years is that it would allow time for several institutional issues to be resolved. Major issues include: HLW criteria; siting and construction of a Federal repository for HLW and TRU wastes and of a regional burial ground for LLW; transportation regulations and jurisdictions; and acceptance of transportation, storage, and disposal of radioactive wastes by other states. At the end of ten years, resolution of these issues might cause the various alternatives to be viewed differently from both a technical and social point-of-view, and new alternatives might be evident. For example, from a technical view, if a Federal repository and regional burial ground were available, the West Valley wastes would not have to be temporarily stored onsite, and thus there would be no environmental impact due to construction and dismantlement of the temporary storage facilities and less occupational dose because workers would not have to handle all the radioactive wastes so many times. This reduction in radiological risks would then be balanced against the risks associated with the extra 10 years of storage of the wastes as a liquid in the tanks plus the extra 10 years of exposure for workers who would maintain and monitor the wastes at West Valley.

B.7.2 Continued Storage in Tanks (Alternative 4b)

At the time the West Valley facilities were designed and constructed, storage of HLW in a liquid form in steel tanks was considered to be the acceptable method for management of the wastes. As a tank reached the end of its useful life (it would eventually corrode), its contents would be transferred to a new tank. This process would presumably continue indefinitely or until a decision was made to manage the wastes in some other way. This approach was being used for the Federal government's defense wastes at Hanford, Savannah River, and Idaho. This method was the original plan for the West Valley wastes.

The Environmental Protection Agency has recently recommended a period of 100 years for institutional control of radioactive wastes. Beyond the 100 years, it should be assumed that there would be no institutional controls (no maintenance, no control of access, no remedial or mitigating measures, etc.). Thus, in order to put the various alternatives for management of the West Valley wastes on a comparative basis for this EIS, it was assumed that there would be no institutional controls after 100 years for the action alternatives and the no-action alternatives. During the first 100 years, there would be continued maintenance and monitoring of the storage (which would continue to expose workers to small amounts of radioactivity and to pose a risk to the nearby public due to the previously discussed potential airplane crash or sabotage event). During this 100 years, the wastes would be transferred to new tanks, as necessary. The original design life of the West Valley tanks was 40 years. Although corrosion coupons in the tanks indicate that the lifetime may actually be much longer, for purposes of analysis in this EIS it was conservatively assumed that after 40 years the wastes would be transferred to new tanks. Because the wastes have already been in tanks for several years, it was further assumed that over the next 100 years there would be three transfers to new tanks. Workers would be exposed to radioactivity during the tank transfers.

The replacement tanks for the neutralized wastes would be 750,000-gallon carbon-steel tanks in underground concrete vaults, much like those now in place. However, the replacement tanks would be designed to facilitate the transfer of the wastes. Internal structures could be minimized by using a single central column to support the vault roof, and provisions could be made for waste homogenization and waste removal. Replacement tanks for the acidic wastes would be 15,000-gallon stainless-steel tanks in concrete vaults. Each replacement tank would be equipped with a waste transfer pump.

Initial transfer of the wastes would take place as described in Section B.1. Subsequent transfers could be facilitated if high-capacity recirculation pumps were installed in the replacement tanks (neutralized waste). These pumps could serve not only to homogenize the supernate and sludge prior to transfer but also to periodically prevent the formation of a hard precipitate.

The existing tank ventilation and off-gas system were assumed to be replaced every 25 years. In the event that the reprocessing plant were to be dismantled, a new stack would be provided. Provisions would be made for evaporation of the wastes in order to accommodate the wastewater volume used at each transfer. Thus, at the first replacement of the tank ventilation system, a waste evaporator would be added.

The liquid LLW generated during storage and tank transfers would continue to be treated in the existing LLW treatment facility. Thus, there would continue to be both gaseous and liquid releases to the environment. None of the other facilities would be used, and they would continue to be left in the current shut-down condition.

The emptied tanks and vaults would be filled with concrete. It is assumed that the tanks would be cleaned to the maximum extent possible, less than 1% of the activity would remain in the tanks. After 100 years, there would be no more transfers to new tanks and no more institutional control of the site.

B.7.3 Environmental Impacts

B.7.3.1 Radiological Impacts

The environmental impacts for both no-action alternatives 4a and 4b would primarily be radiological impacts. The radiological impacts associated with alternative 4a, delayed action, would be the worker doses related to monitoring and maintenance of the dormant facilities plus risks of exposure of the public due to potential releases of liquid HLW for ten more years. The impacts associated with alternative 4b would be the worker dose during maintenance and during transfers to new tanks three times over 100 years, the public risk over 100 years, and the public risk indefinitely beyond 100 years (analyzed out to 10,000 years).

The occupational dose for monitoring and maintenance activities at West Valley is estimated to be 16 person-rem per year based on data supplied by Nuclear Fuel Services (1980). The major source of this dose would not be from activities related to HLW storage, but rather from maintenance of the dormant fuel reprocessing plant, storage of spent fuel in the fuel receiving and storage facility, and maintenance of the waste burial grounds. Any remedial actions taken to minimize these sources of exposure would reduce the annual occupational dose. The occupational dose directly attributable to HLW storage is conservatively estimated to be 8 person-rem per year. This value was used for comparison of occupational doses associated with the waste management alternatives analyzed in this statement. If it were necessary to transfer the liquid HLW to new tanks, an occupational dose of 28 person-rem is estimated, based on the waste retrieval estimate for the action alternatives (see Section B.1) and assuming that the transfer would require two years to complete. For three transfers, the total occupational dose would be 84 person-rem.

The short-term (100-year) population risk is estimated to be 460 person-rem, resulting primarily from sabotage or a possible airplane crash into the HLW tanks, with subsequent release of radioactivity to the surrounding area. This population risk can be compared to the annual population dose resulting from the current maintenance and monitoring of the facilities at West Valley, which is estimated to be 0.55 person-rem (Dames & Moore 1978). The long-term (10,000-year) population risk is estimated to be 1.2×10^5 person-rem. The major source of this dose would be from possible human intrusion.

B.7.3.2 Nonradiological Impacts

There would be no nonradiological impacts during the 10-year delay period for alternative 4a. Subsequent impacts would be those appropriate to whatever action alternative was chosen.

For alternative 4b, there would be use of about 4 more hectares (10 acres) of land for construction of new tanks in the already disturbed portion of the site. There would also be a potential for long-term release of toxic chemicals from the liquid wastes in the tanks. However, using the same groundwater model that was used for the radiological analysis (Nucl. Safety Assoc. 1980), nitrate concentrations were estimated to be one-hundred times less and chromium concentrations ten times less than the EPA drinking water limits (U.S. Environ. Prot. Agency 1976); plutonium concentrations were estimated to be ten times less and uranium concentrations one-hundred times less than chemically toxic concentrations (Dawson 1974). Risk of worker injuries (40) and deaths (0.42) would be associated with construction of new tanks and continued monitoring/ maintenance at West Valley for the duration of the 100 years of institutional controls.

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PUBLIC LAW 96–368 [S. 2443]; October 1, 1980

For Legislative History of Act, see p. 6017

An Act to authorize the Department of Energy to carry out a high-level liquid nuclear waste management demonstration project at the Western New York Service Center in West Valley, New York.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

West Valley Demonstration Project Act. 42 USC 2021a note.

SECTION 1. This Act may be cited as the "West Valley Demonstration Project Act".

42 USC 2021a note.

SEC. 2. (a) The Secretary shall carry out, in accordance with this Act, a high level radioactive waste management demonstration project at the Western New York Service Center in West Valley, New York, for the purpose of demonstrating solidification techniques which can be used for preparing high level radioactive waste for disposal. Under the project the Secretary shall carry out the following activities:

Activities.

(1) The Secretary shall solidify, in a form suitable for transportation and disposal, the high level radioactive waste at the Center by vitrification or by such other technology which the Secretary determines to be the most effective for solidification.

(2) The Secretary shall develop containers suitable for the permanent disposal of the high level radioactive waste solidified at the Center.

(3) The Secretary shall, as soon as feasible, transport, in accordance with applicable provisions of law, the waste solidified at the Center to an appropriate Federal repository for permanent disposal.

(4) The Secretary shall, in accordance with applicable licensing requirements, dispose of low level radioactive waste and transuranic waste produced by the solidification of the high level radioactive waste under the project.

(5) The Secretary shall decontaminate and decommission—

(A) the tanks and other facilities of the Center in which the high level radioactive waste solidified under the project was stored,

(B) the facilities used in the solidification of the waste, and

(C) any material and hardware used in connection with the project,

in accordance with such requirements as the Commission may prescribe.

(b) Before undertaking the project and during the fiscal year ending September 30, 1981, the Secretary shall carry out the following:

Hearings.

(1) The Secretary shall hold in the vicinity of the Center public hearings to inform the residents of the area in which the Center is located of the activities proposed to be undertaken under the project and to receive their comments on the project.

(2) The Secretary shall consider the various technologies available for the solidification and handling of high level radioactive waste taking into account the unique characteristics of such waste at the Center.

(3) The Secretary shall—

(A) undertake detailed engineering and cost estimates for the project,

(B) prepare a plan for the safe removal of the high level radioactive waste at the Center for the purposes of solidification and include in the plan provisions respecting the safe breaching of the tanks in which the waste is stored, operating equipment to accomplish the removal, and sluicing techniques,

(C) conduct appropriate safety analyses of the project, and

(D) prepare required environmental impact analyses of the project.

(4) The Secretary shall enter into a cooperative agreement with the State in accordance with the Federal Grant and Cooperative Agreement Act of 1977 under which the State will carry out the following:

41 USC 501 note.

(A) The State will ma e available to the Secretary the facilities of the Center and the high level radioactive waste at the Center which are necessary for the completion of the project. The facilities and the waste shall be made available without the transfer of title and for such period as may be required for completion of the project.

(B) The Secretary shall provide technical assistance in securing required license amendments.

State costs, percentage.

(C) The State shall pay 10 per centum of the costs of the project, as determined by the Secretary. In determining the costs of the project, the Secretary shall consider the value of the use of the Center for the project. The State may not use Federal funds to pay its share of the cost of the project, but may use the perpetual care fund to pay such share.

Licensing amendment application.

(D) Submission jointly by the Department of Energy and the State of New York of an application for a licensing amendment as soon as possible with the Nuclear Regulatory Commission providing for the demonstration.

(c) Within one year from the date of the enactment of this Act, the Secretary shall enter into an agreement with the Commission to establish arrangements for review and consultation by the Commission with respect to the project: *Provided*, That review and consultation by the Commission pursuant to this subsection shall be conducted informally by the Commission and shall not include nor require formal procedures or actions by the Commission pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, or any other law. The agreement shall provide for the following:

42 USC 2011 note.
42 USC 5801 note.

(1) The Secretary shall submit to the Commission, for its review and comment, a plan for the solidification of the high level radioactive waste at the Center, the removal of the waste for purposes of its solidification, the preparation of the waste for disposal, and the d ontamination of the facilities to be used in solidifying the waste. In preparing its comments on the plan, the Commission shall specify with precision its objections to any provision of the plan. Upon submission of a plan to the Commission, the Secretary shall publish a notice in the Federal Register of the submission of the plan and of its availability for public inspection, and, upon receipt of the comments of the Commission respecting a plan, the Secretary shall publish a notice in the Federal Register of the receipt of the comments and of the availability of the comments for public inspection. If the Secre-

Publications in Federal Register.

tary does not revise the plan to meet objections specified in the comments of the Commission, the Secretary shall publish in the Federal Register a detailed statement for not so revising the plan.

(2) The Secretary shall consult with the Commission with respect to the form in which the high level radioactive waste at the Center shall be solidified and the containers to be used in the permanent disposal of such waste.

(3) The Secretary shall submit to the Commission safety analysis reports and such other information as the Commission may require to identify any danger to the public health and safety which may be presented by the project. Reports and other information to Commission.

(4) The Secretary shall afford the Commission access to the Center to enable the Commission to monitor the activities under the project for the purpose of assuring the public health and safety.

(d) In carrying out the project, the Secretary shall consult with the Administrator of the Environmental Protection Agency, the Secretary of Transportation, the Director of the Geological Survey, and the commercial operator of the Center. Consultation with EPA and others.

SEC. 3. (a) There are authorized to be appropriated to the Secretary for the project not more than $5,000,000 for the fiscal year ending September 30, 1981. Appropriation authorization. 42 USC 2021a note.

(b) The total amount obligated for the project by the Secretary shall be 90 per centum of the costs of the project.

(c) The authority of the Secretary to enter into contracts under this Act shall be effective for any fiscal year only to such extent or in such amounts as are provided in advance by appropriation Acts.

SEC. 4. Not later than February 1, 1981, and on February 1 of each calendar year thereafter during the term of the project, the Secretary shall transmit to the Speaker of the House of Representatives and the President pro tempore of the Senate an up-to-date report containing a detailed description of the activities of the Secretary in carrying out the project, including agreements entered into and the costs incurred during the period reported on and the activities to be undertaken in the next fiscal year and the estimated costs thereof. Report to Speaker of the House and President pro tempore of the Senate. 42 USC 2021a note.

SEC. 5. (a) Other than the costs and responsibilities established by this Act for the project, nothing in this Act shall be construed as affecting any rights, obligations, or liabilities of the commercial operator of the Center, the State, or any person, as is appropriate, arising under the Atomic Energy Act of 1954 or under any other law, contract, or agreement for the operation, maintenance, or decontamination of any facility or property at the Center or for any wastes at the Center. Nothing in this Act shall be construed as affecting any applicable licensing requirement of the Atomic Energy Act of 1954 or the Energy Reorganization Act of 1974. This Act shall not apply or be extended to any facility or property at the Center which is not used in conducting the project. This Act may not be construed to expand or diminish the rights of the Federal Government. 42 USC 2021a note. 42 USC 2011 note. 42 USC 5801 note.

(b) This Act does not authorize the Federal Government to acquire title to any high level radioactive waste at the Center or to the Center or any portion thereof.

SEC. 6. For purposes of this Act: Definitions. 42 USC 2021a note.

(1) The term "Secretary" means the Secretary of Energy.

(2) The term "Commission" means the Nuclear Regulatory Commission.

(3) The term "State" means the State of New York.

(4) The term "high level radioactive waste" means the high level radioactive waste which was produced by the reprocessing at the Center of spent nuclear fuel. Such term includes both liquid wastes which are produced directly in reprocessing, dry solid material derived from such liquid waste, and such other material as the Commission designates as high level radioactive waste for purposes of protecting the public health and safety.

(5) The term "tra uranic waste" means material contaminated with elements which have an atomic number greater than 92, including neptunium, pluto ium, americium, and curium, a d which are in concentrations greater than 10 na ocuries per gram, or in such other concentrations as the Commission may prescribe to protect the public health a d safety.

(6) The term "low level radioactive waste" means radioactive waste not classified as high level radioactive waste, transuranic waste, or byproduct material as defined in section 11 e. (2) of the

42 USC 2014. Atomic Energy Act of 1954.

(7) The term "project" means the project prescribed by section 2(a).

(8) The term "Center" means the Western New York Service Center in West Valley, New York.

Approved October 1, 1980.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 96-1100, pt. I (Comm. on Science and Technology) and pt. II (Comm. on Interstate and Foreign Commerce), both accompanying H.R. 6865.

SENATE REPORT No. 96-787 (Comm. on Energy and Natural Resources).

CONGRESSIONAL RECORD, Vol. 126 (1980):

June 12, considered and passed Senate.

Sept. 15, H.R. 6865 considered and passed House; passage vacated and S. 2443, amended, passed in lieu.

Sept. 17, Senate concurred in House amendment with amendments; House concurred in Senate amendments.

WEEKLY COMPILATION OF PRESIDENTIAL DOCUMENTS, Vol. 16, No. 40:

Oct. 1, Presidential statement.

APPENDIX D. SCOPING AND ISSUES

The Council on Environmental Quality (CEQ) regulations provide for a scoping process to identify "the significant issues related to the proposed action" and "deemphasize the insignificant issues, narrowing the scope of the environmental impact statement process accordingly" (Counc. Environ. Qual. 1978). Through both public and technical input, the Department of Energy has attempted to keep the scope of this environmental impact statement (EIS) sufficiently broad so as to answer public concerns, while at the same time limiting the scope to focus on those actions specific to the proposed high-level-waste solidification.

D.1 PUBLIC INPUT

A notice of intent to prepare the statement, soliciting written comments as to its scope, was published by the Department in the Federal Register on December 12, 1979 (U.S. Dep. Energy 1979a); a public scoping meeting was held at West Valley on February 2, 1980, to receive comments (U.S. Dep. Energy 1980a, 1980b). A summary of written and oral comments received during the scoping process was prepared and published by the League of Women Voters Education Fund (1980). In addition, the scoping process was aided by the extensive public comments received during preparation of the earlier two-volume "Western New York Nuclear Service Center Study"; these comments were presented with that document to Congress (U.S. Dep. Energy 1979b).

The public comments received range from specific concerns about the presence of the high-level liquid wastes to concerns about the disposition of the solid wastes located at the site, the need for a Federal waste repository, the responsibilities of various parties to pay for the waste solidification project, and the ultimate use of the land on which the site is located. Since this EIS addresses alternatives for the immobilization of the approximately 2 million liters (600,000 gallons) of liquid high-level wastes, it gives primary consideration to public concerns related to that specific action. Other issues that are beyond the scope of the project, but that have recurring mention by the public in the context of the Center, are also noted in this EIS.

The principal issues identified during the scoping process can be grouped under the following six headings:

1. <u>Health and safety of public and workers</u>
   Health and safety impacts on workers and the public.
   Radiation impacts on workers and the public.
   Health impact of routine operations.
   Risks and impacts of accidents.
   Impacts and risks of transporting wastes.
   Impacts of final offsite solidification at a Federal facility.
   Risks of terrorism and sabotage.
   Environmental monitoring.

2. <u>Physical effects on surrounding geographical areas</u>
   Impacts on air, soil, groundwater, surface waters, and biota.
   Impacts on all affected geographic areas.

3. <u>Technological questions and concerns</u>
   Waste forms.
   Seismic criteria for solidification.
   Seismic and other natural events.
   Adequacy of existing facilities for carrying out the project.
   Need for new facilities.
   Condition of tanks, nature of contents, and methods for removal of wastes from tanks.
   Disposal of salt cake and other low-level or by-product wastes, in a humid and arid climate.
   Disposal of high-level wastes, both onsite and offsite.
   Decontamination and decommissioning of facilities used during solidification.
   Technical work necessary before implementation of alternatives.
   Earliest possible removal of wastes from the West Valley site.

4. <u>Regulatory questions and other institutional concerns</u>
   Availability of Federal repository and regional burial ground.
   Emergency preparedness.
   High-level and toxic waste criteria and regulations of the U.S. Environmental Protection Agency and the U.S. Nuclear Regulatory Commission.
   Transportation regulations, overlapping jurisdictions.
   U.S. Nuclear Regulatory Commission participation in the solidification project.
   Regulations for disposal of toxic substances (e.g., nitrate salt cake).
   Payments in lieu of taxes.
   Selection of contractors and quality assurance.
   Acceptance of West Valley wastes by other states.

5. <u>Concerns regarding impacts of the solidification project on the site as a whole</u>
   Implications of various alternative actions and cumulative impacts relative to other potential West Valley actions (operation of the two burial grounds).
   Concerns that the West Valley site will become a de facto Federal repository.

6. Social and economic impacts and concerns
   Social and economic impacts, risks, and mitigation (labor force, schools, housing).
   Interaction of the U.S. Department of Energy with Indian tribes, Canadian and local governments.
   Insurance/liability for the solidification project.
   Short- and long-term financial costs.
   Public overview of actions.

There are also several concerns that are not discussed in detail in this statement:

1. Availability of West Valley site for unrestricted or other uses after project completion. This EIS does not consider the ultimate fate of the other site facilities, nor of the site as a whole. The West Valley Demonstration Act (U.S. Congress 1980) allows the Department of Energy to take action only with respect to the liquid high-level wastes and the decontamination and decommissioning of the facilities used. Any decisions with respect to other parts of the site will have to be undertaken by the appropriate authorities based on separate further environmental analysis.

2. Baseline public and worker health program for measuring the radiation health effects of past and future West Valley activities. Because of the high degree of public concern regarding any possible effects that may result from operation of the proposed West Valley solidification project, the Department has contracted the Johns Hopkins University School of Hygiene and Public Health to conduct a feasibility study to determine if a meaningful health-effects study can be designed and performed. This study will consist of two phases. The first phase will determine what available measures of health effects might be sensitive and appropriate markers of potential environmental or industrial exposure to radioactive materials in the West Valley solidification project. The second phase will determine whether such indicators could be used to monitor the health and safety of populations in the area, with a reasonable expectation that any effects that were related to radiation could be demonstrated. A report will be completed recommending the extent and limitations of possible studies that might be undertaken in association with the West Valley project.

3. Funding Arrangements. The West Valley Demonstration Project Act provides for cost sharing between the Federal government (90%) and State of New York (10%), and requires the Department to take into consideration the value of the use of the West Valley Center for the project. The State is responsible for determining the extent of nonstate government contributions to its 10% share.

4. Legal issues between the State of New York and Nuclear Fuel Services. The legal rights and obligations of the State of New York and Nuclear Fuel Services (NFS) relating to the West Valley site, including the condition thereof, has been the subject of legal actions and administrative proceedings between the State and NFS. By its terms, the West Valley Demonstration Project Act of 1980 did not affect the rights, obligations, or liabilities of the site owner, the State of New York, or the previous site operator, NFS. Many of these issues have been resolved by court order (U.S. District Court 1982) to the extent that the West Valley Demonstration Project may now proceed.

5. Use of the West Valley Site for development of alternative (non-nuclear) energy sources. Alternative energy development is the subject of numerous other Department of Energy programs. As noted in Item 1, the final use of the whole site is not within the Congressionally mandated action of the Department, and thus is not within the scope of this EIS.

6. Use of nuclear energy. This is an extremely broad, national and worldwide issue that is beyond the scope of this statement.

D.2 TECHNICAL INPUT

The Department of Energy also sought technical input into the scope of this EIS, particularly with respect to the technical aspects of alternative waste forms and solidification processes. In December 1979 a panel of experts was formed to evaluate current waste form research and development programs, to recommend criteria for selecting alternative waste forms for comparative analysis in the West Valley EIS, and to recommend waste forms for the West Valley high-level wastes which should be the subject of further Department research and development activities.

The members of the panel were drawn from the Department's Operations Offices having responsibility for waste management programs and from contractors with active waste management research and development programs. The panel's conclusions were contained in their report of the January 22, 1980, meeting (Advisory Panel on NFS High-Level Waste Forms 1980).

Waste forms were evaluated for three separate methods of handling the NFS high-level wastes:

- In-tank solidification
- Interim form preparation for shipment to an offsite terminal forms processing plant
- Terminal form preparation for direct shipment to a geologic repository

The Panel's conclusions for each waste form were:

- "In-tank waste form development would be justified only in the unlikely event that it proves impossible to empty and decontaminate the Nuclear Fuel Services, Inc. (NFS) waste tanks. No research and development should be performed at this time.
- Interim waste forms for shipment of NFS waste to a Department of Energy terminal processing plant should be given serious consideration. Depending upon the results of a recommended development program, a low-temperature, fused-salt form was chosen by the panel as the preferred interim waste form.

- Terminal waste forms can be made either from the entire high-level waste volume at NFS or from a concentrated fraction. The concentrated fraction approach was marginally preferred by the panel because it appears better developed and may offer better quality waste forms. However, the choice was judged very close.

- The primary options for the concentrated terminal waste forms were judged to be borosilicate glass, high-silica glass, crystalline ceramics such as supercalcine and SYNROC, and coated particles. All of these forms might be made either as matrices or monoliths. Borosilicate glass is available if a near time-frame plant is desired. Other forms can be made available (if the current research programs warrant) two to three years later. In an analogous manner, silicate glass was the preferred form for an integral waste form. Glass with appropriate packaging was judged likely to meet the various current draft criteria for terminal high-level waste packages.

- The three possibilities--interim, separated, and integral processing--were judged by the panel to be likely cases with substantially different technical requirements. All three should be examined with regard to technical status, environmental impact, and economics before one method is selected.

- An urgent need of the NFS waste form program is an official set of terminal waste form criteria from the appropriate regulatory agencies or from Congress."

REFERENCES

Advisory Panel on NFS High-Level Waste Forms. 1980. "Report of January 22, 1980, Meeting." DPST80-219.

Council on Environmental Quality. 1978. "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (40 CFR Parts 1500-1508)." Fed. Regist. 43:55978-56007 (November 29, 1978).

League of Women Voters Education Fund. 1980. "The West Valley High-Level Liquid Waste Immobilization Project, Public Scoping: What It Revealed." December 1979 - February 1980. Published by the U.S. Department of Energy.

U.S. Congress. 1980. "West Valley Demonstration Project Act." Public Law 96-368, October 1, 1980. Congressional Record, 96th Congress: House, September 15, pp. H8763-H8771; Senate, September 17, pp. 12761-12763.

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U.S. District Court, Western District of New York. 1982. "NYS ERDA/NFS Settlement Agreement Stipulation and Order." Civil Action Nos. CIV-81-18E and CIV-81-683E. Dated February 19, 1982.

APPENDIX E. MAJOR FEDERAL LAWS AND EXECUTIVE ORDERS POTENTIALLY APPLICABLE TO A WEST VALLEY SOLIDIFICATION PROJECT

LAWS

Archeological and Historic Preservation Act of 1974

Archeological Resources Protection Act of 1979

Atomic Energy Act of 1954, as amended

Clean Air Act of 1963, as amended

Department of Energy Organization Act of 1977

Endangered Species Act of 1973, as amended

Federal Water Pollution Control Act of 1972, as amended

Hazardous Materials Transportation Act

National Environmental Policy Act of 1969

Noise Control Act of 1972

Noise Pollution and Abatement Act of 1970

Occupational Safety and Health Act of 1970

Resource Conservation and Recovery Act of 1976

Soil and Water Resources Conservation Act of 1977

West Valley Demonstration Project Act of 1980

EXECUTIVE ORDERS

E.O. 11490, Assigning Emergency Preparedness Functions to Federal Departments and Agencies

E.O. 11514, Protection and Enhancement of Environmental Quality

E.O. 11738, Providing for Administration of the Clean Air Act and the Federal Water Pollution Control Act with Respect to Federal Contracts, Grants, or Loans

E.O. 11807, Occupational Safety and Health Programs for Federal Employees

E.O. 12088, Federal Compliance with Pollution Control Standards

APPENDIX F. PAST AND PRESENT RADIOLOGICAL MONITORING PROGRAMS

Routine monitoring of the radiological environment, both within and outside the West Valley site boundaries, has been conducted by Nuclear Fuel Services, Inc., the former U.S. Atomic Energy Commission (through 1972), and the New York State Department of Environmental Conservation. A summary of the current programs is given in Tables F.1 and F.2. The locations of sampling stations are shown in Figures F.1 and F.2. Additional, nonroutine studies have also been conducted or sponsored by the above agencies and other groups, such as the U.S. Geological Survey, New York State Geological Survey, U.S. Public Health Service, New York State Department of Health, U.S. Department of Energy, and U.S. Environmental Protection Agency. The major emphasis has been on surface and subsurface migration of radionuclides from the waste burial trenches.

These surveys have indicated that the only measurable, above-background external radioactivity occurring outside the site boundaries results from airborne iodine-129 and from radionuclides deposited in Cattaraugus Creek downstream from the plant as a result of pumping from open trenches before installation of the low-level-waste treatment facility in 1972. Within the site boundaries, there are the known quantities of radionuclides in the plant and waste burial areas and some contamination of the soil within the exclusion area northwest of the plant. In addition, some radionuclide concentrations are above background levels in the sediments of onsite streams northwest of the plant; these sediments were deposited before installation of the low-level-waste treatment facility (Nucl. Fuel Serv. 1975; N.Y. State Dep. Environ. Conserv. 1966-1979).

In the following sections, details are given on radiological conditions in (1) offsite and the exclusion area, (2) the plant area, and (3) the waste burial areas.

F.1 OFFSITE AND EXCLUSION AREA

Aerial radiological surveys made during 1968-1972 revealed levels of radioactivity slightly above background (20 μrem/h vs. 4-14 μrem/h) in Cattaraugus Creek at its confluence with Buttermilk Creek. Levels above background (15-50 μrem/h) also were found northwest of the plant and over some streams within the exclusion area. These latter levels fell rapidly toward background near the site boundaries (Nucl. Fuel Serv. 1975). A survey made in 1979 showed that the extent of the area of above-background radiation level is decreasing with time. Excluding specific, localized West Valley site facility areas, the radiation levels for the area now approximate preoperation levels (Mott 1980).

Table F.1. Department of Energy Radiological Environmental Sampling Program at the West Valley Site

Sample Location	Sample Type	Sample Frequency	Analysis
Perimeter stations			
3 stations	Air	Weekly	Gross alpha, gross beta
4 stations	Fallout/rain	Monthly	Gross alpha, gross beta, H-3
16 stations	Direct radiation	Monthly	Dose (mR/mo)
Cattaraugus Creek			
1 downstream	Water	Weekly	Gross alpha, gross beta, H-3
		Monthly	Sr-90, isotopic gamma
1 upstream	Water	Monthly	Gross alpha, gross beta, H-3
1 downstream, above Springville dam	Fish	Semiannually (2nd and 3rd quarters)	Flesh: isotopic gamma, Sr-90; skeleton: Sr-90
Streams and ditches within plant area			
1 location (sewer outfall)	Water	Weekly	Gross beta; monthly composite for gross alpha, H-3, Sr-90
2 locations	Water	Weekly	H-3; monthly for gross alpha, gross beta, H-3
3 locations	Water	Monthly	Gross alpha, gross beta, H-3
3 locations	Water	Monthly	Gross beta
Buttermilk Creek			
1 downstream	Water	Quarterly	Gross alpha, gross beta, H-3
	Silt	Quarterly	Gross alpha, gross beta, isotopic gamma
Onsite monitoring wells			
34 locations	Groundwater	Annually	H-3, conductivity
Perimeter farms			
2 locations	Milk	Annually (in August)	Isotopic gamma, Sr-90, I-129
Vicinity of plant	Deer	Annually	Flesh: isotopic gamma, Sr-90 skeleton: Sr-89, Sr-90

Table F.2. New York State Radiological Environmental Sampling Program at the West Valley Site

Sample Type	Number of Stations	Sample Frequency	Analysis
Air particulates	1	Weekly	Gross beta, Pu, isotopic gamma, Sr-90, Sr-89
Surface water	7	Weekly to monthly	Gross alpha, gross beta, H-3, Sr-90, isotopic gamma as required
Fish	1	Semiannually	Sr-90, isotopic gamma
Milk	1	Monthly	Sr-90, Sr-89, H-3, isotopic gamma
Deer	1	Annually	I-129, Sr-90, Pu, H-3, isotopic gamma
Crops	1	Annually	Isotopic gamma

Air particulate samples collected immediately adjacent to the West Valley site boundaries during 1967-1979 showed annual average gross beta concentrations ranging from 0.01 to 0.25 pCi/m^3. This is generally within statewide annual average ranges and consists primarily of natural background plus fallout from atmospheric weapons tests (Nucl. Fuel Serv. 1975; N.Y. State Dep. Environ. Conserv. 1966-1979). Individual samples collected during the same period showed concentrations ranging from zero to 1.13 pCi/m^3 (N.Y. State Dep. Environ. Conserv. 1966-1979). Average annual rates of external gamma radiation exposure at various locations in and around the exclusion area have been measured as 8.4 to 11.8 μrem/h, slightly higher than the statewide average annual rates. Previously high individual readings (132 μrem/h at Felton Bridge in 1970) have decreased (12.3 μrem/h, 1973) since installation of the LLW treatment facility and the cessation of plant operations (N.Y. State Dep. Environ. Conserv. 1966-1979).

Surface water samples collected during 1968-1979 have shown a progressive decrease in radionuclide levels since the shutdown of the plant (N.Y. State Dep. Environ. Conserv. 1966-1979; West Valley Tank Decontam. Decomm. Task Group 1978). The annual average concentration of Sr-90 measured at the Springville Dam (Cattaraugus Creek) decreased from 69 pCi/L in 1970 to less than 1 pCi/L in 1979, and gross beta activity decreased from 222 pCi/L in 1971 to less than 9 pCi/L in 1979. Tritium (H-3) levels decreased from 31,000 pCi/L in 1971 to less than 500 pCi/L in 1973. Levels then increased to 8400 and 9900 pCi/L in 1976 and 1978 but decreased to less than 500 pCi/L in 1979 as a result of the controlled release of water pumped from the trenches in the State-licensed burial area. Before its release, this trench water was treated in the LLW treatment facility to remove most radionuclides, but not tritium.

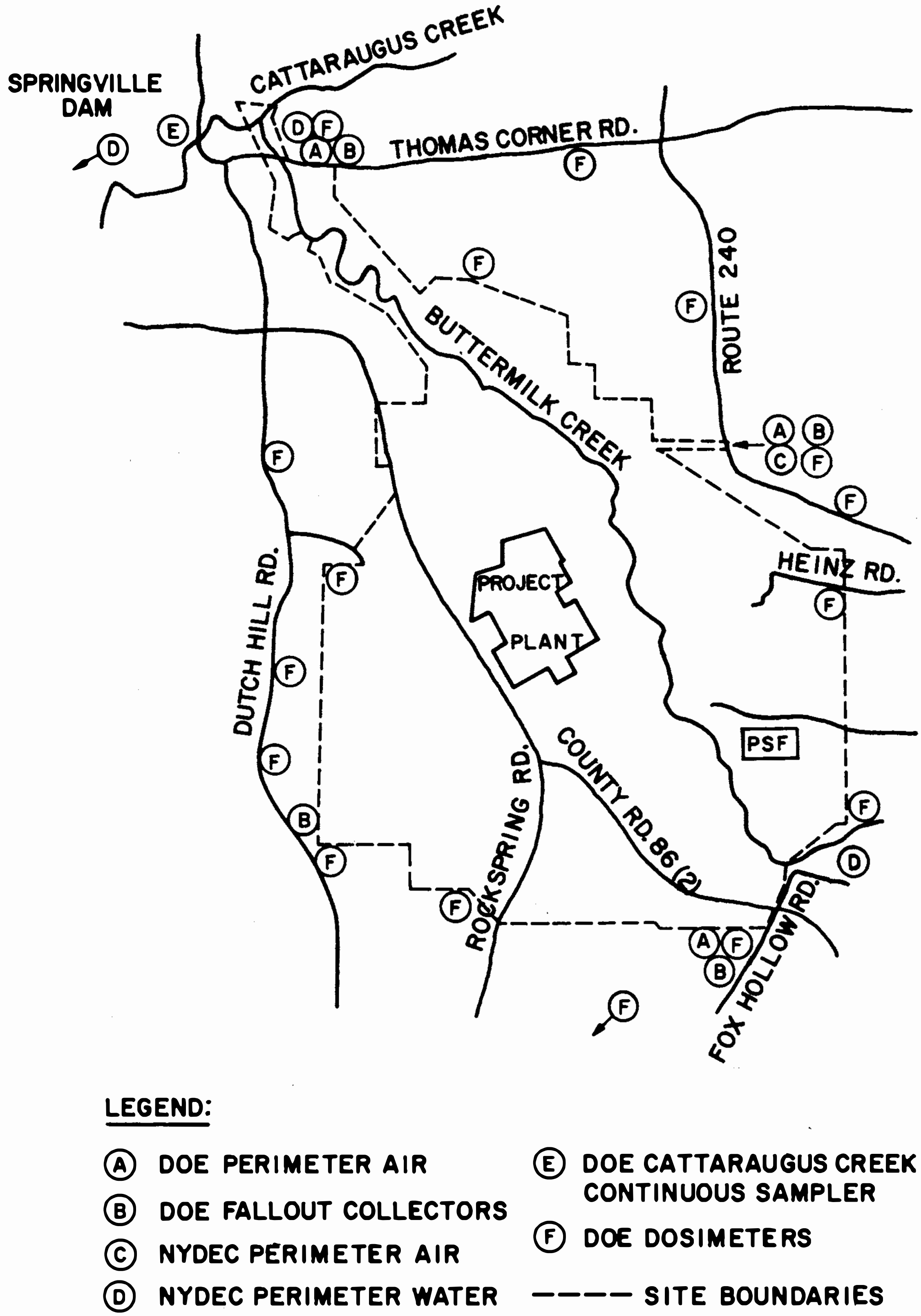

Figure F.1. Offsite and Exclusion-Area Radiological Monitoring Stations at the West Valley Site. Adapted from Dames & Moore (1980).

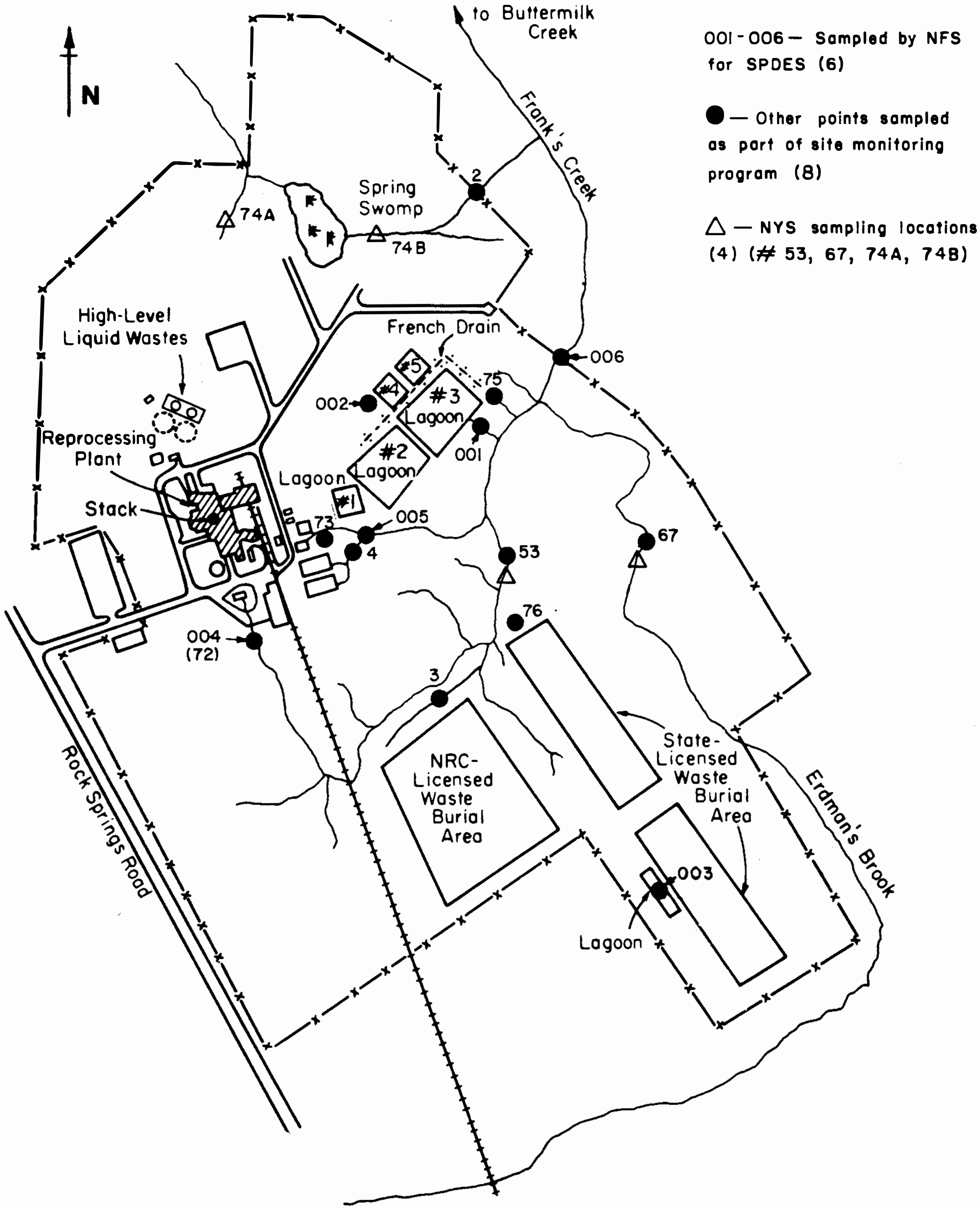

Figure F.2. Radiological Monitoring Stations Within the Plant Area at the West Valley Site. Adapted from New York State Department of Environmental Conservation (1977).

Ground surveys made at six locations in or near the exclusion area during 1970 showed detectable amounts of Cs-134, Cs-137, Zr-65, Ru-106, and Co-60 in the sand and soil regularly wetted by Cattaraugus Creek (at the Felton Bridge) and Buttermilk Creek (at the Thomas Corners Road Bridge). In the four locations away from the streams, levels of the same radionuclides did not exceed those attributable to atmospheric weapons testing (Nucl. Fuel Serv. 1975).

Soil samples taken onsite during 1971-1972 showed a low-level surface deposition of radionuclides in a northwesterly direction from the plant for about 2.5 km. Samples taken east of the plant showed no detectable quantities of these radionuclides (N.Y. State Dep. Environ. Conserv. 1966-1979).

Streambed sediment collected from Cattaraugus Creek behind Springville Dam during 1975 contained above-background level of radionuclides. The highest concentrations (400 to 114,000 pCi/kg) were about 2 m below the stream bottom. These higher concentrations at this depth reflect the releases during the years when the plant was in operation and before the low-level-waste treatment facility was put into service (N.Y. State Dep. Environ. Conserv. 1966-1979; West Valley Tank Decontam. Decomm. Task Group 1978). Additional samples of sediment taken from behind the dam when it was drained in 1977 showed a decrease in activity during the two-year period as a result of radioactive decay. This was particularly noticeable in the case of Ru-106. Analysis of the 1977 sediment for plutonium showed that some Pu-238 came from the burial area as a result of the pumping of the trenches prior to the use of the low-level-waste treatment facility.

Analyses of fish samples collected from Buttermilk and Cattaraugus creeks have followed a predictable pattern in that the highest concentrations of radionulcides were found in the samples collected nearest the plant. Concentrations decreased after the low-level-waste treatment facility was placed into service, and also after the plant was shut down. At the peak levels (1970-1971), the New York State Department of Environmental Conservation (1966-1979) calculated that an individual would have to consume over 256 kg per year of fish captured in Cattaraugus Creek to exceed the allowable limit of Sr-90.

Routine analysis of milk samples from farms in the vicinity of the West Valley site have shown no significant levels of radionuclides that could be attributed to plant operations, with the exception of I-129. Detectable concentrations of I-129 were first observed in milk in December 1971 and reached peak amounts (2.3 pCi/L) in the spring of 1972. With the cessation of plant operations, the presence of I-129 in milk has again decreased to nondetectable levels (N.Y. State Dep. Environ. Conserv. 1966-1979).

F.2 PLANT AREA

Monitoring of onsite streams receiving runoff and discharges from the main plant (Stations 72, 73, 74, and 75 in Figure F.2) was begun in 1972. Continuously elevated levels of radioactivity have been detected at Station 72, the sanitary sewage discharge point. Corrective actions taken during 1972 and again in 1974 greatly reduced the radioactive discharge; however, a low level of radioactivity continues to be measured. The source may be residual activity remaining from the higher concentrations that existed before corrective actions were taken, or it may be continued infiltration of contaminated shallow groundwater into the sanitary sewer (N.Y. State Dep. Environ. Conserv. 1966-1979).

During 1972, relatively high radioactivity levels (gross beta, 24,621 pCi/L; Ru-106, 23,500 pCi/L) were recorded at Station 73, a drainage ditch that received condenser cooling water, cooling water blowdown, and surface drainage from the main plant. In 1973, the cooling water blowdown was rerouted to the main plant discharge. Since then, radioactivity levels at this station have decreased to normal background (N.Y. State Dep. Environ. Conserv. 1966-1979).

Higher-than-background concentrations of radionuclides in samples collected at Stations 74 (spring swamp north of plant lagoons) and 75 (French drain east of plant lagoons) occurred prior to 1973. These concentrations were attributed to contamination of shallow groundwater due to seepage from the main plant lagoons and from contamination beneath the process plant (N.Y. State Dep. Environ. Conserv. 1966-1979; West Valley Tank Decontam. Decomm. Task Group 1978).

F.3 WASTE BURIAL AREAS

Monitoring of onsite streams adjacent to the waste burial areas (Stations 53, 67, and 76 in Figure F.2) was begun in 1969. Higher-than-background activity levels measured in samples collected from Station 53 prior to November 1971 have been attributed to the periodic discharge of water from the burial area lagoons and the continuous discharge from the sanitary sewage system; higher-than-background levels measured at Station 67 have been attributed to contaminated surface runoff resulting from routine burial operations; high tritium (H-3) and Sr-90 levels measured at Station 76 during 1975 have been attributed to seepage from Trenches 4 and 5. Closing the State-licensed burial area and routing the pumped-out trench water through the low-level-waste treatment facility decreased the tritium (H-3) levels from 328,729 pCi/L in 1975 to 42,070 pCi/L in 1976, and to only 632 pCi/L in 1979. The Sr-90 levels decreased from 14,102 pCi/L in 1975 to 375 pCi/L in 1976, and to only 23 pCi/L at the end of 1978. The later values are approximately equal to background levels for New York State (N.Y. State Dep. Environ. Conserv. 1966-1979).

REFERENCES

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APPENDIX G. WRITTEN COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

The Draft Environmental Impact Statement (DOE/EIS-0081D) was made available for public review and comment on July 31, 1981, and a notice of availability was published in the Federal Register on August 7, 1981. Federal, State, and local agencies were supplied copies of the draft statement and were requested to comment on its contents. Copies of the statement were also provided to interested groups and individuals for their comment. Additionally, the opportunity to comment on the draft statement was provided at public hearings conducted in West Valley, New York, on September 26, 1981. The comment period ended October 30, 1981.

A total of 40 comment letters (some with supplements) were received. These comment letters are reproduced in this appendix. They have been numbered in the order received, the numbers serving to identify the commenter for the purpose of response. Responses to the comments are found in Appendix H, Section H.2.

The letters contain approximately 500 comments. All of these comments were considered in the preparation of the Final Environmental Impact Statement (EIS). About 300 were identified as substantive and requiring specific treatment by the Department of Energy. These substantive comments are identified by comment letter number and designated comment number within that letter. For example, comment identification number 18-1 refers to the first designated comment in letter number 18.

The comment designation is given in the left margin next to the specific portion of the comment requiring a response. In many cases, the comment is preceded and/or followed by additional clarification by the commenter. This additional text was used by the Department in determining the intent and thrust of each specific comment.

Comments received by letter and during the public hearings were voluminous and included a number of issues that were not of an environmental nature. However, the Department has attempted to consider and accommodate all substantive concerns identified by each commenter, both written concerns and those presented at the public hearings. The major issues identified in the comment letters were addressed in one of two manners: (a) appropriate changes were made in the text of the EIS in response to the comment, or (b) a written response to the comment was prepared. This first method was used for those comments concerned with text changes, usually dealing with clarifications or revisions of data that were deemed appropriate. The second method was used to provide additional clarification of information in the EIS that could not be covered adequately in the text. These responses are given in Section H.2.

A key to the agencies, organizations, and individuals submitting letters regarding the Draft EIS follows.

KEY TO COMMENTS

Letter 1

10 NASHOBA RD
SUDBURY MA 01776
8-19-81

West Valley Program Office
Office of Waste Operations & Technology NE 320
Nuclear Waste Management & Fuel Cycle Programs
US Dept. of Energy
Washington DC 20545

This is a comment on the DEIS for West Valley High Level Waste Management DOE/EIS-0081D

Page 2-3 footnote change "--- are believed to be reasonably attainable with near term technology." to "---- have been attained with current technology."

The reason can be found on page B-19 "The fact that incorporation of radioactive wastes into borosilicate glass is a currently proven technique is the chief reason for using this waste form as the reference terminal waste form for environmental analysis in this EIS."

1-1 The fact of environmental impact assessment being based on current technology is very important.

Welles Hotchkiss

Rec'd WVPO
AUG 25 1981

Letter 2

West Valley Program Office
Office of Waste Operations and
Technology, NE-320
Nuclear Waste Management and
Fuel Cycle Programs
U.S. Department of Energy
Washington, DC 20545

8-27-81

Dear Sir,

I am of the opinion that the current storage of the High Level Liquid Waste at the N.F.S. West Valley plant poses no significant danger to the surrounding area or public. The carbon steel tank (8D-2) has shown no sign of corrosion after fourteen (14) years of use and the stainless steel tank (8D-4) is still in perfect condition.The storage system seems more than adequate considering the pan and the vault that 8D-2 sits in, the surounding clay,the water injection system,the silty till,and the ability to transfer either tank to its spare (8D-1 or 8D-3).

The exposure and the expense involved in re-handling this material to solidify and transport is not justifiable.

I belaive reprocessing is of vital importance to our nations' energy independence. It is a tribute to the "Power of the Press" that this plant was legislated to an early grave,and that private industry was forced to abandon it so that it now represents a liability of instead of an asset to the American people.

If there are any technological advances that might be of benefit to the reprocessing industry that could be gained by solidifing and transporting this material,then I would be in favor of such an undertaking,but if the whole idea of the West Valley Demonstration Project Act of 10-1-81 is to rid the area of what the press refers to
2-1 as a "Nightmare", then I am in favor of Option # 4b, because I don't belaive a safety problem exists. Thank You for your time.

Britta M. Conlin

Britta M. Conlin
47 Parkside Ave.
Hamburg, N.Y. 14075

Letter 3

501 Vine Street
Middletown, PA 17057
September 2, 1981

West Valley Program Office
Office of Waste Operations and Technology (NE-320)
Nuclear Waste Management and Fuel Cycle Programs
U.S. Dept. of Energy
Washington, DC 20545

Dear Sir:

I am pleased to see citizen participation mentioned in section 4.3.12.2 on page 4-69. It is my sincere hope that the Department of Energy develop a citizen participation plan that will rely on timely information dissemination and early needs sensing of the affected persons to increase utilization of such information.

Certainly some activities of the West Valley Project will create stress. Stress is a necessary part of living but too high or low levels not managed can create problems for <u>all</u> directly and indirectly involved in the project.

3-1 A supportive environment will help lessen stress, if constructed in a thoughtful manner. In order for individuals to contend with stress generated or exacerbated by the West Valley Project the fine tuning of a citizen participation plan is essential.

In my view the plan should consist of many items of which several are listed below:

1. Development of a dissemination list of interested citizens, organizations, businesses and others through community outreach.
   A. Utilize the list to alert those of press releases, meetings and up-dates or reports.

2. Regularly scheduled public/press meetings conducted by DOE, contractors, and representatives of New York state government agencies. (perhaps monthly or every 2 to 3 months)
   A. The purpose is to give information and answer questions.
   B. The meetings should be held in local communities and all held in the evenings or Saturdays.

3. Implementation of a Citizens Advisory Committee.
   A. Composed of predominately local citizens and citizen organizations, local government, businesses, industry, university, and available "independent" technical persons.
   B. Employees of the state government agencies and project shall act as ad hoc members with no voting power but shall sit on the committees.

   C. Voting members of the committee shall represent <u>all</u> segments of <u>the community</u>.
   D. One newspaper and one television station (predominantly covering the affected area) shall have representatives on the board to insure appropriate pre and post meeting publicity.

4. Transcripts of meetings should be available to the public via dissemination lists and free of charge.

These are just a few thoughts on how I feel a meaningful plan could be used to better inform the public and allow constructive public input into this project which will be in the "Public Eye" for several years.

Sincerely

Donald E. Hossler

Donald E. Hossler

Letter 4

Jesuit Centre

FOR SOCIAL FAITH AND JUSTICE

September 10, 1981

Mr. D.J. McGoff
Projects and Technology Team
Office of Waste Operations
and Technology
U.S. Department of Energy
Washington, D.C. 02545

Dear Mr. McGoff,

Enclosed are my comments on the Draft Environmental Impact Statement for West Valley. I would like to make an oral presentation on September 26, 1981, in addition to this written report.

The worker health study is also of concern to me, and I was surprised to read in the newspaper that workers involved with the West Valley clean-up would be compared with other nuclear workers. This, of course, assumes the other nuclear workers are not at risk which is hardly an acceptable research assumption. May I please have a copy of the protocol of this proposed study to be conducted by Johns Hopkins University.

Thank you.

Sincerely,

Dr. Rosalie Bertell

Rosalie Bertell, Ph.D., G.N.S.H.

RB/np
Encl.

947 Queen Street East • Toronto Canada M4M 1J9 • Tel. (416) 469 1123

COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR WEST VALLEY NUCLEAR WASTE PROJECT

4.1.1. Introduction

4-1 The solidification of waste at West Valley will involve measurable gaseous and liquid radioactive effluence. This toxic material may be expected to spread globally and eventually impact the food chain through normal air currents and ocean recycling of chemical "nutrients." The Environmental Impact Statement for the West Valley clean-up should include the effect of all radioactive chemicals released, integrated globally and into infinite future time. It is unacceptable to declare that only the impact on "people assumed to live within an 80-km radius of the disposal sites", is of concern to the residents of Western New York.

4.1.3. Radiological Impact Assessment

4-2 Only atmospheric releases were considered for the first hundred years, and exposures were only assessed for persons within the 80-km radius of the plant. Aside from the geographical contradiction in assuming global distribution of airborne radioactive chemicals while only the health effects on a small localized group of people are considered, there seems to be a serious omission of the impact of radioactive chemicals due to wash out, barnyard run-off, surface water contamination, and other transport process in the biosphere. Moreover, the EIS has failed to demonstrate that there will be no liquid effluence from the solidification process. No filtration system is perfect and there is no known way to prevent tritium loss. Perfect containment of radioactive waste water is not a credible scenerio.

Figure 4.2 does not reflect air-to-water and water-to-air pathways secondary to air and water releases.

4-3 It is also well known that airborne radioactive material is deposited downwind at the nearest place of high rainfall and immersion in the radioactive plume occurs at the point of plume touchdown, which may well be beyond the 80-km radius. There are no determinations of where these places of highest exposure are located, nor are the expected population doses associated with them given.

4-4 The Heidelberg scientists (See Reference at end) have demonstrated that the uptake factors used by the NRC, as given in the Regulatory Guide (page 4-7 of the EIS), are neither conservative nor adjusted for local soil conditions. The suggested modifications of the dose conversion factors proposed by Kollough and Dunning, and recommended by the ICRP No. 26 are generally unacceptable to many experts in the health hazards of radiation. They have not been approved for use in the United States.

4-5 The EIS relies on reports of the International Commission on Radiological Protection (ICRP) recommendations and on the research backing these recommendations. Neither the U.S. Nuclear Regulatory Commission nor the U.S. Environmental Protection Agency has recommended that these ICRP changes be implemented for use in the United States.

The I.C.R.P. cannot be classed as an independent scientific body making recommendations protective of public health. There is not even one independent organization able to appoint members on this body. It is a self-perpetuating closed club of radiation users. The I.C.R.P. has never taken a position in behalf of public health in any major radiological question raised since it was founded in 1952. It never even took a stand opposing the above ground testing of nuclear bombs. The Department of Energy should be made aware that the people of Western New York are not ignorant about the pro-nuclear bias of this organization and its poor record with respect to protecting worker or public health.

4-6 On page 4-8, reference is made to regulations given in 10 CFR20 allowing 5 rem exposure to nuclear workers per year. This dose refers only to exposure from sources external to the body. The worker is allowed another 5 rem per year internal dose, and even these limits of 10 rem can be exceeded using other loop-holes in the Regulations. Since the EIS stated on page 4-5 that it meant to deal with both internal and external contamination, reporting only a part of the standard for workers is misleading.

4.1.4. Short-Term Releases of Radionuclides

On page 4-16 it is stated that the fractional frequencies for accidents represents less than one event per year. A detail analysis of accidents at the West Valley facility prior to closing
4-7 makes this estimate seem overly optomistic. The Department of Energy should provide detailed information on the nature and number of accidents per year at its Savannah River Plant, the Idaho National Engineering Laboratory and the Hanford Reservation. This base, plus allowance for the fact that the West Valley clean-up is a new process should lead to a more realistic estimate.

4.1.5. Long-Term Releases of Radionuclides

4-8 An assumption is made that the HLW has been immobilized as borosilicate glass. For most processes of glassification this implies that some of the cesium 137 and other radionuclides are lost to the environment since their boiling points [1000 to 1400°] are below that needed for glassification. Total cesium 137 inventory has not been given and total health impact of the percentage gaseous radionuclide releases seems not to have been considered.

Tables 4.5 through 4.10 page 4-23 through 4-26.

The event with greatest potential for release of radioactive material is the airplane crash. In this event the maximum individual dose to members of the general public is 30,000 rem - well above the dose of 250 rem where 50% of those exposed would be expected to die

within 48 hours. The estimate of population dose in person-rem is 500,000,000, which when divided among the population within the 80 km radius means an average dose of 333 rem for each of the 1.5 million persons. It should be obvious that such massive doses to the population nearest the facility implies contamination of Lake Erie, Lake Ontario, the Niagara and St. Lawrence Rivers, together with contamination of land downwind for two or three thousand kilometers. It also means a minimum of 750,000 prompt fatalities in the 80 km radius alone. The land 240 to 480 km downwind would most likely become uninhabitable.

It is also obvious that any major cause of a disaster breaching building integrity and scattering the contents would have the same
4-9 effect as a direct airplane crash. In this event and others of widespread effects, the Department of Energy estimates of population dose are too low because of the 80 km radius limitation. The 100 year cumulative risk is significantly underestimated because of the underestimation of population dose and the low probability assigned to a too narrowly defined event.

4.1.6. Short-Term Radiological Impacts

It is incorrect from the point of view of public health to justify exposure to fission products - especially internal alpha emitters - on the basis of exposure to "normal" background sources. These "normal" sources have their own impact on human health and should not be unnecessarily increased. Moreover fission fragments inhaled or ingested cause specific organ damage not associated with naturally
4-10 occurring radionuclides in their natural state. The EIS used "natural background" in a misleading way.

4.1.8. Health Effects

The Department of Energy dependence on the BEIR III estimates is naive at best. This report represents an unsatisfactory compromise achieved by expelling from the committee the Chairperson and chief critic of the report, Dr. Radford. This report has also become outdated since the May 22, 1981 Science release (see News and Comments) revealing the "mistakes" in dosimetry at Hiroshima. The Department of Energy should present several health effect estimates rather than choosing to use only the contraversial BEIR III report and ICRP pro-industry recommendations as basic to their estimates in Table 4.2.

The Department of Energy is considering only cancer deaths and serious transmittable genetic disease as radiation effects of concern. In some of the accidents listed, the members of the general public would die of destruction of the brain and Central Nervous System, damage to the gasto-intestinal tract and severe bone marrow damage
4-11 not cancer. In the more "routine" scenarios there would be non-fatal

4-11 cancers, benign tumors, earlier occurence of chronic old-age diseases, teratagenic disease, and general "non-serious" genetic diseases. It is not clear that omitting these from the EIS makes these radiation effects acceptable to the general public.

The people most at risk from West Valley have agreed to assume an unusual health burden so that the West Valley nuclear waste dump may not become the Love Canal horror of the future. Recognizing this generosity and acknowledging the true cost would go a long way toward
4-12 restoring public trust. The EIS methodology of reducing dose estimates and limiting health effect to those labeled "of concern" causes further erosion of public confidence in either the technical competence of honesty of this government agency, the Department of Energy.

On page 4-37, the EIS seems to have made an underlying assumption that future generations will be as susceptible to ionizing radiation as present generations. This is contrary to evidence relative to mild mutations (see enclosure), which would indicate that they will be less able to cope with radiation pollution than were their relatively less genetically damaged fore-bearers.

Reference: Heidelberg Scientists affiliated with Institute fur Energie und Umweltforschung Heidelberg, have challenged the U.S. Nuclear Regulatory Commission estimates of human doses of radiation from known fission product release rates. The N.R.C. has responded to the IFEU documented report, and IFEU has responded to the criticisms raised by the N.R.C. At this point in time the contraversy is not resolved (see NUREG-0668)

Rosalie Bertell, Ph.D.

Rosalie Bertell, Ph.D., G.N.S.H.

September 15, 1981

Letter 5

Irwin D.J. Bross, Ph.D.
Director of Biostatistics
Roswell Park Memorial Institute
666 Elm Street
Buffalo, N.Y. 14263

[illegible]

September 29, 1981

West Valley Program Office
Office of Waste Operations
and Technology NE-320
Nuclear Waste Management and
Fuel Cycle Programs
U.S. Department of Energy
Washington, D.C. 20545

Dear Sir:

In accordance with the instructions on DOE/EIS-0081D, I am submitting written comments to the Department of Energy which will be postmarked well before October 30, 1981. However, to insure that there is no slip-up on this point, I would appreciate receiving a postcard or other written notification that the material has been received by the Department of Energy.

From previous communications with DOE and other federal agencies, I do not think the procedure for reviewing objections to DEIS's does much to protect the public health and safety. The dangers pointed out in this critique can be brushed off and subsequently ignored--as has happened with suggestions previously made to DOE on West Valley (e.g., secondary containment). These issues can only be thrashed out at an evidentiary or judicial hearing before a neutral panel. Neither the detailed critique nor a detailed response can be adequately presented in a couple sentences in a document.

Since DOE seems very unwilling to face its critics in a neutral or judicial forum, the practical purpose of preparing the critique was to try to bring the issues before such a forum. It would be nice if DOE took the initiative for this, but I am afraid that that's wishful thinking.

Very sincerely yours,

Irwin D.J. Bross, Ph.D.
Director of Biostatistics

IDJB/mak
Enclosures

CRITIQUE OF DOE/EIS-0081D

Written testimony submitted to:

WEST VALLEY PROGRAM OFFICE
Office of Waste Operations and Technology, NE-320
Nuclear Waste Management and Fuel Cycle Programs
U.S. Department of Energy
Washington, D.C.

October 1, 1981

Testimony of:

Dr. Irwin D.J. Bross
Director of Biostatistics
Roswell Park Memorial Institute
Buffalo, New York 14263

I testify as an individual and for no institute or organization. As a public health scientist and biostatistician-epidemiologist for more than 30 years, I have published more than 300 papers and my latest book, SCIENTIFIC STRATEGIES TO SAVE YOUR LIFE (just published by Marcel Dekker, Inc.), deals in detail with studies of the hazards of low-level ionizing radiation. For more than 20 years, I have been Director of Biostatistics at Roswell Park Memorial Institute for Cancer Research in Buffalo, New York (for 7 years as Acting Chief of Epidemiology) and before that was at Cornell University Medical College and Johns Hopkins.

DATE: October 1, 1981

TO: WEST VALLEY PROGRAM OFFICE
Office of Waste Operations and Technology, NE-320
Nuclear Waste Management and Fuel Cycle Programs
U.S. Department of Energy, Washington, D.C.

FROM: DR. IRWIN D. J. BROSS

SUBJECT: CRITIQUE OF DOE/EIS-0081D

PURPOSE:

The purpose of this critique is to demonstrate the need for judicial intervention to protect the health and safety of Western New Yorkers from the potentially catastrophic hazards of the West Valley Demonstration Project (WVDP).

Nominally an Environmental Impact Statement is supposed to identify the radiological hazards of the project and to give plans which would avoid or minimize these hazards. However, DOE/EIS-0081D is a
5-1 fraudulent document. There is no consideration of the actual health hazards (only fictitious calculations that do not even identify these
5-2 hazards). Moreover, there is no specific contingency planning to deal with the actual radiological hazards of the West Valley project.

The purpose of this critique is to show that from a scientific standpoint the document is incompetent--it was prepared by persons who seem to know nothing about the actual health effects of low-level ionizing radiation (the figures used are a decade out of date and are now recognized as scientifically invalid). The critique will also show that from a public health standpoint, the DOE/EIS is irresponsible.

When the WVDP, the most dangerous radiological project ever attempted, is planned in this unscientific and incompetent way, the DOE/EIS is itself a clear danger to the health and safety of both workers and the public. As DOE has previously demonstrated in its West Valley operations, it pays absolutely no attention to anything said or submitted at the hearings that are not judicial or evidentiary-type
5-3 hearings. It is therefore essential that judicial and evidentiary-type hearings be conducted on the radiological health hazards of the West Valley Demonstration Projects--before it starts and not after a disastrous loss-of-containment accident has resulted from the actual operations.

DANGER TO WESTERN NEW YORKERS

Table B.2 (page B-9) gives the inventory of more than 30,000,000 curies in Tank 8D2 that makes the West Valley Demonstration Project (WVDP) potentially the most dangerous radiological project ever undertaken. There are three incontrovertable factors that make this project so dangerous to the health and safety of Western New Yorkers. The first is the extremely dangerous isotopes in the inventory—6,700,000 curies of Strontium-90 for example. The second is the geographic factor—West Valley is located in a well watered area not far from Lake Erie and
5-4 metropolitan areas. The third factor is the lack of any proven technology for coping with the intractable sludge in Tank 8D2 and the greatly increased chance of making bad mistakes with unproven technology. These three factors result in a non-neglible risk of a serious loss-of-containment

accident. Such an accident could produce an environmental catastrophe affecting the entire Northeast quarter of the North American continent.

Any competent Environmental Impact Statement must deal with the factors that make the WVDP uniquely dangerous, must assess the risks of a serious loss-of-containment accident, and must at least outline the precautions and procedures that would be needed to prevent such an accident or to minimize the adverse health effects if one should occur. Although the DOE/EIS contains tables or text confirming what has been

5-5 said here about all the three factors, it does not consider or even mention the possibility that the operations of the WVDP could result in a loss-of-containment accident. There is no specific consideration whatsoever of the steps that could be taken to avoid such an accident in the WVDP or to minimize the adverse effects on the health and safety of the Western New Yorkers. It is precisely this failure of DOE to consider the potential risks of a loss-of-containment accident which greatly increases the chance that such an accident would occur during the WVDP operations.

Unlike the inconsequential risks that the DOE/EIS actually considers (e.g., an airplane flying into the tank), there is a considerable risk of a loss-of-containment accident. For risk calculations based on general past performance, there is a long and dismal record of DOE mismanagement of its programs. This is documented in the July 29, 1981 report of the General Accounting Office (GAO). GAO reviewed four DOE program areas (Occupational Safety, Emergency Preparedness, Facility Design Safety, and Environmental Monitoring) and found serious short-

comings in all of them. GAO concluded that the "specific problems (in these areas) warrant immediate corrective action." These areas are, of course, crucial to the DOE/EIS. Similarly, the past record of West Valley technological decision-making shows one bad mistake after another. This is why a corporate investment of less than $10,000,000 has necessitated a $700,000,000 remedial program (with the taxpayers picking up the tab). On the basis of the past record, a loss-of-containment accident might seem almost inevitable under DOE management.

What is perhaps even more ominous, risk calculations based on the specific operations proposed in the DOE/EIS show that there would be a high risk of a loss-of-containment accident if these plans are implemented in the West Valley Demonstration Project. For example, the most crucial step in the WVDP operations is what the DOE/EIS calls "removal of the high-level liquid wastes from the storage tanks". The proposed operations discussed in B.1 of the EIS are simplistic in the extreme. Basically high pressure nozzles would be used to stir up the wastes in 8D2 so that the tank could be pumped out like a flooded cellar. While the composition and nature of the sludge is in fact unknown (as is admitted later in the section), it is very unlikely that the sludge can be pumped out like an ordinary liquid. For instance, there is a complicated internal structure in the tank. The sludge is probably cladded to this structure. Hence, any high-pressure operations that could loosen the sludge could also collapse the structures and cause a loss-of-containment accident.

What is particularly disturbing is that the DOE/EIS assumes that the removal of the high-level wastes will be a quick-and-easy operation in its estimates of worker and public exposures. Yet elsewhere the DOE/EIS admits that there is no proven technology for the job and that it may not even be possible to get the sludge out of the tank. There is no consideration (or even mention) of the main danger in this job—a loss-of-containment accident. There is no recognition that such an accident could be an environmental disaster which in the long term could produce more deaths and disabilities in Western New York and Canada than the A-bombs produced at Hiroshima and Nagasaki. There is no suggestion of even the simplest precautions against such an accident (e.g., the secondary containment plan previously presented to Argonne).

HEALTH EFFECTS OF LOW-LEVEL IONIZING RADIATION

The key to a realistic appraisal of the radiological impact of the West Valley Demonstration Program is a clear understanding of the nature of low-level radiation hazards and up-to-date and scientifically valid estimates of the health effects of low-dose exposures. There is nothing in DOE/EIS-0081D to suggest that any of the preparers, reviewers, or DOE administrators involved in the preparation of the document know anything about current research on low-level radiation or have any

5-6 competence in public health matters. The section of Health Effects occupies less than 6 pages in a document running over 300 pages and includes nothing more than the outdated and erroneous "official" estimates (which are in line with the DOE and the official Interagency position that "low-level radiation is harmless").

Since the actual risks are anywhere from 30 to 200 times greater than the "official" risks, all of the calculations in the

DOE/EIS would be meaningless for this reason alone. As previously noted (Schedule A), DOE calculations consistently employ this meaningless ("Mickey Mouse") arithmetic.

The "official" figures are based on obsolete data on populations exposed to high levels of ionizing radiation (e.g., Japanese A-bomb survivors or sick persons given high-dose therapeutic radiation) and on discredited methods of analysis. For example, in a recent Science article, BEIR III Chairman, Dr. Edward Radford, reports on the dosimetry errors in the A-bomb data that:

> "As I have pointed out elsewhere, this leads to an increase of the BEIR III coefficients of about 2 for males and about 4 for females; use of cancer incidence for risk evaluation changes these factors to 4 and 7 respectively. Thus it is in correcting a misinterpretation of the Japanese results by the BEIR III report that the new dose information has the greatest significance." (Schedule B)

There is no longer any reason to use dubious data and discredited methods of extrapolation to get estimates of radiation health effects in 1981. There are now more than 20 studies of populations actually exposed to low doses of ionizing radiation where direct and valid estimates of risks can be made. These are listed in Schedule C. The scientific advantages of the new studies, some by federal agencies, are detailed in Schedule D.

One major advantage is that some studies, such as the Portsmouth Naval Shipyard (PNS) study (CDC/NIOSH), are on healthy workers exposed to the Nuclear Regulatory Commission ALARA levels. In other words, the

PNS estimates are directly pertinant to the WVDP worker exposures. The NRC ALARA levels are assumed "safe" in the DOE/EIS. Yet government studies such as PNS and the Big Smoky Bomb Tests (CDC) have confirmed the results of our earlier studies of myeloid leukemia in man exposed to diagnostic x-rays: The doubling dose is about 5 rem. Thus, the 5 rem/year dose to workers currently permitted annually by the NRC is unsafe for workers—a point further discussed in Schedule D.

DOE SUPPRESSION OF RADIOLOGICAL HAZARDS

It should be noted that the gross underestimate of low-level radiation hazards is not due to a casual DOE mistake; it reflects a longstanding DOE policy. DOE not only refuses to use current scientific estimates of health effects (which are 30 to 200 times greater than the "official" estimates), it has actively attempted to suppress the scientific research that developed these estimates—including Dr. Thomas Mancuso's study of the health effects for workers at the Hanford reprocessing plant. The DOE efforts to sustain the myth that "low-level radiation is harmless" by force are detailed in testimony from both sides at a Congressional hearing (Serial No. 95-179). The Chairman, Paul Rogers, gave this instance of DOE mismanagement of health effect research:

> Mr. Rogers. It's the most disordered, unstructured mess that I have looked into in some time. If our research programs are being carried on in this manner, where you just take a study from one scientist and give it to some other group without even knowing who the principal investigator will be or his qualifications,

> this is a very inefficient, poor way of managing a research program and it is not a competent way to spend tax dollars. We are going to have to go into this in some detail, and I will ask other committees to do so as well. We may also ask the Department of Justice to look into this whole matter. Certainly you may comment.
>
> Dr. Liverman. After your comment, what's left to say?
>
> (Dr. Liverman was testifying for DOE).

It is characteristic of the DOE/EIS-0081D that the Health Effects section fails to mention the fact that the scientific community cannot even agree on the order of magnitude of the radiation risks (so the specific numbers are clearly unreliable). Apparently, the only risks known to the preparers and reviewers are the discredited "official risks", so any housewife in West Valley knows more about health effects of low-level ionizing radiation than the authors of the DOE/EIS.

The hazard to the public and to nuclear workers from the gross underestimates of the actual radiation risks used in the EIS are not so much the meaningless "Mickey Mouse" arithmetic of the report as in the fatuous attitude and engineering that seems to go with these numbers. DOE and its staff believe in the myth that low-level radiation is "harmless". This is the myth that led inevitably to the long series of progressively worse management decisions at West Valley. This chain of bad decisions produced the mess that WVDP is supposed to remedy. Section B.1 of the DOE/EIS is just one example of this deliberate disregard for actual radiological impacts in the decision-making. The health and safety of the citizens of Western New York are endangered when this potentially catastrophic project is managed by persons who seem to have no understanding of the radiological dangers. The DOE report seems to have been written by "children playing with nuclear firecrackers", persons incapable of writing a competent EIS on one hand or of effectively managing the West Valley Demonstration Project on the other.

DOE MISMANAGEMENT OF NUCLEAR PROGRAMS

Perhaps the greatest practical danger to the health and safety of Western New Yorkers arises from the fact that DOE is managing the WVDP. The program would be a difficult undertaking at best because there is no proven technology to do the job and the on-the-job development and testing of new technologies is always a risky business. The WVDP is the kind of project that requires the best possible management, managers who are particularly aware of and sensitive to the enormous potential for environmental disaster. Unfortunately, it is under an agency which has the worse managerial record of any federal agency—not an easy distinction to achieve.

The simplest way to deal with the management issues--which are crucial to the potential health hazards from WVDP—is to go directly to a recent report on DOE mismanagement of its nuclear installations. Taken together with the potential for disaster in the WVDP, the report is frightening (Schedule E):

> Rep. Pat Schroeder (D-Colo.) has released a General Accounting Office (GAO) report that charges the Department of Energy is failing to meet adequate health and safety standards at its nuclear facilities. He says:

> "You can't allow DOE to police itself and still expect the health of the public to be protected. GAO's study clearly states that major changes have to be made before we can rest easy about the safety of DOE facilities."

GAO found serious shortcomings in four DOE functions. Of particular pertinence is Occupational Safety:

> "--Is DOE's program adequate to assure the employees at DOE's nuclear facilities are provided with safe and healthful working conditions? The short answer is 'No'."

On Environmental Monitoring:

> "—How does DOE assure itself that information concerning radiological releases from DOE's nuclear facilities is accurate and reliable? GAO's answer is that DOE has little assurance."

In its report GAO recommends a "major reorganization of DOE's safety and health program".

When DOE's past performance in these areas is so badly flawed as to be incompetant and to provide little assurance of protection for either workers or the public, its ability to provide an assessment of the future hazards of the West Valley Demonstration Project is highly questionable. DOE has consistently underestimated, ignored, or otherwise failed to adequately deal with the radiological hazards at it current installations and does the same thing in its West Valley assessment.

UNDERESTIMATION OF RADIATION EXPOSURES

To estimate radiological impact on a human population, there are two distinct factors that enter as a product term. The first is the risk of a health effect (e.g., lung cancer) per unit dose (e.g., rem). The second is the amount of radiation exposure of a population (e.g., person-rem). As previously noted, the risk of health effects has been greatly underestimated in DOE/EIS-0081D. However, the underestimation of exposures of workers and the public is even worse. Because a product term is involved, the actual impacts are underestimated by factors of 100 to 10000, so the numbers in the DOE/EIS are so remote from reality as to be meaningless. The use of such numbers in decision-making (e.g., in choice of options) is extremely dangerous to the public health and safety, particularly when a potentially catastrophic project like WVDP is being planned. The decisions will not be based on science but on fantasy.

Just one example of the absurdity of the DOE exposure estimates will be considered here but it should suffice. The most critical step in the proposed program is the one called "removal of liquid high-level waste" and discussion in section B-1. This is the phase of the operations where the work directly involves the inventory of 30,000,000 curies in Tank 8D2. It is the most hazardous part of the operations both for workers and for the public because of the risk of loss-of-containment accident for Tank 8D2.

The radiological impacts that DOE estimates for the waste retrieval phase of operations are given on page B-16 and B-17. For

occupational and population doses respectively, they are at most 35 person-rem and 46 person-rem. It might seem a little surprising to anyone unfamiliar with DOE "Mickey Mouse" arithmetic that specific (and very low) numbers like these could be obtained for operations where all of the essential engineering information for calculating exposures is missing. In section B.1.4, under "Development Needs", there is a list of "areas of resolution"--information currently not available but presumably to be developed during the project. No less than 5 different areas of information, each one essential for a meaningful assessment of radiological impacts of this phase of the operations, are lacking at the present time:

> B.1.4 Development Needs
>
> A number of uncertainties remain concerning removal of the wastes from the tanks. Some of these uncertainties can and must be resolved by experimental work conducted before removal operations are undertaken. Others are unlikely to be resolved by any feasible prior experimental work and must, therefore, be taken into account in the planning and design of the equipment and operation. Areas of resolution include:
>
> - Structural analysis of the neutralized-waste tank.
> - Characterization of the physical properties of the sludge.
> - Chemical and radiological analyses of the wastes.
> - Development and testing of methods and equipment to be used in sluicing and in other operatons such as coring of the vault roof and installing new tank openings. A mockup of the neutralized-waste tank will be tested using simulated waste.
> - Safety analysis (of tanks, pipes, pumps, etc.) based on detailed removal-from-tank operations.

How then were the calculations made when the information needed is unavailable. Here is what is said on page B-2:

> "Where information was lacking it was necessary to make assumptions to analyze the environmental impacts. The assumptions were conservative so as to overstate, rather than understate, the impacts."

DOE's notion of a conservative assumption does not correspond with the usual public health evaluation where it is the worst case that is conservative. For example, the proposal in B.1.3.3 for removal of nuclear wastes assumes that all that is necessary for removal of the sludge is to stir it up and pump it out. This scenario is so wildly optimistic as to be both ridiculous and highly dangerous. If there were no more to this project than pumping out a flooded cellar, then of course there is little reason for workers to be exposed to radiation. If everything were to go perfectly, there would be little exposure to the public. The "conservative" DOE estimates are made on these two unlikely assumptions. There is no factual evidence to support either assumption and there is the record of DOE operational experience to support the opposite assumptions. Under ideal and perfect conditions the DOE estimates might be realized, but this is not an appropriate way to analyze radiological risks for an environmental impact statement. The next section details why the actual result of the proposed method of removing the sludge is more likely to be a major environmental disaster.

However, even without a disaster, the exposure estimates would be increased by factors of 100 to 1000 if realistic assumptions were

made. The removal of the sludge is the most difficult part of the WVDP operations. The man-year estimates and exposure estimates used here would not even suffice for the very first step--sampling the tanks to get the information essential to proceed with the development of a removal technology. There is no proven technology for this purpose available and the new technology cannot be developed until the information previously noted as missing is obtained.

One example of a general (non-specific) assumption used in the calculations may suffice to illustrate the way DOE consistently underestimates by factors of 10 or more the actual exposures in these operations. The calculations start out by assuming the most optimistic (not the most conservative) assumptions about worker exposure. For example, it is assumed that NRC/ALARA exposures will be achieved (e.g., about 0.5 rem per worker/year). In actual fact, the direct reprocessing operations carried out by DOE come nowhere close to these figures.

It is true that NRC/ALARA over the entire range of nuclear operations averages one-tenth of the annual permissible 5 rem per year level. However, this 0.5 rem represents an average of a very few "dirty" operations (such as active reprocessing operations) diluted by the
5-7 majority of "clean" operations (such as nuclear power plants). The WVDP reprocessing would be in the class of "dirty" operations (where DOE has consistently failed to meet even the 5 rem per year level). At West Valley and other "dirty" operations, "human sponges" had to be brought in to do the "dirty work" in order for the installation to operate at all. To conceal these excessive doses, installation averages are often

diluted by including large clerical staffs that do not have any nuclear exposures. However, the DOE/EIS estimates are for WVDP personnel who would be the hands-on workers for the extremely "dirty" Tank 8D2 operation.

The net effect is that realistic exposure estimates would be at least ten times higher than the DOE/EIS estimates even if the man-year estimates for the job were accurate. However, these man-year estimates should also be about 10 times greater for this phase of the operations. So even under optimum circumstances, the radiological impacts would be 100 times greater than the DOE/EIS figures. Moreover, as the next section details, the circumstances are very far from optimal.

HOW THE DOE/EIS PLAN WILL PRODUCE A MAJOR DISASTER

A careful reading of section B.1.3.3 together with a little common sense will reveal that the DOE plan for "Removal of Neutralized Wastes from Tank 8D2" is very likely to breach the tank and produce a major loss-of-containment accident. It is unnecessary to go into elaborate engineering details to understand how the proposed method of waste removal will jeopardize the structural integrity of the tank--something that DOE/EIS fails to consider and fails to include in the radiological impacts. All that is necessary is to have some picture of the peculiar structure of Tank 8D2 (Figure B.1), what is in this tank, what happens to metals in this environment, and the violent method proposed for removing the wastes.

The first sentence of B.1.3.3 suggests the incredibly simplistic approach that is proposed:

> "The first operation would involve turning over the contents of the neutralized-waste tank at a high rate of flow while slucing to mix the sludge with the supernate."

The section goes on to describe the use of submerged, rotatable sludging nozzles and 15000 L/min flow rates inside a structure whose current status is unknown but which is probably in a dangerously weakened condition:

> "It is assumed that the wastes would be mixed to the fullest extent possible in about 10 such tank turnovers, or in about 25 hours."

Now let us consider the state of Tank 8D2 while all of these "tank turnovers" are going on. As DOE acknowledges later no "Structural Analysis of the neutralized-waste tank" has been made but this agitation will certainly subject the structure to severe and turbulent forces. It is useful to know (though no one in DOE seems to know it) that <u>the strength of materials is greatly affected by the very hot radiological environment of Tank 8D2</u>. In much milder environments than a 30,000,000 curie inferno, radiation affects the structure of steels and other metals. Everyone has read in the newspaper about the troubles with warping and fracture of reactor rods and other nuclear hardware. In Tank 8D2 there are almost certain to be structural weak spots that could give way under stress. If this were to happen, there could be a loss-of-containment accident.

It is also important to note the engineering history of Tank 8D2. First, the tank was never designed for this kind of operation. Second, the whole point of its design was to save money. This meant cutting corners. For instance, it was a bad mistake in retrospect to use carbon steel, but this saved a few dollars. Third, there was no intention to store the hot materials in this tank for longer periods—certainly not for the years that have now elapsed. It was only for temporary storage of liquids—not for the intractable sludge that has resulted from the excessively long storage. This plan to use high-pressure nozzles to violently agitate the sludge which is probably now in a semi-solid or even partially in a solid state suggests that DOE is looking for an easy way to do the EIS calculations rather than a realistic way to deal with the extremely difficult engineering problems that would be involved in the waste removal. Merely to do a structural analysis for 8D2 would be a very demanding task. To propose a plan involving violent agitation of the contents of 8D2 without any analysis which proved that the structure could withstand this agitation is irresponsible. It clearly shows that DOE does not give a damn about the public health and safety.

For a reader who would like a simplified picture of what would be likely to happen to Tank 8D2 if the DOE plan were implemented, the following image might help. Suppose that an ordinary kitchen blender were filled with a mix of soda water, ice cream, and some nuts and

bolts. Suppose that there is a fragile glass holder and that the agitation is at top speed. With a little imagination it is clear that the kitchen would be a mess from the shattered blender. When the analogous "waste removal" from Tank 8D2 caused structural collapse of supporting members or rupture of the weakened steel containment, the result would not be a messy kitchen, but an environmental disaster that would plague Western New York and Canada for centuries to come.

The 6,700,000 curies of Strontium-90, one of the deadliest fission products, is enough to poison the entire Northeast corner of North America. Sooner or later much of this Strontium-90 would get into Lake Erie (there has already been detectable radioactivity in Lake Erie from low-level leaks at West Valley). The half-lives of radioactive isotopes here is so long that we are talking about a <u>geological</u> time scale. On this time scale (as Argonne admitted) the local spill will eventually get into the drinking water of the entire region.

It would be difficult to contain the wastes after the fact since a large area around the spill would be extremely dangerous. If a secondary containment system were in place this would minimize the risks. However, DOE has no plans for such a protective system and the EIS doesn't even mention the possibility.

It goes without saying that a loss-of-containment accident would multiply by a millionfold the total population risk of 46 person-rem in Table B.6. Even taking probabilities into account, the radiological impact would be enormously increased. The failure of DOE to even consider the possibility of such an accident is one reason why the probability of such an accident would be substantial.

DOE RESPONSE TO THIS CRITIQUE

From experience over the years with the DOE hearings on West Valley it is possible to anticipate the DOE response to this critique. Basically it will be a non-response. Unless there are typos or other non-essential errors in the critique, there will be no scientific response to any of the substantive points that have been made. There will be no remedy (other than cover-up) for the deficiencies that have been pointed out in the DOE/EIS. Instead, DOE will rely, as it always has, on the reluctance of the public to try to understand or deal with technical issues. It will simply reiterate its usual bland reassurances that there will be no danger to the workers and to the public. For more than 20 years the Atomic Energy Commission and successor agencies such as DOE have been making these reassuring noises.

The difference in 1981 (as compared to 1971 or earlier) is that there are biostatistical-epidemiological studies of what happened to workers and the public who were exposed to these supposedly "safe" levels of ionizing radiation (according to the bland assurances of the federal agencies). We have now counted and verified the excess cancer and other diseases in the populations exposed to these "harmless" doses. We now have solid factual evidence (more than 20 years after the fact because of the long latent periods involved) that the DOE and predecessor agencies have consistently and as a matter of policy misrepresented and grossly understated the actual radiological health hazards of nuclear programs. The radiological impacts in the DOE/EIS are derived with the same Mickey Mouse arithmetic that has consistently failed to protect the public health and safety in the past.

DOE is becoming aware that it no longer has much public credibility so it will embark on an all-out campaign to stroke the local citizens. It will, for instance, use that overused gimmick, the "health study", to provide false assurances that the public health will be protected. However, past experience with the "health studies" has been that all they can do is provide (after a 20-year latent period) evidence that humans were harmed or killed by low-level radiation—which doesn't prevent the adverse health effects. As the Portsmouth Naval Shipyard and other studies have shown, the scientific findings of serious health hazards does not even facilitate the claims for compensation or widows benefits for the workers. So "health studies" do not protect the public health and safety for the West Valley Demonstration Project, they can at best confirm that there has been no protection.

There is internal evidence that DOE does not really believe that the simplistic plan in section B.1.3.3 would work. If it were this easy to pump out Tank 8D2, there would be an alternative to the options listed on page 2-1 which would be quicker, easier, and cheaper than any of the positive actions listed. All that would be necessary would be to pump the contents of the tank into casks, transport the casks to an airstrip, have a military airlift to Idaho, and be rid of the deadly high-level wastes within a year or two. There would be no point in processing the wastes at West Valley and the airlift of the nerve gas cannisters shows the feasibility of the alternative transport route. This alternative would cost less than one-tenth the cost of the processing alternatives.

Why wasn't this alternative considered? Because DOE knows it would not work. The reason it is not feasible is that the simplistic plan in B.1.3.3 would not work. But while the scheme for waste removal from Tank 8D2 is too silly to be the basis for an airlift alternative, it is being used in the calculation of radiological impacts in the DOE/EIS. This shows that the DOE Environmental Impact Statement is a fraudulent document and that the DOE knows it.

THE NEED FOR JUDICIAL HEARINGS

The legal requirement of an environmental impact statement is intended to protect the public health and safety. For the West Valley Demonstration Project, potentially the most dangerous nuclear program ever attempted, the determination of the radiological impacts on human health and safety should not be a perfunctory or meaningless exercise. As has been repeatedly shown here, the DOE/EIS-0081D does not make a competent assessment of the actual risks of the project. Instead, DOE proposes operations which would recklessly endanger the health and safety of most of the citizens of Western New York.

To protect the public there should be a judicial or evidentiary hearing on the issues raised in this Critique. DOE should be required to produce testimony to support its estimates in DOE/EIS-0081D. If it fails to show that it had produced a meaningful EIS, then there should be no work on the WVDP until there is a realistic assessment of the radiological hazards of this project. In particular, there should be a specific contingency plan in place which would provide protection to

Western New Yorkers in the event of a loss-of-containment accident during operations—an obvious contingency completely ignored in the DOE/EIS.

Even without a hearing, this Critique will serve to establish the liability of DOE and its contractor, Westinghouse, for any and all risks which DOE/EIS-0081D failed to anticipate. In the event of a loss-of-containment accident, all preparers, reviewers, and administrators for DOE/EIS-0081D could be brought to book for criminally negligent homicide.

LIST OF SCHEDULES

HOW TO LIE WITH MATHEMATICS

Well over a year ago, the Department of Energy (DOE) was given one year, a million dollars, and a Congressional mandate to produce a feasible plan for cleaning up the nuclear wastes stored at West Valley, New York, not far from Buffalo. The end-result is a DOE Final Report which, like most such reports, contains many numbers. Some of these numbers are the estimates of radiation dosage that will be considered here. These numbers were obtained by methods known in the trade as "Mickey Mouse arithmetic". These numbers are windowdressing. They have almost no value for making the decisions on the clean-up of the West Valley wastes--particularly the 600,000 gallons of high-level liquid wastes which constitute a major potential public health problem.

How can the public tell that the numbers in this Final Report are meaningless and useless? Surprisingly enough, the public has only to read (and understand) the Companion Report put out by DOE. To anyone who can read the technical languages, the latter report plainly says that the numbers in the Final Report are worthless. Is such candor in a report from a federal agency incredible? Not really. This is a way that the technologists who do the Mickey Mouse arithmetic can cover themselves against criticism by their peers. At the same time, the public will go on believing that it has received something of value for its million dollars when in fact it has not.

This fool-proof method of having your cake and eating it too is based on a simple fact: The mathematical and technical jargons used in these federal reports are incomprehensible to the public and its representatives. No one who can read these jargons is likely to embarrass his colleagues by translating this jargon into plain English. However, that is precisely what I am going to do here: First of all, I will give a paragraph of the jargon in Section 4.2.2 on Estimation of Radiological Dosages. Then I will explain what it means.

> "The dose estimates presented in this report are for the implementation of the various options. The future population doses which could occur after the various options have been implemented were not addressed. The possibility of exposures from accidents was not considered, nor were risks for the various decommissioning options assessed. An option with a low dose estimate may have a higher potential for accidents, and consequently additional exposure, than one with a higher dose estimate. The doses were calculated simply to scope the choices in a gross way. In order to assess the radiological hazards of the various decommissioning options, a detailed pathway analysis based on a detailed work plan would have to be performed. This type of an analysis was beyond the scope of this report."

Now what is all this about? From a public health standpoint, there are certain concerns about low-dose radiation that are especially important. The whole point of any disposal plan is to prevent future radiation exposures to the general population and to minimize the exposure of workers in the clean-up operations. The future exposures are "not addressed". In general, as long as standard operations are going routinely (as in a smoothly functioning power plant) the radiation exposures to workers or the public are quite low. The risks occur when everything doesn't go smoothly and there are "accidents". However, "exposures from accidents...(were)...not considered".

High risks also come into the picture when, as here, the clean-up requires development of new operations for which there is little or no previous operating experience. There is obviously no scientific way to get accurate estimates of radiological risks when the clean-up methods ("decommissioning options") have not yet been developed or tested. The authors of the cited paragraph complain that they could not do what they consider an appropriate risk analyses ("pathway analyses") because the options lack any "detailed work plan". In order to draw up such a plan (which is what should have been done in a competent Final Report) it is necessary to have operating experience with the processes used. But none of the proposal options have ever been used for anything like the clean-up operations needed at West Valley. No one really knows how they work or even if they would work.

In other words, the report concedes that it did not do the job of assessing radiological hazards that was required by the Congressional mandate. Only the hazards for routine operations have been considered and this omits the more serious hazards. The authors do warn that the numbers are not a reliable guide for decision-making. They point out that if the estimated risk for one option is lower than for another option, this doesn't mean that the actual risks are lower (because "a higher potential for accidents" has been left out of the calculations). What, then, are the numbers good for?

The answer is: "These doses were calculated simply to scope the choices in a gross way". What does this mean? To "scope the choices" means to consider the options only in a vague general way (such as might be called in plain English "talking around the point instead of to the point"). The appearance of words such as "simply" or "gross" in technical jargons is rare. They make this a strong statement which might be freely translated as: "You can talk about these numbers but for heavens sake don't try to use them to make serious decisions". Some of the DOE staffers do realize that the health and safety of most Western New Yorkers would be jeopardized by a bad decision on the clean-up of the high-level wastes.

When Congress gave DOE a mandate to come up with a plan to clean up the nuclear wastes at West Valley, DOE had two choices. It could have tackled the difficult job of producing the "detailed work plans" which are lacking here. Or it could take the easy way out, so often used before, of lying to the public in a mathematical language. DOE chose to produce a Final Report consisting of a set of unevaluated and unevaluatable options. DOE chose to fake it. While technical readers get a warning of this in the Companion Report, the Final Report for public consumption gives these dangerously misleading numbers without any warning.

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December 22, 1978

SCHEDULE B

Letters

Radiation Dosimetry

Eliot Marshall's articles on the dosimetry of radiation from the atomic bombs dropped on Hiroshima and Nagasaki (News and Comment, 22 May, p. 900; 19 June, p. 1364) are, in general, accurate in their appraisal of the present situation; but there are a few sources of confusion in them. On a personal note, contrary to Marshall's statement, I have long been a member of the Radiation Research Society; I did not "skip" the 31 May meeting of the society at which the dosimetry was discussed but was returning from Iceland, where I was U.S. representative at a World Health Organization meeting on health surveillance related to environmental pollution.

Also, it was not clear from Marshall's presentation why the new data support the view that estimates of cancer risk from low LET (linear energy transfer) radiation should be raised. It is not simply because the new evidence changes the total cancer risk per rad according to the linear hypothesis, although this effect would be expected for the new Nagasaki data. Jablon and Loewe and Mendelsohn (Letters, 3 July, p. 6) correctly point out that for the Hiroshima results the total dose changes little with the new evaluation, and Jablon takes me to task for suggesting in testimony presented before an Environmental Protection Agency hearing in March that the gamma-ray doses in both cities might have been overestimated. At the time I prepared that testimony I had only recently received copies of the original data and tables presented by Loewe and Mendelsohn in August 1980; subsequently they revised Hiroshima gamma-ray exposures upward (1). In telephone conversations I had with Loewe at that time, he pointed out the possibility that gamma-ray shielding factors for Japanese buildings might have been underestimated, and if Marcum's new evaluation of these factors proves to be correct, I believe my original statement may still be generally valid, although significant for the higher dose categories in Hiroshima only.

The new dosimetry suggests greater cancer risk for low LET radiation not only because the data for Nagasaki cancer incidence may show about twice the risk found previously, but more important because the linear hypothesis was not the basis for computing risk by the current version of the report of the Committee on the Biological Effects of Ionizing Radiations (BEIR III) (2). The discrepancy in results for cancer mortality between the two cities (not observed for total cancer incidence data) was one of the principal justifications of use in the BEIR III report of the linear-quadratic model for calculation of low-dose risks for low LET radiation from the Nagasaki results. Now, however, there is no reason not to combine the results for the two cities, and on that basis use of the linear extrapolation is strongly supported, especially by the cancer incidence data. As I have pointed out elsewhere (3), this leads to an increase of the BEIR III coefficients for total cancer mortality by a factor of about 2 for males and about 4 for females; use of cancer incidence for risk evaluation changes these factors to 4 and 7, respectively. Thus it is in correcting a *misinterpretation* of the Japanese results by the BEIR III report that the new dose information has the greatest significance.

Dobson and Straume (Letters, 3 July, p. 8) still are explaining the apparent difference in results for cancer mortality between the two cities as due to the almost negligible contribution of neutrons at Hiroshima; in fact with the new dosimetric data the cancer *incidence* results in the two cities give remarkably similar slopes relating cancer excess to gamma-ray dose, when the old T65 dose categories are roughly corrected. I believe, however, that everyone involved in this controversy agrees that any conclusions about the Japanese results are premature until the individual doses are recalculated for each survivor in the light of the new findings and applied to results from more complete follow-ups of the study population.

Finally, I strongly support Jablon's comments that "this controversy is a compelling argument for bringing the data into the public arena. . . ." It is unfortunate that computational details concerning the T65 doses determined by the Oak Ridge group were not adequately published in the open literature; had they been, some of the errors in the T65 estimates might have come to light sooner. It is, to say the least, regrettable to learn now, 36 years after the events and after more than $100 million has already been spent by U.S. taxpayers for follow-up study of the A-bomb survivors, that the dosimetry related to this study population will now have to be completely redone. Because of potential biases alluded to by Jablon associated with publicly stated positions on radiation risks being taken by many concerned with these dosimetric determinations, it would appear that an independent scientific panel should be appointed, possibly by the AAAS, to review the new dosimetric data as they are developed.

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SCHEDULE C

A 1981 REASSESSMENT OF THE HEALTH HAZARDS OF LOW-LEVEL IONIZING RADIATION

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Abstract

A decade ago the risks of leukemia from exposures to low levels of ionizing radiation were estimated by linear extrapolation from data on persons exposed to much higher levels. In recent years, however, a number of scientific studies have reported excess risks where the data was on persons actually exposed to low-level radiation. The new findings are incompatible with the estimates based on the linear hypothesis although these estimates continue to be used in public health. Fifteen studies involving low-level nuclear radiation and ten studies involving diagnostic radiation are listed and briefly described. Most of these studies have positive qualitative findings but a few also have quantitative estimates of risk such as doubling doses. The qualitative findings would be extremely unlikely at the estimated exposure levels (which represent average exposures well under 5 rads or rems) if the extrapolative estimate of over 100 rads of the Federal Interagency Task Force Report were correct. The quantitative estimates from the data on persons exposed to low-level radiation give doubling doses in the vicinity of 5 rads and are also incompatible with the extrapolative estimates. The failure of the linear hypothesis to fit the new facts seems to reflect a greater efficiency-per-rad in producing genetic damage for the low-dose range than for the high-dose range.

1. Introduction: The Reassessment of Risks in 1981

In the past, the assessment of the hazards of low-level ionizing radiation has been carried out by large, federally-sponsored committees or task forces. Hence, this might appear to be too formidable a task for one person without federal funding to carry through. However, in 1981 there are several reasons why such a reassessment is both feasible and desirable. It is desirable because official panels funded by the government are in a conflict of interest situation since findings on radiation hazards would have immediate impact on federal agencies. Some agencies have actively promoted radiation technologies and others are involved in legal claims such as those of servicemen at the Big Smoky nuclear weapons tests. Under these circumstances, some recent official reports lack credibility.

While the reassessment is not an easy task for one person, there are several factors that make such a review feasible in 1981 when it might not have been feasible earlier. The main reason why the task has become feasible is that there are now a series of scientific studies which are directly relevant to the crucial public health issue, the health effects of exposures in the vicinity of 5 rems or less. For the first time there are facts on the occurrence of leukemia and other diseases in populations actually exposed to these low levels of ionizing radiation. The new facts complicate the assessment since they contradict the earlier findings but they greatly simplify the task in other ways.

When there are reliable facts that can give direct answers to questions about low-level radiation hazards without guesswork, there can

be no scientifically valid reason for bringing in obsolete, less relevant data and for using extrapolations that are mostly guesswork. Most of the evidence that was the basis for the earlier assessments, the animal data or the high-dose human data, can be omitted from a 1981 assessment without any serious loss. While this facilitates the assessment here, it creates difficulties for the official panels by creating another kind of conflict of interest. No panel scientist can easily acknowledge that his area of expertise or his lifework has become irrelevant to a 1981 reassessment of radiation hazards.

Finally, a consensus of opinion of a large panel may be one way of striving for objectivity when the facts are lacking, but when there are directly relevant facts at hand objectivity is achieved by looking at these facts and by disregarding subjective opinions or interpretations. This is what will be done with more than a score of new biostatistical-epidemiological reports of health effects in populations exposed to low doses of nuclear radiation or medical x-rays.

Yet another reason why assessment is easier today is that there have been major scientific advances in our understanding of the causes of human cancer, in the area of carcinogenesis, in the past 20 years. Despite the impression created by the traditional mystique of cancer research, we almost certainly now know the immediate cause of radiation-induced cancers and probably all human cancers. The first event in the long evolutionary biological process that ends with death from leukemia or other cancer is the occurrence of a biochemical lesion or a break-point in the complex chemical structure of the DNA in the genetic material of a human cell. This break-point may be inherited from a parent as genetic damage, or it may be produced by radiation, chemicals, or biological materials in the environment. We now know that this genetic degradation is the cause of cancer and some other chronic diseases. Hence, although the type and circumstances of the radiation exposures are different in the score of positive reports, the underlying process of radiogenesis is the same in all of them.

Finally, in 1981 it is possible to narrow the question to a specific quantitative evaluation of the health hazards. The issue today is not whether there is a hazard but how much of a hazard there is. While various measures have been used, the technical concept that is probably most easily grasped is the doubling dose. The health effect that shows up most clearly is the occurrence of leukemia. Hence, the reassessment can focus on very specific questions such as: What is the doubling dose for leukemia in man?

While this focus may seem overly narrow, the official position of the federal agencies stands or falls on the answer to such questions. The doubling dose estimate is directly related to official standards such as the 5 rems per year permissible exposure to nuclear workers set by the Nuclear Regulatory Commission. Thus if, as was claimed in recent federal reports, the doubling dose were over 100 rems, this standard is defensible. On the other hand, if the doubling dose is around 5 rems then NRC is permitting a dangerous exposure. No other carcinogen is permitted at levels close to a doubling dose for cancer in humans.

2. The Rival Risk Hypotheses: Three Theories of Low-Level Risks

Putting the question in the form "What is the doubling dose for leukemia?" allows a relatively clear and simple statement of the three hypotheses that are involved in the current controversy. The doubling dose can be calculated from the relationship between, say, dose in rems and relative risk of leukemia for a given dose, from what is generally called a dosage response curve. The rival hypotheses can be represented as three curves on the graph for the dosage response curve. The three theoretical curves are shown in Figure 1.

INSERT FIGURE 1

The three rival theories are shown as curves A, B, and C in Figure 1. They are:

(A) The original threshold hypothesis which was probably the most popular view in 1960 and which supported the official doctrine that "Low-level radiation is harmless". This curve is shown as a heavy dotted line that goes down to the x-axis at some point, say above 5 rems. According to this theory there would be no risk at dosages below the point where the curve intercepts the horizontal axis.

(B) The linear hypothesis which was probably the most popular view in 1970. It is the theory adopted in the 1972 BEIR report (1) and this curve is a solid straight line in Figure 1. When the dosage response curve plots excess radiation (in addition to background) versus excess risk of leukemia, the straight line should go through the point where the x-axis and y-axis intercept. The linear hypothesis (or some variant) is an irreplaceable assumption for all of the estimates in the BEIR report since the actual data used is on persons exposed to higher dosages of radiation, generally over 100 rads. Extrapolation over log orders of magnitude must be used to estimate the risks at the low levels, generally under 5 rads, which are the critical levels for the public health problems from both nuclear and medical radiation.

(C) From a public health standpoint the worst possible curve is the one which arises with what might be called a genetic degradation hypothesis. This curve is the light dotted line that bends off above the straight line at the lower doses. It will be argued that this is the hypothesis that fits the facts that are available in 1981. We now have information on leukemia risks in groups which were actually exposed to low-level radiation. Hence, estimates of risk can now be made directly from the data without the strong assumption of the linear hypothesis.

The difference between the three rival hypotheses can be expressed very simply in terms of the notion of excess risk-per-rad. The linear hypothesis assumes that there is a constant risk-per-rad--the risk being the same at high doses as at low doses. The threshold hypothesis assumes that the risk per rad is less (or vanishes entirely) at low doses. The genetic degradation hypothesis assumes that the risk per rad is greater at low doses than at high doses. One rationale for this hypothesis is that, at low doses, chances are that there will be one break-point produced or none at all. At high doses, however, multiple

break-points are produced. This heavy damage blocks the cellular reproduction needed to produce the cancer. It therefore "wastes" the break-points and results in a lower risk-per-rad at higher doses. Another factor is "repair" at low doses (now known to often be misrepair).

3. Testing the Hypotheses: Qualitative Tests

Modern science began with the Galilean Rule: A theory must fit the facts. So the first step in the 1981 reassessment of radiation risks is to determine how well each of the three rival theories fits the epidemiological facts that are now available. In principle, the best test would be a quantitative one: A dosage response curve for the range around 5 rads would be constructed from actual data on persons exposed to radiation in this range, and this actual curve compared directly with the theoretical curve. This will be done in a later section. However, the quantitative tests are more complicated, and we may start with the simpler qualitative tests of the three hypotheses.

The reason that qualitative tests are feasible here is that there is an enormous difference between the estimates from the linear hypothesis and the estimates from the genetic degradation hypothesis. The latter, as will be seen later, gives an estimate of the doubling dose that is probably less than five rads. The official estimates, such as those in the latest Federal Interagency Task Force Report (2), put the doubling dose at over 100 rads. With one estimate more than 20 times another, even a qualitative approach can indicate which estimate

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fits the facts and which does not. The threshold hypothesis is easily distinguished from both other hypotheses since it implies an infinite doubling dose at low doses.

If the doubling dose were over 100 rads or if it were infinite, then the effects of doses between 100 millirads and 10 rads, in what will be called the 1-rad range, would be negligible. My testimony of March 6, 1979, to the Senate Government Affairs Subcommittee on Energy, Nuclear Proliferation, and Federal Services in Washington, D.C. (3), began by noting this point:

> "Three years ago it was widely believed by the self-styled radiation protection community that it would be impossible to detect any health effects in studies of people exposed to dosages in the 1-rad range. At that time, Tom Mancuso and I were the only ones doing large-scale epidemiological studies to look at these hazards. Two years ago I predicted that if scientists would only try to look at populations with exposures in the 1-rad range they would find, as we did, that there are serious health hazards. Since that time more than half a dozen new studies have looked at what happened to persons exposed to nuclear radiation in the 1-rad range and have reported positive results. These are the studies that I want to try to put together.
>
> In ten minutes I cannot hope to go into details on all the studies, the criticisms of these studies that have been made by the members of the radiation protection community who wrote the interagency report, or the answers to these criticisms. Very

> briefly, there are three kinds of studies of nuclear radiation hazards at the 1-rad level. The first kind deals with persons who were exposed to fallout from the nuclear weapons testing of the cold war era. This includes studies of the servicemen at Big Smoky and other tests. There are also the after-effects on adults and children in the areas of Utah downwind from the tests. The second kind of study involves occupational exposures. This includes studies of the workers at the Hanford reprocessing plant and at the Portsmouth Naval Shipyard. The third class of study involves exposures to nuclear wastes such as the uranium tailings or releases from power plants. Depending on what is counted, there are now between half a dozen and a dozen positive reports of hazards to persons exposed to nuclear radiation in the 1-rad range. It is virtually impossible that they are all false alarms."

This testimony involved an early draft of the Interagency Report, commonly called the Libassi Report, but the bibliography of the final version (2) will be used here.

In the final version of the Libassi Report, there are five references for the hazards of nuclear radiation from fallout when thyroid cancer is also considered (4-8). However, this list is largely limited to publications in the technical literature. It omits all reports on fallout from Dr. Ernest Sternglass and others even when they appear in Congressional publications (9). It omits media reports entirely, for instance the reports on the marines at Nagasaki (10). The coverage of hazards to workers at nuclear installations is somewhat better. Seven references with positive results are cited (11-16). There are three positive reports on hazards of nuclear wastes or emissions or areas of high natural radiation (17-19), but none of the studies of populations in the vicinity of nuclear power plants (20) is cited. The Rocky Flats and uranium tailings hazards are mentioned without citation. Despite these omissions, it can be seen that well over a dozen positive studies were cited in the Libassi Report, disparaged, and then disregarded.

There are eleven reports of positive findings for diagnostic x-rays cited (21-31), all of which find excess leukemia among patients exposed to this low-level radiation. A negative study of occupational hazards of radiologists is cited (32) but not the positive studies on radiologists. An important study of the children of radiologists (33) is omitted as are some of the important diagnostic x-ray studies (34).

One might wonder why in 1981 there are so many positive studies on groups exposed to low-level radiation when in 1960 or 1972 there were so few. Basically what has happened is this: Time is running out on both the threshold hypothesis and the linear hypothesis. The nuclear exposures started in the 1950's and 1960's, but because of the long latent period for the malignant diseases the health effects are only now coming to light (35).

These are the qualitative facts. How well do the three rival theories fit the facts? The long list of positive reports cited above is about what would be expected if the genetic degradation hypothesis were correct and if the doubling dose for leukemia were less than 5 rads. They would be extremely unlikely if the linear hypothesis were

correct. They would be impossible if the threshold hypothesis were. correct. Or putting it another way: In accordance with the Galilean Rule that a theory must fit the facts, the threshold hypothesis would have to be rejected completely and the linear hypothesis almost as strongly rejected on the basis of these facts. This does not absolutely prove the genetic degradation hypothesis but it makes it the only tenable hypothesis of the three.

4. Combined Weight of Scientific Evidence From Fragile Studies

Because the studies of nuclear radiation hazards are likely to involve relatively few cases of leukemia or myeloma or other radiogenic diseases under study, they are not "robust" (in the technical statistical sense). Therefore, it may not take much to change a study which is "positive" (i.e., achieves the traditional 5% probability level) into one which is "negative" (i.e., fails to achieve this level). Critics have only to change an underlying assumption, exclude a few cases directly or indirectly (by analytical decision), or simply use a less powerful statistical method in the analysis. Hence, in a technical sense, the studies tend to be "fragile" and individually they are vulnerable to critical attacks such as those in the official reports. As I noted in my 1979 Senate testimony (3):

> "The radiation protection community has used a divide and conquer strategy to deny or discredit these reports, treating each as if it is separate and unrelated and attacking each in turn. The

main thrust of the criticisms is that the numbers of leukemias or cancers in the critical series that give positive findings is generally small. The numbers range from 6 in the Portsmouth Shipyard study (with one expected) to 32 in the Utah children (with 13 expected). It is argued that this is too few to be sure of the hazard. It is also claimed that even if there was a hazard, the casualties would be unimportant and not worth worrying about. The attitude of the radiation protection community has been that we should take a few civilian casualties for the sake of nuclear power or nuclear deterrents."

Although it is relatively easy to fault the positive findings of each study separately and difficult to argue that any one study is conclusive, with so many positive studies it is now necessary for critics to deal with the <u>cumulative</u> evidence of excess risks of leukemia and other diseases in persons exposed to low-level radiation. This they have not done. Indeed, there are difficult technical questions involved in assessing the combined weight of evidence for any series of fragile studies. Although more than 20 studies have been cited here, no 2 of them are similar enough in all respects to simply pool the data.

Scientific guidelines for assessing the combined weight of evidence are needed here. The casual and subjective "expert opinions" that have been offered so far are no substitutes for such guidelines. As might be expected, such opinions depend on preconceived opinions on the hazard issue. Those who wish to discredit the low-level data argue that any number of "iffy" studies add up to an "iffy" conclusion. Their

opponents argue that while an individual study might be called a "frail reed", the analogy to a bundle of frail reeds suggests the combined evidence is strong.

More adequate guidelines can be obtained by applying well-known general statistical principles and procedures to the specialized problem of combining the information in a set of fragile studies. A mathematical derivation using what is called the "likelihood ratio" approach is too lengthy to present here. However, a brief outline can be given. Starting with a minimal mathematical model for an individual case history in a study of low-level radiation hazards, the scientific structure can be characterized in terms of observed quantities and parameters. The radiation exposure, z, and the health effects, x (e.g., leukemia, no leukemia), are observed. The age-sex-disease specific risk, π, and the inverse of the doubling dose, θ, are parameters. The probability of a leukemia death, $P(x|\theta,\pi, z)$, can then be written as:

$$P(x|\theta,\pi, z) = (1 + \theta z)\pi \qquad (4.01)$$

from the definition of a doubling dose and a linear interpolative assumption for the low-dose range. Note if the exposure z equals the doubling dose the risk is doubled ($\theta z = 1$).

All of the hypothesis tests commonly used are related to the likelihood ratio of a series of case history reports in a given study. Full details on likelihood ratio methods can be found in Chapter 24 of Kendall and Stuart's, <u>The Advanced Theory of Statistics</u>. Here, the purpose is to test the null hypothesis that low-level radiation is harmless (or nearly so), $\theta = 0$, against the counterhypothesis that it is a serious hazard (i.e., the doubling dose is in the vicinity of 5 rems or $\theta = 0.20$). The likelihood ratio, l_i, for a given fragile study contains all or almost all of the information relevant to the hypothesis under test and can be used directly or indirectly for a standard significance test. The strength of an individual study is usually measured by what statisticians call its "power", (i.e., the probability of detecting a radiation effect when the counterhypothesis is true). This power is a function of a ratio (i.e., the ratio of the estimate θ to its standard error). For a fragile study, the power would be somewhere in the vicinity of 0.50 and detection of a real radiation effect if it exists would be "iffy."

To assess the strength of the combined information in a set of fragile studies, we can apply the concept of "power" to the set of studies rather than to the individual studies. To make the results more conclusive, the more stringent 1% (or 99%) probability level will be used here instead of the usual 5% level. At this more stringent level, the odds would be heavily against any one fragile study being statistically significant. By a straightforward use of the likelihood ratio approach, it is possible to combine the information by using the product, l, of the individual likelihoods ($l = \Pi_i l_i$). An asymptotic significance and the power of this test comes directly from likelihood ratio theory (40). The results are shown graphically in Figure 2 and they provide the desired guidelines for assessing the combined weight of evidence in a set of fragile studies.

As would be expected from common sense, the power increases as the number of studies, m, increases and as the average strength of an individual study in the set, A, increases. What common sense alone does not provide is the quantitative relationship between factors m and A and the power of the combined test. However, this is shown in Figure 2. As might be expected, when an estimate is no larger than its standard error (A = 1), the cumulative evidence is relatively weak and the power increases very gradually. In this situation one would expect most of the fragile studies would turn out negative (e.g., at least 5 out of 6). However, when the studies are strong enough to have a 50-50 chance of a positive result (e.g., A = 2.7), the strength of the combined evidence rises rapidly as the number of studies increases. When (as for the cited studies of low-level radiation) the studies are predominantly positive, this corresponds to the region of Figure 2 where A is greater than 4. Here the power of the combined evidence is high even for as few as half a dozen fragile studies.

INSERT FIGURE 2

What Figure 2 suggests is that the evidence from the more than 20 studies cited is conclusive. The null hypothesis that low-level radiation is harmless ($\theta = 0$) must be rejected. The official estimates of doubling doses over 100 rems (where $\theta \leq 0.01$) must likewise be rejected. Indeed, the evidence is probably decisive for three separate subseries of studies. These are the series of studies on (1) nuclear workers, (2) fallout from nuclear weapons tests, and (3) diagnostic medical x-rays.

The analogy with the strength of a bundle of "frail reeds" seems to hold.

5. Testing the Theories: Quantitative Analysis

While there are numerous epidemiological studies which provide qualitative evidence of serious hazards at low levels of ionizing radiation, there are fewer that provide quantitative results. The main reason for this is the relatively large number of cases of leukemia or other radiogenic diseases needed for a quantitative analysis. Leukemia is such a rare disease that even if risks are doubled or tripled there will only be a handful of cases in most studies. Quantitative studies are also much more demanding with respect to the design of the study, the methodologies used in collecting the data, and the amount of detailed and verified information on each person. The two main quantitative studies are those of Mancuso, Stewart, and Kneale on the Hanford workers (11-13), and those of Bross, Ball, Natarajan, Falen, et al on the Tri-State Survey (21-25).

The kind of extensive and detailed data that is needed for quantitative studies is illustrated by Table 1. Table 1 shows the observed numbers of men in the Tri-State Survey who were 65 years or older tabulated by three factors. One factor was a report of non-lymphatic leukemia or no leukemia. The second factor was a report of heart disease or no heart disease. The third factor was the dosage of medical x-rays estimated in rads from verified reports of exposures. The table also shows expected numbers which are numbers predicted under

a genetic degradation hypothesis. Similar tables can be constructed for men 15-44 and 45-64 years of age (25).

INSERT TABLE 1

An inspection of Table 1 indicates some of the strengths of the Tri-State Survey data for quantitative analysis. There are more than 100 leukemia cases in this one table. For purposes of comparison, there are also 68 "controls" without leukemia. These are not the "pick-up" controls that are so often used in epidemiological studies. The controls are persons in a stratified random sample of households in the general population that was carried out concurrently with the leukemia survey. Random samples are ideal (but too expensive for most epidemiological studies) and they allow further methodological refinements such as "double-blind" interviewing. In other words, the person interviewed in the household was told only that this was a health survey while the interviewer was given an address and not told whether it was a leukemic or a random sample household. Other precautions were taken to avoid interviewer biases such as validation of all reports of x-rays against hospital or other records.

Speaking informally, the basic idea of the mathematical model for the genetic degradation hypothesis that was used here to calculate the expectations is this: The x-ray produces genetic degradation, break-points in the DNA of genetic material of the human cells. This concept leads, in turn, to what can be called a co-occurrence hypothesis. In other words if a clone of defective cells develops, the breakpoint is likely to have a spectrum of health effects rather than the single effect of producing leukemia. This is because we are dealing with non-specific break-points and the actual biological end result of putting this misinformation into the genetic code is likely to be a loss or reduction of some enzyme. As Dr. B.N. Ames has noted, "Damage to DNA appears to be the major cause of most cancers and genetic birth defects, and it may contribute to aging and heart disease." (36)

Such a deficiency, in turn, affects the operations of the complicated host defense system in a variety of ways. One result may be impairment of the feedback controls for the white cell system and clinical symptoms of leukemia. Another result may be difficulties with the circulatory system and clinical symptoms of heart disease. Thus one cause, a given break-point, can therefore produce more than one effect. In this data, we are looking at co-occurrence of two effects, heart disease and leukemia. Bringing in heart disease may seem odd since it is not generally considered to be radiogenic, but if it were not radiogenic the co-occurrent analysis would fail. Recently, new and independent evidence of the radiogenity of heart disease has been reported in a study of risks of radiologists over seven decades (37).

By using the co-occurrence hypothesis, it is possible to confront the three theories directly with the facts. What does the dosage response curve actually look like in the dosage range of about 5 rems? Figure 3 shows the results from one of our studies of men who received diagnostic x-rays with dosages in this range. The x-axis shows the estimated trunk dosage in rads for the men in the various age and

exposure categories. These are calculated from verified medical x-rays for each individual and then averaged over the category. The y-axis shows the percentage increase in the risk of non-lymphatic leukemia and confidence intervals on the individual estimates. Note that the percentage increase has already adjusted out the background risk of leukemia so that this dosage response curve should go through the origin. The graph shows separately the results for three age groups and this turns out to look like three replications of an experiment.

What does this graph tell us about the health effects of low-level radiation? There are several points that can be seen directly from the data here. First of all, there is clearly a coherent dosage response curve coming out of this analysis. As the dosage increases, the percentage excess risk of leukemia goes up. Not shown on this graph are data on a few persons at dosages averaging over 30 rads, but these show still higher excess risk. The pattern in this data is clear and reasonably consistent and it is evident that the 100% excess risk of leukemia, the doubling dose, is well down in this low-dose range.

What else do these facts tell us? For one thing, they suggest that the worse case from a public health standpoint, the genetic degradation hypothesis, seems to be right. The threshold hypothesis and the linear hypothesis are wrong. The diagonal lines shown on the graph make this point in another way. One of the lines, the steeper one, is the line for a doubling dose of 5 rems while the other pictures a doubling dose of 100 rems. The 5-rem line fits fairly well although it is possible to do a little better. The 100-rem line doesn't fit at all and obviously lies well below the confidence intervals.

INSERT FIGURE 3

6. Quantitative Estimates of Doubling Dose

The mathematical model that successfully predicted the Tri-State Survey data in Table 1 and gave the dosage response curve in Figure 3 can be readily extended to provide a relatively precise estimate of the doubling dose for non-lymphatic leukemia in men. In Figure 3, each estimate of the "percent increase in the risk of leukemia" is separately determined by the data for a given age and dosage category. If an additional parameter is introduced, the doubling dose, then the simple mathematical relationship between this parameter and the original parameters of the model permits the calculation of the expectations for the entire body of data. Providing that there is a coherent dosage-response pattern to the overall data, the numerical value of the doubling dose that minimizes the total Chi-Square will predict (or explain) the whole of the data.

The Minimum Chi-Square procedure that has just been described in words can be reduced to algorithmic form (e.g., to a completely mechanical procedure) that can then be programmed on an electronic computer. Details are given elsewhere (38). When this has been done, the basic data can be typed in at a terminal, a button pushed, and an estimate of the doubling dose will be printed out that is determined solely by the data and is uncontaminated by opinions, expert or otherwise. This has in fact been carried out and the results are shown in Figure 4. On the x-axis of Figure 4 are different values of the doubling

dose parameter and on the y-axis the corresponding values of Chi-Square. The estimate of doubling dose and its confidence interval can be read off directly from Figure 4.

INSERT FIGURE 4

Two curves are shown in Figure 4. The solid curve shows the push-button results for all 13 age-dosage categories. The dotted curve shows the corresponding results obtained by omitting the most divergent category. The horizontal lines indicate the critical level for the confidence intervals (e.g., the minimum Chi-Square plus the 95% tabular value for one degree of freedom). The intersection of the horizontal line with the corresponding curve for Chi-Square is shown by arrows and gives the confidence limits on the estimates. Thus for the full data the minimum occurs for a doubling dose of about 5 rads and the confidence interval is 3.6 to 7.6 rads. For the dotted curve the estimate is 3.3 rads and the interval from 2.2 to 4.4 rads.

There are now other estimates of doubling dose which serve to reinforce the Tri-State Survey results. The Mancuso, Stewart, and Kneale studies of Hanford find excess blood cancers although they do not find excess leukemia, for reasons probably related to the small number of cases. For the blood cancers, the doubling dose reported in Vienna was 3.6 rem (12). The Hanford data also provides estimates of doubling doses for solid tumors such as breast cancer in women and lung cancer in men. These values are higher than for the blood cancer but are generally in the low-dose range.

Dr. Thomas Najarian and Dr. Theodore Colton have redone their original study using the badge doses for the individual workers that were finally released by the Portsmouth Naval Shipyard. As reported in congressional testimony (39), they have largely confirmed their original findings by what amounts to an independent study. The excess risks of blood cancers and of leukemia are double or triple the expected values but the overall cancer risks are about what would be expected. The CDC/NIOSH follow-up of the Portsmouth Naval Shipyard workers inspired by the Najarian-Colton studies has now been completed. It was hoped that this massive study of more than 25,000 PNS workers would settle these questions, but only 6 relevant leukemia cases were found. The estimates of doubling dose are therefore imprecise. On the basis of average dose in the leukemics, an estimate of 9 rems is obtained. A slightly more precise non-parametric procedure gives an estimate of 3 rems. About all that can be said with any assurance is that the doubling dose is somewhere in the vicinity of 5 rems. However, this indicates that the exposures permitted by NRC on an annual basis are hazardous to nuclear workers.

7. Implications for Protecting the Public Health

In the time interval between the first presentation of this report as an invited lecture in Heidelberg in October 1979 and the present, the list of low-level radiation studies was twice updated, but new reports have been appearing in the literature and in the media and quickly make any list out of date. However, a few recent items will be noted here and for balance let's start with two negative studies.

A negative study on diagnostic x-rays from Mayo Clinic has appeared in the New England Journal of Medicine (41) and my critique will appear in the same journal (42). Science has published a negative report on background radiation in China (43), but for reasons noted in a Health Physics letter (44) this class of studies is of doubtful relevance here.

Among the positive reports was a retrospective study of myeloma in the New England Journal of Medicine (45). Media reports indicated 5 proven malignant myelomas in about 1000 servicemen involved in the clean-up operations after the Japanese A-bombs (46). There are also media reports that updated studies of the Big Smoky bomb tests confirming a relative risk of leukemia of about 2.5. Excess melanoma has been reported among workers at the Livermore facility by biostatisticians using the excellent population-based cancer registry that operates in California (47). Many scientists have a misleading impression of the available evidence because of biased reporting in the technical literature (48).

On the basis of present facts, the best 1981 estimate for the doubling dose for leukemia (or for blood cancers) would seem to be about 5 rads or rems. However, in view of the historical trends in the estimates of risks from ionizing radiation, the present estimate should be viewed with some caution. The hazards have consistently been underestimated, and the estimates have been drastically revised every generation. Improvements in the data or the biostatistical techniques for analyzing the data might well result in the lowering of the estimate of the doubling dose to 1.0 rads or less. Hence, in cost-benefit evaluations for the deployment of new radiological technology the 5-rad estimate should be regarded as a minimum cost.

The 1981 scientific evidence on radiation risks indicates that these risks are more than 30 times greater than official estimates made in 1979. This drastic revision in the risk estimates should in theory require major changes in the way in which radiation technology is currently deployed and used. In practice, however, the standards set by the Nuclear Regulatory Commission and other official agencies or by the quasi-official organizations (e.g., ICRP, NCRP) reflect the state of the art in the technologies rather than health statistics. Unfortunately, this situation is not likely to be changed by the current scientific evidence on health hazards.

Perhaps public and judicial awareness that compliance with the present standards does not adequately protect the health and safety of nuclear workers or of the general public may compel changes in the present promiscuous and sometimes dangerous uses of radiation technologies. Litigation involving low-level radiation exposures is rapidly increasing in the United States. Lawsuits involving compensation, malpractice, or environmental protection may eventually make it unprofitable to misuse radiation technologies even if the official standards continue to permit such abuses.

Table 1

Observed and Expected Numbers of Men Over 65 Years (Tri-State Survey) by Disease Status (Non-Lymphatic Leukemia, Heart Disease) and Number of Rads

			Heart Disease	No Heart Disease
Less than 1 rad				
	Leukemia	Observed	9	14
		Expected	8.27	17.43
	No Leukemia	Observed	5	17
		Expected	4.98	17.92
1-5 rads			Heart Disease	No Heart Disease
	Leukemia	Observed	9	19
		Expected	9.35	17.43
	No Leukemia	Observed	4	17
		Expected	4.88	16.98
5-10 rads			Heart Disease	No Heart Disease
	Leukemia	Observed	7	9
		Expected	6.56	12.38
	No Leukemia	Observed	5	10
		Expected	3.47	12.14
10-20 rads			Heart Disease	No Heart Disease
	Leukemia	Observed	10	13
		Expected	11.76	11.68
	No Leukemia	Observed	4	4
		Expected	2.74	6.62
20 rads or more			Heart Disease	No Heart Disease
	Leukemia	Observed	5	6
		Expected	6.40	4.66
	No Leukemia	Observed	1	1
		Expected	0.93	1.15

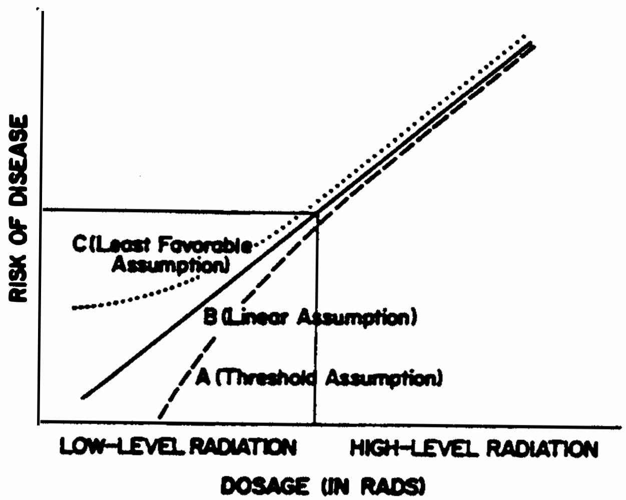

FIGURE 1

THE POWER OF COMBINED STUDIES

Note: The power curves are for the 1% probability level, α = 0.01, according to the number of studies, m, and the average strength, A.

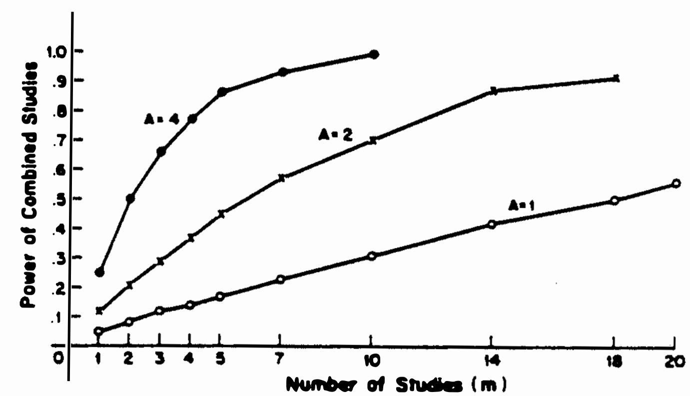

FIGURE 2

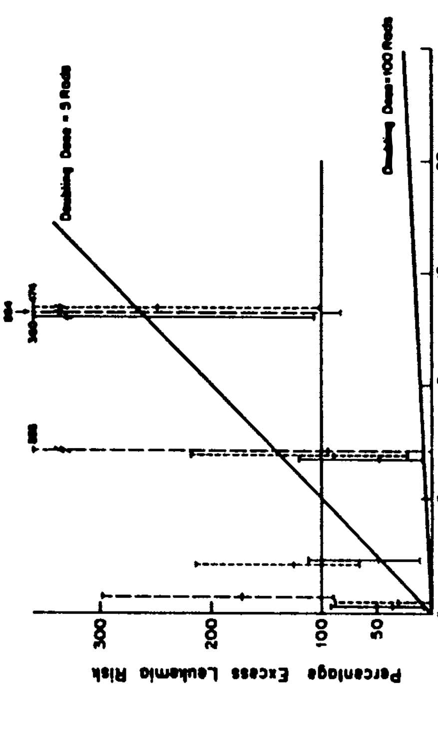

FIGURE 3

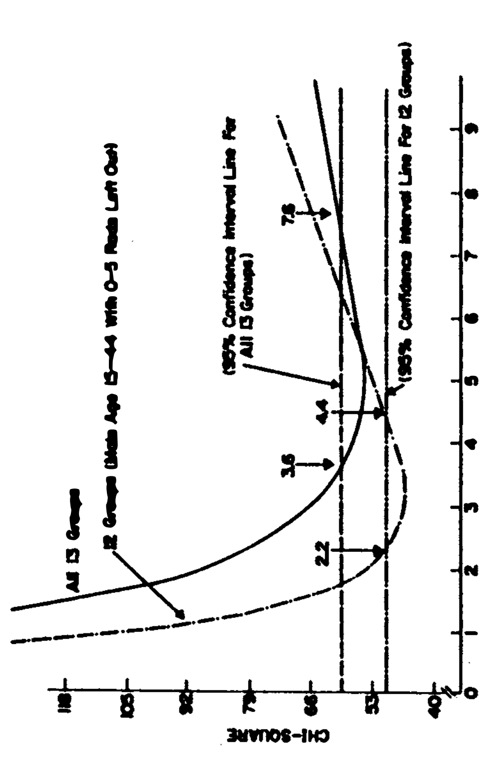

FIGURE 4

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SCHEDULE D

TESTIMONY ON RADIATION PROTECTION GUIDANCE FOR OCCUPATIONAL EXPOSURES

Docket No. A-79-46

April 20, 1981

Testmony of:

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(716-845-5835)

PREAMBLE

At the suggestion of Mr. Luis Garcia, I am submitting the following written testimony on the proposed federal radiation protection guidance for occupational exposures with reference to Docket No. A-79-46.

The purpose of this testimony is to provide a basis for future legal challenge of any regulatory decisions based upon or derived from the proposed guidance.

I testify as an individual and for no institution or organization. As a public health scientist and biostatistician-epidemiologist for more than 30 years, I have published more than 300 papers and my latest book, SCIENTIFIC STRATEGIES TO SAVE YOUR LIFE (just published by Dekker), deals in detail with studies of the hazards of low-level ionizing radiation. For more than 20 years, I have been Director of Biostatistics at Roswell Park Memorial Institute for Cancer Research in Buffalo, New York (for 7 years as Acting Chief of Epidemiology) and before that was at Cornell University Medical College and Johns Hopkins.

THREE CONTENTIONS

Three main contentions will be presented and the remainder of the testimony will provide scientific and historical facts that will establish these contentions. The contentions are:

(1) There is now extensive biostatistical-epidemiological evidence that the doses of low-level ionizing radiation currently permitted by the Nuclear Regulatory Commission (NRC) cause at least a doubling of the risks of leukemia, lung cancer, and other fatal and non-fatal diseases. <u>The dosages currently permitted in normal operations of</u>

nuclear installations are dangerous to the health and safety of nuclear workers.

(2) The scientific evidence has been deliberately and systematically suppressed by the federal agencies in the interagency task force on radiation hazards. In particular, what is probably the best factual scientific evidence currently available has recently (March 17, 1981) been concealed from the general public and from Congress by the National Institute of Occupational Safety and Health. The incompetence, mismanagement, and malfeasance of the federal agencies that are involved in interagency actions on radiation hazards (including the actions published in the Federal Register for January 23, 1981) should preclude them from any participation in public health actions.

(3) The above-mentioned Register does not recommend or mention any guidance that would appreciably improve the protection of the health and safety of radiation workers. Genuine protection would require the use of the best available scientific evidence, particularly the evidence on nuclear submarine workers at the Portsmouth Naval Shipyard which has been suppressed by NIOSH. There will be no real protection of radiation workers until public health guidelines are set by the use of scientific principles and procedures, the best available evidence, and competent scientists who are not in federal agencies or in research organizations that do the bidding of these agencies.

Until there is a genuine scientific and public health effort, the objectives of the January 23, 1981 Register item are a fraud, the procedures a charade, and the whole thing a waste of time and taxpayer dollars that should be stopped immediately.

THE CDC/NIOSH COVER-UP

Turning now to the testimony and documentary evidence to establish the three contentions, I can speak as an original member of the scientific advisory committee named by Congress for oversight of the Center for Disease Control/National Institute of Occupational Safety and Health (CDC/NIOSH) follow-up study of the nuclear workers at the Portsmouth Naval Shipyard (PNS). CDC/NIOSH had been given a specific Congressional mandate to confirm or deny the 1978 report by Najarian and Colton of excess leukemia and cancer among the nuclear shipyard workers.

(1) In the 31 January 1981 issue of The Lancet the final CDC/NIOSH conclusion was:

"Finally in PNS radiation workers, we found no positive dosage response relationships between ionizing radiation dose and mortality from any cause reported."

At the March 17, 1981 meeting of the advisory committee the reason for this conclusion came to light: At the time when the report was submitted CDC/NIOSH had not carried out a single statistical analysis of the dosage-response relationship for any cause of death.

At this meeting CDC/NIOSH admitted that, after actually doing some analysis of their own data; they had found positive relationships between ionizing radiation dose and mortality from a number of different causes of death.

(2) In my January 26, 1981 memo to the committee and CDC/NIOSH (Attachment A) I had pointed out a strong relationship to lung cancer and there are relationships ranging from iffy to moderately strong for various other causes of death. Clearly, NIOSH had published a false

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report in the scientific literature, a report that was flatly contradicted by the actual data in the PNS study.

(3) The circumstances leading up to the publication of this false report on the nuclear shipyard workers by CDC/NIOSH suggest that the agency intended to support the interagency position on radiation hazards irrespective of what was in its own data.

(a) The advisory committee did not see (or even hear of) the article CDC/NIOSH submitted to The Lancet until it was in print.

(b) The advisory committee was not given the key data tables (dose x latency) for most causes of death (including obvious causes such as lung cancer). The original version of the final report and the published version only included tables for leukemia and a few related causes. The committee was denied access to the data until after the fact because NIOSH claimed there were "too many" tables and "nothing" in them.

(c) The Lancet article was submitted despite repeated objections from myself and other members of the advisory committee to an earlier version of the final report. Months earlier I had stated in no uncertain terms that the so-called "final report" was inadequate and incompetent and had no statistical analysis of dose-response relationships.

(4) Thus, NIOSH withheld information from (and refused to listen to) the oversight committee that Congress had set up in 1978 specifically to avoid this kind of cover-up.

These historical facts make it difficult to avoid the conclusion that CDC/NIOSH published predetermined results (supporting the interagency position on radiation hazards) even though it meant lying to the public and to Congress about the results of the PNS study.

IMPORTANCE OF THE PNS STUDY

While it is not possible here to present the important scientific findings that come out of a competent biostatistical analysis of the dose-response relationships in the CDC/NIOSH data from PNS, this data is of crucial importance in setting future guidelines to protect workers. It is probably the best available data on what happens to nuclear workers under normal operating conditions and current NRC/ALARA permissible levels. This point is amplified in Table A.

What any adequate analysis of the PNS data will show is that exposures well under the 5 rem/year level (most workers had less than 10 rem lifetime exposure) caused at least doubled risks of death from lung cancer, leukemia, and a number of other causes. Hence, the levels of radiation exposure currently permitted are clearly causing serious health hazards to workers.

TABLE A

COMPARISON OF THE NEW DATA ON THE PORTSMOUTH SHIPYARD WORKERS WITH THE DATA USED IN OFFICIAL REPORTS (INTERAGENCY, BEIR, ICRP, ETC.)

CHARACTERISTICS OF THE DATA	PNS DATA	OFFICIAL REPORTS
Who are the persons under study?	Nuclear workers under normal working conditions.	Survivors of an A-bomb or persons with grave disease requiring therapeutic x-ray.
What are the dosages of ionizing radiation?	Low-level radiation directly pertinent to occupational exposure standards.	Dosages in most subjects of well over 100 rem.
What is the quality of the dosimetry for persons under study?	Continuous concurrent monitoring of the exposures with recording of dates, doses, etc., for each individual.	Retrospective guesstimates of exposures with no adequate crosschecks or control of the dosimetry.
What is the quality of the follow-up of the persons under study?	Virtually complete (98%) with full death certificate and other information.	Incomplete and often inadequate follow-up and poor quality of information on individuals.
What was the quality of the information used for comparisons?	Nosology review enabled use of age-sex-race-cause specific U.S. rates.	Pick-up or biased comparison series (e.g., In some A-bomb comparisons, persons exposed up to 10 rem are used as controls).
What assumptions were necessary for estimates of doubling dose or other quantitative measures of health effects?	Estimates can be made directly without any strong assumptions.	Estimates require assumption of dubious "linear" or other hypotheses and are merely guesswork.
What was the quality of the statistical analysis used for the determination of dose-response relationships?	NIOSH failed to do any statistical analysis of dose-response in the "final report".	Most of the dose-response statistical analyses are inadequate or incompetent.

OTHER SCIENTIFIC EVIDENCE OF LOW-LEVEL HAZARDS

While the PNS data is especially pertinent, there are now extensive data from a large number of studies which are relevant to the setting of guidelines to protect workers. A review of the studies where populations actually exposed to low-level radiation showed serious adverse health effects (more than 30 such biostatistical-epidemiological studies by many different authors) is attached (Attachment B--material submitted for publication elsewhere).

For setting permissible levels of exposure to low-level ionizing radiation, it is essential to obtain quantitative estimates of risk such as "doubling doses". In 1978 at a special NRC meeting for this specific purpose, I presented the first accurate estimate of the doubling dose for myeloid leukemia in men. This estimate, based on an analysis of exposures to diagnostic x-rays in the Tri-State Survey data, was about 5 rem—thus showing that NRC permissible levels were hazardous. Whenever the doubling dose for leukemia can be estimated from more recent data, this 5 rem estimate has been confirmed. The PNS data confirms it. The CDC study of veterans exposed to the nuclear weapons tests at Big Smoky (which was published after Attachment B was written) also confirms this 5 rem estimate.

The purpose and quality of the official reports on low-level radiation hazards can be judged from this simple fact: While these reports mentioned and disparaged the positive studies cited above, none made estimates of doubling doses or other quantitative estimates from the data they were supposed to be evaluating. All of the recent reports (such as the Libassi Report (Interagency), the new BEIR report, and the

GAO Report on January 2, 1981) include attacks on the new positive studies—often attacks on the honesty, competence, and reputations of the independent scientists doing the studies--but they make no attempt to utilize the new information in a constructive way. Instead, they rely on the obsolete estimates and data described in Table A.

OVERALL VIEW

For the past 25 years, the federal agencies have been committed to the official policy laid down in 1955 by the Eisenhower Administration that low-level ionizing radiation is "harmless". At the 1978 House hearings reported in Serial No. 95-179 the participation of the Department of Energy, National Cancer Institute, and Atomic Energy Commission in this long-standing cover-up of radiation hazards is detailed. In SCIENTIFIC STRATEGIES TO SAVE YOUR LIFE (Dekker, 1981) the participation of other agencies including the Nuclear Regulatory Commission, Defense Nuclear Agency, and Veterans Administration is described. Therefore, the CDC/NIOSH cover-up of the serious radiation hazards at PNS should be viewed as one more attempt to maintain the official interagency position despite overwhelming new evidence that it no longer has any scientific or public health validity.

The maintenance of the myth that low-level radiation is "harmless" has endangered the public health and safety for 25 years and has resulted in thousands of unnecessary deaths and disabilities to workers the public, casualties that could have been prevented by more careful and sensible use of radiation technologies. The "harmless" myth has

been maintained by a combination of incompetence, mismanagement, malfeasance, and fraud in the federal agencies and interagency panels. Hence, it should be clear that effective guidance on radiation protection cannot be expected from federally controlled-and-funded units.

The best hope of setting guidelines that will actually protect workers and the public is to have competent people apply modern scientific and public health principles and procedures to the best factual evidence currently available. This is how to determine levels of exposure that will not jeopardize the health and safety of human beings. It would then be up to the managers of radiation technologies to operate within these limits or not to operate at all. In special circumstances (e.g., national defense) workers might be given the option of working at higher levels if they get hazard pay, guaranteed medical care, and adequate compensation for radiogenic health effects.

SCHEDULE E

RADIOACTIVE READINGS

Volume 2, Number 8 August 3, 1'

GAO ASSAILS SAFETY OF DOE NUCLEAR FACILITIES

Rep. Pat Schroeder (D-Colo.) released a General Accounting Office report that charges the Department of Energy is failing to meet adequate health and safety standards at its nuclear facilities.

The report, released on July 29, 1981, is available from U.S. GAO, Document Handling and Information Services Facility, P.O. Box 6015, Gaithersburg, Md. 20760 (EMD-81-108, Jul 27).

"You can't allow DOE to police itself and still expect the health of the public to be protected," said Schroeder. "GAO's study clearly states that major changes have to be made before we can reset easy about the safety of DOE facilities."

Last March, Schroeder had requested that GAO study the issue.

DOE's nuclear facilities, which are operated for DOE by contractors, are exempt from Nuclear Regulatory Commission and Occupational Safety and Health Administration safety and health regulation and oversight.

DOE owns facilities for producing nuclear reactor fuel, and, for example, at the Rocky Flats plant in Golden, Colorado, developing nuclear explosives.

GAO found instances where DOE allowed the health of workers and the public at large to be threatened. For instance:

--On June 9, 1980, DOE was informed of an improperly installed filter on a glove box at the Rocky Flats plant. Three days after receiving the complaint the situation was investigated and the area found to be contaminated.

The delay was attributed to a supervisor's reluctance to disrupt production to correct the problem.

--In November 1978, alarms at the Richland Operations Office were found to be inactive creating a hazardous condition.

Although reported, nothing was done about the problem. In November 1979 the situation resulted in the undetected leakage of contaminated water.

--On August 30, 1976, an explosion at DOE's Hanford complex, contaminated 5 employees with radioactive americium. The subsequent investigation stated that although a safety analysis had been done, it did not analyze the process as it was actually performed and therefore could not signal operators to identify a potential hazard.

In its report GAO recommends a "major reorganization of DOE's safety and health program" and suggests "that the Congress consider legislation to require the Nuclear Regulatory Commission to review the safety of several DOE nuclear facilities."

GAO reviewed four DOE functional program areas and found serious shortcomings:

1. Occupational Safety:
"--Is DOE's program adequat to assure the employees at nuclear facilities are provided with safe and healthf working conditions? The sh answer is 'No.'

2. Emergency Preparedness
"--Is DOE providing adequat emergency preparedness guid and assuring that DOE facil ties are prepared to respon to nuclear accidents? The short answer is 'No.'

3. Facility Design Safety
"--What actions is DOE taki to assure that its older facilities meet current safet criteria and standards? Th short answer is 'Very limit if any.'

4. Environmental Monitorin
"--How does DOE assure itse that information concerning radiological releases from DOE's nuclear facilities is accurate and reliable? GAO answer is that DOE has litt assurance.

GAO concluded: "The speci problems noted in DOE's occu pational safety, emergency preparedness, facility desi safety, and environmental monitoring programs warrant immediate corrective action

Schroeder has asked DOE, t Federal Emergency Managemen Agency, the Nuclear Regulat Commission, and the Occupational Safety and Health Ad istration to respond.

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Enclosed you will find written testimonies from citizens of Buffalo, NY who have asked us to forward them to the DOE.

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sierra club
radioactive waste
campaign

Letter 6

STATEMENT
of
ROBERT N. FRANKI
to the
U.S. DEPT. of ENERGY

September 24, 1981

Robert Franki
1152 Kensington
Buffalo NY 14215

Good evening. My name is Robert Franki. I am a Buffalo resident and a student at the University of Buffalo.

On February 2, 1980, I gave testimony before the Dept. of Energy (DOE) on technical concerns with the High Level Liquid Waste Demonstration Project and its preceding Draft Environmental Impact Statement (DEIS). Today I will comment on the contents of the DOE's projected Long Term Management of Liquid igh Level Radioactive Wastes.

The DEIS raises serious questions concerning the safety of workers in and around the now defunct reprocessing building. Radioactivity has permeated the cement walls in many of the cells. Radaition levels range as high as 3000 rems/hr in some hot areas. This is over 6000 times normal background radiation levels. DOE estimates for occupational exposures during the decontamination of the plant total over 350 millirem/hr for 2000 person hours. Using this DOE exposure estimate, a worker would receive the maximum Nuclear Regulatory Commission (NRC) allowed 5.0 rem yearly exposure after 14 hours on the job. If the decontamination were completed in one year, the job would "burn out" approximately 140 workers. Also, these estimates are based on incomplete data gathered about past experience at the Hanford waste storage facility in Washington. West Valley's worker contamination history has been worse than Hanford's. This estimate also assumes that no illegal overexposures would occur, such as those which happened in 1971, when the 164 full time workers at NFS received an average dose of 7.24 rems for the year.

6-1 Because of general scientific aggreement on the potential toxicity of such a high dose of radiation as 5.0 rems, more educational material must be provided for both full and part time workers.

Since this is a pilot project, especially the borosilicate option, worker protection must be a maximum consideration. DOE estimates that over 90% of predicted worker exposure will result from the decontamination of the 10 year old reprocessing building. This high percentage of an alarmingly high dosage should not be quickly conceded to workers at the facility. If better protection cannot be provided, a new facility may be the only way to assure a relatively clean working environment.

The DOE advocates the borosilicate glass conversion option over the calcine conversion option. While calcination has been used for 20 years at an Idaho waste reprocessing facility, vitrification is an experimental technology. The calcination process is approximately half as hot as the vitrification process, decreasing the probability of high temperature related

6-2 radiation releases. Calcine is an interim form which can be converted to a glass later, once a proper disposal medium has been chosen, glass is permanent. And, glass is incompatible with the host rock currently favored by the DOE. for a final repository - salt. Because of this incompatibility, vitrified waste may not be removable once it has been converted.

6-3 The DOE provides insufficient data regarding expected radiation releases from the project. Radioactivity will be released to the environment

6-4 at several points in the solidification process. During the heating of the liquid waste in the tanks, the high temperatures will volatilize cesium and other elements. There is insufficient data provided regarding the technical capability of capturing these gaseous effluents. Given the presence of 11 million curies of highly volatile cesium in the high level liquid, the amount that will be released must be disclosed.

6-5 The League of Women Voters related the great public concern about preparedness for a major accident during the removal of the radioactive sludge and liquid in their compilation of the February 2, 1980 DOE scoping sesion. The DOE document fails to consider this potential consequence of the solidification process. When one examines the awesome 1957 Ural Mountain waste explosion accident, where 1000 square miles of Russian land were devastated, the absence of strontium-90 indicates that some waste management process was underway at the time of the accident. A major accident at the West Valley facility poses a serious threat to the metropolitan regions of Buffalo, Olean, Salamanca and others. This DOE omission indicates a lack of consideration for the health and safety of more than 1.3 million residents in the Western New York area in the event of a major accident.

Even if no accidental releases of radioactivity occur, the DOE promotes leaving the high-level tanks in the ground after the radioactive sludge and liquid have been removed. Even after 95% effective cleaning of the tank, which may not be possible, 500,000 curies of the strontium-90 and other high-level radioactive materials will remain in the tank. This hazardous, long-lived poison will leach into the surrounding soil as the tank corrodes and the back-filled concrete crumbles. The strontium will be hazardous for 300 years and the tank may only last for 30-60 years.

6-6 The tank must be exhumed after its contents have been removed.

6-7 The DOE also fails to address the impact of sand lenses, underground springs, swamps and gravel aquifers at the site on the hazards associated with the leakage from the high-level waste solidification process or an accident. Sand lenses in the vicinity of the tank could carry radioactive material to nearby streams. How rapidly material could migrate off-site must be determined by a full geological investigation.

The high level radioactive waste in West Valley must be removed. However, Federal assistance does not justify irresponsible planning on the project. The citizens of Western New York must insure for themselves that the DOE, Westinghouse Corp., and any other subsequent contractors manage themselves appropriately, keeping worker safety and regional environmental contamination protection priorities over mere profit.

Letter 7

This comment to the Draft Environmental Impact Statement (DEIS) on the West Valley Project is directed towards two perceived deficiencies in that statement.

7-1 The first is the assumption on the part of the DOE that there would be no release of radionuclides from high level waste (HLW) during interim on-site storage prior to relocation to a Federal repository. (#B.4.4.1; p. B-73) By its own admission, no attempt was made by the DOE to identify a range of potential accidents at the West Valley site which might lead to the release of radionuclides into the environment. (#4.1.4; p. 4-10) Thus the entire analysis of short-term radiological impacts to the popu-
7-2 lation is inadequate. The possibility and associated risks of a number of man-made, seismic, and hydrogeological incidents must be assessed, and the resulting effects on public health and the natural environment must be included in the DOE calculations on overall project impacts.

7-3 With regard to the potential for non-radiological, chemical contamination, the DOE states that the very low permeability of the local soil will prevent the lateral migration of toxic dissolved nitrate salts, and other substances, from the existing disposal trenches. (#4.2.1.5; p.4-49) It does concede, however, that trench overflow from rainwater infiltration is possible. The DOE's contention that the toxic runoff will be rendered harmless by seepage back into the soil is self-contradictory, for the soil characteristics that inhibit horizontal movement will also inhibit vertical movement. Thus the runoff is likely to flow overland to nearby streams. Dilution of this runoff to safe limits once in a stream cannot be assured under widely varying streamflow conditions, as claimed.

7-4 A second major deficiency in the DEIS as a whole is the assumption that a secure Federal repository will be available by 1997 to receive the solidified HLW generated at the West Valley clean-up. Such a repository is a required facility for the enactment of Alternatives 1a, 1b or 2, yet neither the exact geological medium, nor the appropriate disposal technology, nor even the assurance that either is attainable, has been determined. Formulating alternatives dependent on facilities and equipment that do not, and may not, exist is non-sensical.

The environmental impacts of waste disposal in the proposed hypothetical repository receive limited analysis in the DEIS. Again, the DOE concedes that the probabilities of rare geologic events that may disrupt such a repository "cannot be accurately predicted" and that the potential releases of radionuclides over long-term periods are "uncertain". (#4.1.5; p. 4-22) Section 1502.4(a) of the National Environmental Policy Act requires that ". . . proposals which are related to each other closely enough to be, in effect, a single course of action shall be evaluated in a single (environmental) impact statement." Thus the DOE is mandated to apply the EIS process to all proposals related to its
7-5 stated objectives. The failure to thoroughly assess the environmental impacts of the proposed repository is an undermining of the original intent of NEPA.

Frederick M. Swed, Jr.
26 Huntington Avenue
Buffalo, NY 14214

Letter 8

Sept. 24, 1981

STATEMENT TO THE CITIZENS HEARING RE: D.O.E. West Valley Clean-up Operation

The citizens need to know the following:

8-1 What steps will be taken to monitor the emissions from West Valley?

8-2 How much radiation is likely to enter the food-chain and waterways?

8-3 What method of solidification will be used and why?

We insist that there be continuous monitoring of emissions, by an independent agency, while the clean-up and solidification are taking place.

I do not feel very confident about the governments remedies because approximately nine years ago when my son was very small the Federal Government decided to pass legislation to protect young children from the highly flammable synthetic sleepwear. Their goal was a noble one. however, in attempting to correct one hazard they developed another. Instead of requiring that more cotton cloth be used in the manufacture of childrens sleeping garments they took a "new" approach, insisting these garments be treated with flame retardant chemicals. As a result millions of small children spent about 40% of their time wearing cloth containing the chemical carcinogen Tris. During the years of its use most childrens sleepwear never came into contact with flame - but their skin had much contact with Tris.

We must guard against situations like this in which the remedy is not a safe solution. We know that the clean-up of West Valley is necessary. The citizens of Western New York must be reassured that they will not be guinea pigs. The utmost of care must be taken to select a method to achieve the clean-up and solidification that we can be assured will be the safest, most reliable and proven technology available. We also need to be assured that our problems will not be compounded by having more nuclear waste sent to West Valley.

Suzanne Jantz
47 Flower ST
Buffalo NY 14316

Letter 9 - No response required.

WESTERN NEW YORK PEACE CENTER

sponsored by riverside-salem united church of christ
an affiliate of clergy & and laity concerned (CALC)

Program office at 440 Leroy Ave., Buffalo, N.Y. 14215 835-4073, 833-0213

Sept. 24, 1981

Statement for Citizen's Hearing on DOE Draft Environmental Impact Statement on Clean Up At West Valley.

The Western New York Peace Center is grateful to the Sierra Club Radioactive Waste Campaign, the Coalition on West Valley Nuclear Wastes, and C.A.N.C.E.R. for the opportunity to speak to our concerns about nuclear wastes and West Valley.

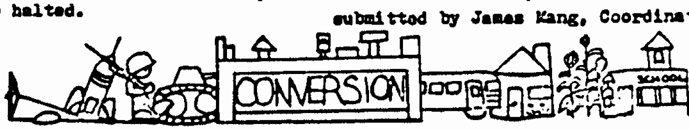
We begin with the wise words of Albert Eistein, "We must carry the facts of nuclear energy to the village square. From there must come America's voice." The reason we are here, not at the request of DOE, is because we believe these words and because DOE doesn't. In fact, in early September the Senate Armed Services Committee reported S.1549, the Department of Energy National Security Programs Authorization Act, to the full Senate. The Senate is expected to vote on S.1549 within the next few weeks. This landmark bill, if passed, would authorize nearly $5 billon for a dramatic expansion of nuclear weapons production and testing while severely curtailing citizen access to information about the expansion plans and their health and safety effects.

We don't have the scientific experts to critique the specifics of the DOE Environmental Impact Statement on West Valley but we find it generally incongrous and lacking in credibility because it comes out at the same time and from the same department which wants to dramatically expand nuclear weapons production and testing while at the same time trying to curtail citizen access to information on their safety and health aspects.

Because of this, we must highly suspect the motives of DOE in regards to West Valley. In fact, we believe the DOE wants to experiment with West Valley at the possible expense to all of Western New York, that DOE wants to make wider use of West Valley for nuclear wastes.

Therefore, we propose that total storage and reprocessing efforts be halted until the many unresolved scientific and safety questions are resolved. In the meantime, all further nuclear development should cease. It is absurd to add to the waste stockpiles when no safe disposal methods exist now or in the foreseeable future. DOE should call a complete nuclear moratorium: no additional construction or operating permits should be issued for civilan reactors; and the further production of nuclear weapons should be halted.

submitted by James Kang, Coordinator



Letter 10 - No response required.

Sept. 24, 1981

STATEMENT TO THE CITIZENS HEARING RE: D.O.E. West Valley Clean-up Operation

Nuclear Waste is dangerous to our health and should be disposed of properly. I would feel much better if the President of the United States lived at West Valley. If Reagan lived at West Valley I feel it would be cleaned up safely.

I would like to contimue to live in Buffalo because I have friends, family and a home here that I love.

I, and a lot of other people and future generations have a right to grow-up in an enviornment free from the hazards of radiation. The D.C.E. and Westinghouse should be careful to choose the safest way to clean-up West Valley.

Scott Jantz (age 10)
47 Flower St
Buffalo N.Y. 14216

Letter 11

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 81/1622

OCT 6 1981

West Valley Program Office
Office of Waste Operations
and Technology, NE-320
Nuclear Waste Management and
Fuel Cycle Programs
Department of Energy
Washington, D.C. 20545

Dear Sir:

Thank you for your letter of August 6, 1981, transmitting copies of the draft environmental impact statement for long-term management of liquid high-level radioactive wastes stored at the Western New York Nuclear Service Center, West Valley, Cattaraugus County, New York. Our comments are presented according to the form of the statement or by subject.

11-1 The discussion of the regional geology and hydrology fails to provide adequate details on the geology and hydrology next to and near the waste tanks. Before estimates can be made as to the potential for ground-water contamination from the wastes in the tanks, reasonable knowledge of the ground-water flow system is required. The final statement should describe the principal direction of ground-water flow.

The migrational release through the subsurface would be calculated based upon the rate of ground-water movement and the flowpath. If the tanks are finished mostly in the alluvial fan deposits then the direction, rate, and discharge points in the fan deposits must be known. In the draft statement the direction of ground-water flow is noted as eastward. This should be shown on a map and the points of discharge should be located. If the tanks are finished mostly in the fine-grained till, then the direction, rate, and discharge points for this path must be known or at least estimated. Presumably, the hydrology of the till near the tanks is similar to the till near the commercial landfill in that water flows predominately downward through the till at a rate of a few centimeters per year. However, the final statement should describe the direction the ground-water flows once it moves through the till. It is unclear whether the ground-water moves laterally through a fine sand or silt layer to Franks Creek or to Buttermilk Creek, or it moves downward until it reaches the weathered shale and then along the weathered shale until it intersects Buttermilk Creek at some unknown point. The final statement should estimate how long it will take for a water particle to reach the discharge point.

Little of the overflow would seep back into the soil if the ground was saturated or frozen, which is frequently the case in the early spring at the commercial landfill for radioactive wastes nearby as noted on page 4-49.

11-2 It is stated that water from existing wells would be used for decontamination and that the rates of withdrawal would not exceed those previously required for operation. The final statement should indicate at least the approximate capacities of existing wells which might be used and indicate aquifer(s) utilized and typical rates of withdrawal during operation. This information would permit assessment of the adequacy of the source, potential for recirculation of contaminants, etc. These considerations seem pertinent, because section 3.1.3 indicates that even the shallow water-table aquifer is not reliable.

We hope these comments will be helpful to you in the preparation of a final statement.

Sincerely,

Bruce Blanchard

Bruce Blanchard, Director
Environmental Project Review

Letter 12

8 East Main Street Ilion, N.Y. 13357

New York State Conservation Council Inc.

October 14, 1981
1190 Parkhurst Blvd.
Tonawanda, N. Y. 14150

West Valley Program Office
Office of Waste Operations and Technology, NE-320
Nuclear Waste Management and Fuel Cycle Program
U. S. Dept. of Energy
Washington, D. C. 20545

After much "homework" on the subject, I have taken the position to support the calcination process for the future decontamination of the West Valley facility.

12-1 The reasoning mainly has to do with policy issues. Calcination would allow time to design waste forms compatible with geologic repository. Glass, I feel would be incompatible with salt repository. Agglomerated calcination would have lower process temperatures and radiation releases to the atmosphere.

12-2 High temperature processes that are necessary for borosilicate glass means frequent breakdown of equipment; also cesium volatilizes at 770° and therefore more of it would be released by the borosilicate glass method. The bottom line being that calcine can be made into glass later when the most compatible geologic repository is found.

Sincerely,

John E. Bens, Environmental Chairman
New York State Conservation Council, Inc.

Letter 12a - See Letter 12.

Erie County Federation of Sportsmen's Clubs Inc.

Member of New York State Conservation Council

Conservation Pledge

I give my pledge as an American to save and faithfully to defend from waste the natural resources of my country — its air, soil and minerals, its forests, waters and wildlife.

October 15, 1981

West Valley Program Office
Office of Waste Operations & Tech. NE-320
Nuclear Waste Management & Fuel Cycle Prog.
U.S. Dept. of Energy
Washington, D.C. 20545

RE: WEST VALLEY FACILITY

Dear Sirs;

After much "homework" on the subject, the Erie County Federation has taken the position to support the calcination process for the future decontamination of the West Valley facility.

The reasoning mainly has to do with policy issues. Calcination would allow time to design waste forms compatible with geologic repository. Glass, we feel would be incompatible with salt repository. Agglomerated calcination would have lower process tempertures and radiation releases to the atmosphere.

High temperture processes that are necessary for bonosilicate glass mean frequent breakdown of equipment; also cesium volatilizes at 507°c and therefore more of it would be released by the bonosilicate glass method. The bottom line being that calcine could be made into glass later on when the most compatible geologic repository is found.

Sincerely,
Yours for conservation,

JOHN H. BUNZ
Erie County Delegate
Director-at-Large of NYSCC, Inc.

JHB/vc
CC: Mary Lou Rath, Environ. Comm. & Erie County Legislator

Letter 13

Act No. 310 By Mr. Dewey, Mrs. McGee, Mr. Taylor and Mr. O'Connell

REQUESTING INFORMATION AND INPUT FROM UNITED STATES DEPARTMENT OF ENERGY ON WEST VALLEY CLEANUP PROJECT

WHEREAS, the Western New York Nuclear Service Center is located within the County of Cattaraugus, State of New York, and

WHEREAS, Public Law 96-368 was approved by the Congress of the United States and enacted into law on October 1, 1980, and

WHEREAS, Public Law 96-368 requires the United States Department of Energy to, among other things, undertake the responsibility for the safe removal of certain high level radioactive wastes presently stored in tanks at the Western New York Nuclear Service Center, and

WHEREAS, present estimates by the United States Department of Energy indicate that cleanup activities at the Western New York Nuclear Service Center will extend for a period of several years, now, therefore, be it

13-1 RESOLVED, that the Cattaraugus County Legislature hereby requests the United States Department of Energy and its contractors engaged in the implementation of Public Law 96-368 to provide, throughout the entire period during which activities pursuant to Public Law 96-368 are undertaken, the following:

(1) information to the officials of the County of Cattaraugus and to the public detailing the methods and progress of the activities undertaken pursuant to Public Law 96-368, and

(2) a means for input by officials of Cattaraugus County and the public concerning such activities, and be it further

RESOLVED, that the Clerk of the Legislature be, and he hereby is, directed to forward a certified copy of this resolution to the United States Department of Energy for inclusion as a part of the record of comments to the Draft Environmental Impact Statement (DOE/EIS-0081D).

STATE OF NEW YORK }
COUNTY OF CATTARAUGUS } SS:

I, the undersigned, Clerk of the Legislature of the County of Cattaraugus, New York, do hereby certify that I have compared the foregoing copy of Resolution No. 310 of the Legislature of Said County of Cattaraugus with the original thereof on file in my office and duly adopted by said Legislature at a meeting of said Legislature on the 14th day of October, 1981 and that the same is a true and correct copy of such resolution and of the whole thereof.
In testimony whereof, I have hereunto set my hand and affixed the seal of said County this 15th day of October, 1981.

C. W. Baker
Clerk, Cattaraugus County Legislature

Letter 14

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
BUFFALO AREA OFFICE
107 DELAWARE AVENUE, STATLER BUILDING, MEZZANINE
BUFFALO, NEW YORK 14202

REGION II

IN REPLY REFER TO:

2.1S

October 16, 1981

U.S. Department of Energy
West Valley Program Office
Office of Waste Operations &
Technology, NE-320
Nuclear Waste Management &
Fuel Cycle Programs
Washington, D.C. 20545

To Whom It May Concern:

Subject: Draft Environmental Impact Statement
Long Term Management of Liquid High-Level
Radioactive Wastes Stored at the Western
New York Nuclear Services Center, West Valley

We have reviewed subject draft EIS and find it to be highly technical in nature. Since FHA mortgages have been written in the surrounding area in the past and will likely continue, our primary concern is relative to possible degradation of ground water. We, therefore, favor alternatives that provide for ultimate removal to a Federal repository rather than storage of any solidified material on the site.

14-1 In addition, we would suggest that a more definitive indication of transportation routes that will be utilized (than that given in the draft) be included in the final EIS.

Thank you for the opportunity to review this document.

Sincerely,

Richard W. Lippold
Acting Area Manager

Letter 15

Glass Research and Melting Processes for the Glass Industry

Penberthy Electromelt International, Inc.

Cable Address: PENELECTRO SEATTLE

631 South 96th Street

Seattle, Washington 98108, U.S.A.

Telephone: (206) 762 4244

Nuclear Waste Division

19 October 1981

West Valley Program Office
Office of Waste Operations, NE-320
Department of Energy
Washington, DC 20545

Re: Comments on DEIS for West Valley
DOE/EIS-0081D

Gentlemen:

I take exception to certain technological statements in the above draft as follows:

15-1 Page B-18 The list of Terminal Waste Forms should have included the alumino-silicate family of glasses. These were rated top choice by Dr. L.L. Hench at a Congressional hearing (McCormack) 15-17 May 1979. Further, alumino-silicate glass should have been listed as Available because that family is the basic glass of history and today.

Still further the Atomic Energy of Canada Ltd. staff made blocks of alumino-silicate glass in 1960 loaded with activity at 2000 watts per ton. Their 20 year tests have proven outstanding success.

15-2 Page B-19 The properties of the finished glass are critically dependent on waste or glass-former compositions or on processing conditions. The statement near the bottom is incorrect.

Suppose the waste comes with high soda content and the frit being used as a glass former has 28% soda. The resulting glass will have such bad properties that it will dissolve in hot coffee.

Suppose the temperature in in-can melting is allowed to drop to 600°C (1120°F). The resulting "glass" will be worthless for leaching resistance.

15-3 Page B-24 The purified sodium or calcium sulfate formed in the offgas system will amount to 90 tons which will go in 180 drums (55 gal), not 890 as stated.

My figure is derived from Page B-8 where the sulfate is given as 89,800 kg. The number of drums may be less, because part of the sulfate will stay in the glass.

PEN ELECTRO

West Valley Program Office
DOE
19 October 1981

15-4 Page B-26 The Spray Calcination step should be noted as a troublesome process on account of dust and oxidation of ruthenium and molybdenum. At SRL, this process has been abandoned.

15-5 Page B-28 In-Can Melting is presented as a trouble-free process. Deterioration over the 90 hour cycle of the stainless steel cans should be described or at least mentioned: Bulging, grain growth, weld degradation, nitric acid vapor attack.

By contrast, the French AVM process melts in stainless steel, but delivers the glass to a fresh stainless steel canister which has never been subjected to melting temperatures.

15-6 B-30 An additional development need of the in-can melting process is how to maintain quality control. If the tank sludge (calcine) and frit (glass former mixture) are not thoroughly mixed, the resulting glass will be distinctly inferior. This has been noted in some destructive examinations of in-can melts.

PAGE B-30 NONSEPARATED SALT/SLUDGE OPTION

This is the option strongly advocated by the writer. The writer has decades of practical industrial engineering and knowhow supporting the following comments.

The Joule heated ceramic melter for this option already exists in the form of a 6 ton per day furnace purchased by the DOE in July 1981. This is a standard industrial design and has been demonstrated successfully at full rate. Using this furnace, the entire solid oxide contents of the tanks can be glassified in 600 days.

15-7 The statement in the draft "it is anticipated that this ceramic melter could be available for plant application in 5 to 10 years provided developmental support continues" is pure bunk. Melters of this kind have been in production use since 1932, and the melting process itself is being currently used to melt 20,000 tons of glass a day. Moreover, the furnace for West Valley has already been built and tested.

Engineering work for remote installation is required, but this is engineering, not development.

15-8 B-31 There would not be large quantities of NO_x evolved if the prescribed mild reducing conditions are maintained in the batch blanket. The statement on line 13 is incorrect.

B-31 The sodium oxide in the slurry from the tank provides all the soda required for the glass. The additional ingredients for making glass are silica sand, limestone and alumina. They are sandy in texture and are mixed with the slurry just before entry into the furnace.

The melting temperature in the existing 6 ton furnace is 1320°C (2400°F) which is low by glass industry standards.

The reference in the draft to "glass-former mixture" is misleading. The reference to melting point "higher than 1400°C (2550°F)" is false.

The reference in the draft that "elimination of alkali from the glass-former mixture makes it more difficult to ensure quality" reflects a misconception of the glass melting process. It is easy to make glass of excellent uniform quality in a standard industrial electric glass furnace.

15-9 B-31 The levels of sulfate in the slurry are not really high. Large tonnages of glass having 10 times this level of sulfate are made in regular production in areas of the world where sodium carbonate is not as easily available. Coke is added to the batch to reduce the sodium sulfate to sodium oxide. There is no accumulation of a sodium sulfate phase. The statement in the draft to the contrary is misleading.

15-10 B-31 A Strong reducing agent used properly in the batch is beneficial to the electrodes by capturing any available chemical oxygen before it can get to the electrodes. The statement to the contrary in the draft is false.

15-11 B-31 Sulfur is not a potentially corrosive agent of the ceramic melter refractories in industry, and has no effect on the operating lifetime of the ceramic melter. The generic statement attributed to Dierks et al 1980 is false.

B-32 Rather than show a ceramic melter which is not designed for remote operation, it is better to show the 6 ton/day furnace which is designed for remote operation. A photo and drawing are enclosed.

15-12 B-33 The reference to production of SO_3 when reducing agents are added to the feed before melting is incorrect. The evolved gas is SO_2. The number of drums of calcium sulfate formed in the offgas system is 180, not 890.

15-13 B-33 Rather than use thermal decomposition of nitrate/nitrite, it is better to use chemical decomposition. Evolution of NO_x is thus avoided. No ammonia burner is required.

B-34 The statements in the draft regarding development needs for the nonseparated salt/sludge option may be true for that writer, but they certainly aren't true for the present writer. The correct statement follows.

1. No further characterization of the contents of Tanks 8D2 and 8D4 is required. The 8D4 tank contents are to be mixed into 8D2. The only control of the 8D2 slurry going to the melter is soda content. This is measured by electrical conductivity. The ratio of slurry to inert dry ingredients is adjusted accordingly.

2. An excellent formulation for the product glass was developed early in 1980 and presented to the Savannah River Laboratory High Level Waste meeting May 1980. The soda content is 14.5%.

   This glass composition, P-19, is attached. Excellent resistance to leaching (9 times better than PNL 76-68 borosilicate glass) has been measured in the MCC-1 test by Battelle Pacific Northwest Laboratory.

3. Studies of effectiveness of destruction and/or removal of NO_x and SO_x from the melting process have already been done, but it would be fun to do it again.

4. Engineering design is required for installation of the 6 ton/day melter, but not for design and remote operation. The latter have already been done.

B-34 The glass from the PE process 6 ton/day melter mentioned above was tested by Battelle Pacific Northwest Laboratory in comparison with Battelle 76-68 glass for in-can melting the MCC-1 test. The PE glass was found to be 9 times better for retention of Cs and Sr and 4 times better for resistance to dissolution of the silica network. The test time should be lengthened beyond 28 days.

The statement in the draft to the contrary is not correct.

B-35 The comparison in the draft of the separated and non-separated options needs a lot of rework.

15-14 The space in the repository for the high level waste glass is the same for both options. The canisters of glass made by the non-separated option are proportionately lower in activity heat and are spaced proportionately closer together.

15-15 In-can melter technology is not more developed than continuous ceramic melter technology. In-can melting still has to deal with the problems of stainless steel degradation and quality assurance, whereas the industry type ceramic melter has no such problems.

West Valley Program Office
DOE
19 October 1981

Comments on DEIS for WV
Page Five

Salt cake from the separated process may have to be disposed of by the SRL "saltcrete" process whereby the 1200 tons of salts become 4000 tons of saltcrete. This would be a disadvantage of the separated process.

Another disadvantage of the separated process is that no convenient quality assurance method for in-can melting has been developed.

An advantage of the continuous ceramic melter process is that grab-cup sampling of the falling stream of molten glass can be accomplished readily.

15-16 The use of bias terms such as "much smaller" and "very large" should be eliminated in a comparison. Better in this case to say 700 tons glass plus 1200 tons of salts for separated and 3500 tons glass for unseparated process.

The 1200 tons of salts may have to be disposed of as 4000 tons of saltcrete. The text on page B-35 says only that the salt cake probably can be disposed of as low level waste.

Under the non-separated option, it is falsely stated that control of glass composition is very difficult. Further, the planned campaign for the PE melter at six tons a day is only 600 days, not three years.

Contrary to the statement in the draft, the overall process for non-separated is very well developed.

Another advantage of the non-separated process is that only one hot cell (CPC) will be used, and existing equipment in it may remain. Decontamination for man-entry is not needed beyond the Decon Room.

Yours truly,

PENBERTHY ELECTROMELT INTERNATIONAL, INC.

Larry Penberthy

Larry Penberthy

LP/nc

cc: G.K. Oertel
David McGoff
James Turi

Enc: Photo and drawing of 6 ton/day furnace (Photo by separate cover)
P-19 Glass composition

P-19 WEST VALLEY

SIMULATED WASTE GLASS COMPOSITION, WT%

Oxide	As Slurry	As Dry	Total
SiO_2		66.34	66.34
MnO_2	0.07		0.07
MoO_2	0.04		0.04
Al_2O_3	0.05	5.80	5.85
Fe_2O_3	1.70		1.70
Cr_2O_3	0.14		0.14
R.E. Oxide	0.05		0.05
P_2O_5	0.48		0.48
Na_2O (K_2O)	14.90		14.90
Cs_2O	0.11		0.11
CaO		9.20	9.20
MgO		1.00	1.00
SrO	0.05		0.05
NiO	0.07		0.07
			100.00

Letter 16

Bill Hafner
54 Robinwood Street
Mastic, NY 11950
25 October 1981

U.S. Department of Energy
Washington, DC 20545

SUBJ: offered public comment on the Draft Environmental Impact Statement regarding DOE's proposed plan to solidify high-level radioactive waste at the now-closed West Valley, New York facility.

Gentlemen/Ms,

With regard to the above DEIS issued by your office on August 7, 1981 I have several comments regarding this plan:

Department of Energy proposes the use of Borosilicate Glass. It seems somewhat absurd to chose a final waste form (the vitrification process is irreversible) when no decision has yet been made regarding what type of repository is to be selected. While the DOE favors
16-1 salt, that type of repository is, unfortunately, incompatible with Borosilicate Glass.

While glass has favorable characteristics there is ample evidence to indicate that such material will rapidly crack and frugment when subjected to a brine solution. In addition, while Borosilicate Glass has a low leachibility factor under moderate temperature and pressure conditions, experiments have shown that under severe temperature and pressure conditions- as one would expect to find in granite, basalt, or salt repositories- small samples of Borosilicate Glass containing synthetic wastes have also devitrified in a matter of weeks.

It is recommended that DOE give further consideration to the use of Agglomerated Calcine. While this form may properly be considered an "interim" waste form, it has the definite advantage over Borosilicate Glass in so far as it can later be transformed into a final waste form compatible with the selected repository.

Furthermore, unlike vitrification which is still an experimental technology (although a long studied one), Calcination has been used for over 20 years. Arguments that Calcination is highly dispersible- which it is- can be eliminated by the use of a binding agent. The product can then be compacted and subsequently formed into round pellets for storage.

5453

PAGE TWO
Comment on West Valley DEIS
Hafner/CSNP

And finally, if in spite of the offered evidence against the use of glass the DOE feels that it is still the best form of waste, the department should make known their arguments as to why they feel so- there is currently no reason given by the DOE for their support of vitrification process.

16-2 Since the DOE favors Borosilicate Glass, there is an extremely good possibility of increased radiation releases due to the high process temperatures involved. There is believed to be somewhere in the vicinity of 11 million curies of radioactive Cesium contained in the liquid of the HLW tank. The Borosilicate process involves temperatures in the vicinity of 1050°C considerably beyond the volatizing temperature of Cesium (570°C) potentially releasing more of the isotope than the Calcination process temperature of 550°C. Considering the highly toxic nature of this fission product, the question of how much of this material will be released and not recovered must be answered.
16-3 The DOE provides no data on origin of estimates concerning potential releases of radioactivity "up-the-stack" and what subsequently happens to it. The radioactivity which does escape will eventually settle on the ground, be washed into Cattaragaus Creek (and wind up in the Buffalo water supply) or land on nearby dairy farms which supply milk to New York City and other areas.

DOE proposes to leave the "cleaned" tanks in the ground after the HLW liquid and sludge have been removed. Even after these tanks are 95% cleaned (a realistic figure considering the internal configuration of the tank) more than half a million curies of radioactivity will remain- mostly Strontium 90. With a half life of about 30 years (therefore toxic for 300 years) it would just be a matter of time before the tank and concrete corrode releasing the radioisotopes into the environment- long before safe radioisotopic levels have been achiev-
16-4 ed. The tanks must be removed.
16-5 There is clearly also a need for a full geologic investigation of the area around the HLW tanks in order to determine the impact the solidification process will have on geologic formations (sand lens, underground springs, etc) at the site. DOE does not discuss or analyze this concern but the speed at which radioisotopes can migrate off-site (as the result of leaks/accidents) is the key to public health and safety.

16-6 Apparantely the DOE has failed to consider the possibility of a major accident at the site while the radioactive sludge and liquid are being removed as well as during the solidification process.

The exact physical and chemical composition as well as the volume of the sludge is unknown. If it turns out to be compacted and cement-like the DOE had proposed that it be broken up with high-pressure sluices- a technique which has already been tried at Savannah River. However, the NFS tanks, weakened by the effects of cor sion, may not be able to withstand high-pressure if that method is selected. Murphy's Law is as applicable in this endeavor as it is anywhere else-- but with more potentially drastic consequences. Failure to consider and plan for these possibilities is nothing more than poor planning- a characteristic, hopefully, not common to the entire DOE plan.

16-7 And one final comment, it is strongly urged that the Department schedule at least one public hearing on this project- before the implementation- for the Buffalo area. As a former Buffalo resident I am well aware of the impact this project could have on this city as well as surrounding communities. They should be thoroughly briefed by DOE representatives and have whatever questions they may have answered. To implement such a first-time plan (which no one really knows will work-- and if it does how well) without public hearings is, in my opinion, nothing but irresponsible.

Thank you for your time and the opportunity to offer my comments,

Sincerely,

Bill Hafner

Letter 17

157 sharon Parkway
Lackawanna, N. Y. 14218
October 25, 1981

West Valley Program Office
Office of Waste Operations and Technology, NE-320
Nuclear Waste Management and Fuel Cycle Programs
U. S. Department of Energy
Washington, DC 20545

Dear Sirs:

17-1 Again and again, your literature stresses that you want input from the public and then so called "public meetings" are held only in rural sections of Western N.Y. Time after time, many citizens have pleaded for hearings in Buffalo and the DOE justed ignored them. Certain persons that watch the West Valley situation have said that the greatest impact of the project will be during the transportation phase of the project. If they are correct, the DOE has no excuse for not having more public at the "public hearings". After all, various persons from the DOE have said that the greatest impact would be in the West Valley area. Who's right? Who shall I believe? Let's discuss the EIS or what we who are concerned aboutWest Valley call the Environmentally Insane Statement.

I consider Alternatives #3 & 4 non-alternatives. There is concern that the aging tanks may have been breached already and that the environment is contaminated. These would have the most detrimental effect on the environment in the long run and would not solve anything.

Of the other alternatives being considered, Alternative #2, Onsite Processing to Interim Waste Form, seems to be the best plan for a number of reasons.

The fact that the waste will be in an interim form in itself is a plus since it will compatible with its final resting place. I'm told that vitrification may not be compatible with salt dome storage for instance.

The process ,itself,would be at a lower temperature than other alternatives And possibly less radiation would be released. As far as safety goes, calcination would be less of an experimental process. Let's go with safety first! Calcination of these type of materials has at least a brief history to fall back upon. Plus, with an interim form, the wastes should be acceptable for the national repository and therefore could be taken out of West Valley.

While we're talking about taking wastes out, let's consider the waste tanks. In any of the alternatives the tank is left behind. I find it unacceptable since effective cleaning of the tank inside is
17-2 impossible. Again, leaving the tank in the ground is unacceptable!

My biggest concern about the project is that safety issues have not been discussed thoroughly. Workers and the environment will be exposed, the question is how much exposure will occur if everything goes right and what if the unexpected happens, an accident, or whatever you might want to call it. Workers in the past have not even been monitored as far as their health goes. The legally allowable rates at which workers can be exposed has gone down in the past, who is to say that they might go down once again in the future?
17-3 This time around, let's keep records of workers'health before the project starts and after.

17-4 I don't think that the aspects concerning the estuaries of Cattaraugus Creek as far as contamination has been looked at in the past and will not be studied for this project. The DOE hasthe power to make West Valley the "Love Canal of the Nuclear Idustry". The world is watching, so let's be careful......

Thank you sincerely,

John S. Opalka

John S. Opalka

Letter 18

DEPARTMENT OF HEALTH & HUMAN SERVICES
FOOD AND DRUG ADMINISTRATION

Public Health Service

Food and Drug Administration
Rockville MD 20857

West Valley Program Office
Office of Waste Operations
and Technology, NE-320
U.S. Department of Energy
Washington, D.C. 20545

OCT 26 1981

Dear Sirs:

The Bureau of Radiological Health Staff have reviewed the Draft Environmental Impact Statement (DEIS) DOE/EIS-0082lD, for the Long Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley, July 1981.

1. Our review is limited to an evaluation of the health and safety aspects of the six alternatives as presented in the DEIS. However, because of the different technical requirements for processing the waste, and the expected results from future development programs, we cannot make judgments on the merits of specific alternatives.

2. It is evident from discussions throughout the DEIS that there are many uncertainties due to lack of data and, as a result, conservative assumptions were used in many cases to estimate the radiological impacts for routine operations and for accident scenarios. The radiological impacts for the six alternatives presented in Section 2 have adequately assessed the potential occupational exposure of workers and the population for both the short-term and long-term. We note that the time periods used for this assessment of 100 years and 100 to 10,000 years for the short-term and long term, respectively, are consistent with those currently being used by the U.S. Environmental Protection Agency and the U.S. Nuclear Regulatory Commission. Sufficient data is not available in the DEIS to independently estimate the occupational and population exposure and risks. If we assume that the radiological impacts as presented in Table 2.2, page 2-9, are best estimates, we note that the range of occupational risk and the population risk in the short-term for the six alternatives, and in the long-term for alternatives 1a, 1b, 2 and 3 are not significantly different. However, the range of long-term health effects for alternatives 4a and 4b are substantially higher compared to the other alternatives, as shown below:

Alternatives	Range of Health Effects		
	Occupational	Short-Term (100 Years)	Long-Term* (100-10,000 Years)
1a, 1b, 2, & 3:	0.9-1.8	0.004-0.34	0.007-4.2
4a & 4b:	0.008-0.7	0.05-0.37	12-96

*These estimates of long-term health effects (fatal cancers and genetic defects) are included in this table but it is recognized that such predictions are only best estimates and have large error probabilities.

Health effects are also discussed in Section 4.18 and provide estimates of risk to the maximally exposed individual (Table 4.19) and estimated cumulative health effects among the surrounding population at each storage/disposal site (Table 4.20). These data for the West Valley are in substantial agreement with those in Table 2.2. The cumulative health effects data included in Table 4.2 on regional burial ground, transportation and Federal repository do not show any significant differences in health risks among the possible alternatives. It is noted in perspective that the accumulated health effects are all orders of magnitude lower than the expected health effects from natural sources.

Any alternative selected in the future for management of the liquid high-level radioactive wastes that maintain the occupational and population health risks within these limits would be considered adequate protection of the public health and safety.

3. The past and present radiological monitoring programs have been conducted to the extent necessary to measure potential emissions both within and outside of the West Valley site as indicated by the discussion in Section 3.1.8 and
18-1 Appendix F. However, there is no presentation in Section 3.1.8 that scopes the plans for operational radiological monitoring at the West Valley site for the period of time that the high level liquid wastes are being processed. The role of environmental monitoring as a mitigative measure is presented in Section 4.5 which identifies the purpose of the program. It would be helpful if the future operational monitoring programs could be specifically related to past and present programs, as shown in Appendix F and to identify any areas where new or modified environmental pathway sampling may be required as a mitigative measure. It is recognized that the monitoring program would be dependent upon the alternative selected for implementation.

4. The environmental pathways identified in Section 4.1.3 and Figure 4.2 cover all possible emission pathways that could impact on the population within the environs of the West Valley site. The dose computational methodology, models and dose-effect conversion factors used in the estimation of radiation dose to individuals near the site and populations within 80 km have provided reasonable percentages of doses resulting from normal operations and accident scenarios. The data for the radiological doses and risks to the general population for the action alternatives 1a, 1b, 2 and 3, as shown in Tables 4.6 - 4.10 and 4.12 - 4.16 tend to confirm that the maximum individual dose risk and cumulative risk to the population are reasonable estimates. However, in view of uncertainties in the technology of the alternatives under consideration and the potential release scenarios, we cannot effectively assess the radiological impact at this time. Our assessment will await the selection of an alternative and completion of a detailed safety analysis based on actual design of the facility.

The emergency preparedness discussion in Section 4.3.10 provides an adequate assessment of measures that would need to be taken to mitigate the consequences of potential accidents at the facility. The planned coordination with the State and local agencies and with other Federal agencies with emergency planning and response capabilities has been addressed in the DEIS and provides assurance to the public that adequate emergency plans are being developed and will be tested. It appears that the emergency plans for the West Valley site should provide reduced environmental impact and risk to the public from potential accidents at the site.

In our review of this DEIS, we find that there are long standing issues germain to the problem of high-level waste disposal that remain unresolved and contribute to the difficulty of making an objective assessment of the alternatives. We recognize that DOE is cognizant of the problem areas, but believe it is essential that we point out, for emphasis, the areas of our concerns. These are as follows:

18-2 o Availability of Federal repository and regional burial grounds.

18-3 o Availability of finalized high-level waste disposal regulation from the U.S. Environmental Protection Agency (40 CFR 191).

o Availability of high-level waste regulation from the U.S. Nuclear Regulatory Commission (10 CFR 60).

18-4 o Transportation regulations.

18-5 o Waste form/package criteria (assumed borosilicate glass).

18-6 o Uncertainties in the technology for processing the high-level waste in a form suitable for long-term isolation.

18-7 o Research and scientific effort required before selection of an alternative.

18-8 o Decontamination and decommissioning technology for the West Valley facility.

Thank you for the opportunity to review and comment on this Draft Environmental Impact Statement.

Sincerely yours,

John C. Villforth
Director
Bureau of Radiological Health

Letter 19

566 Crescent Avenue
Buffalo, New York 14214
October 26, 1981

West Valley Program Office
Department of Energy
Washington, D.C. 20545

Dear DOE:

I have lived in or around Buffalo, New York all my life. I am gravely concerned about the overall situation at West Valley, specifically the issue of how to proceed with the "solidification" project involving 600,000 gallons of high level liquid waste sitting in underground tanks. Following are my comments on the DEIS.

I want first and foremost to say that the ~~people~~ of West Valley, Olean, Salamanca, Western New York, should be considered before anything else. It is always the people who have to bear the costs physically, spiritually, emotionally of a profit-seeking industry. The communities of Western New York and their citizens are as important as the technology in this project. A local citizens' advisory committee with representatives from a cross section of the ~~community~~ should be formed, meeting with the DOE and the contractor and becoming a liaison between technical personnel and

19-1 citizens. Citizens should be given the facts, the truth, at every step of the project. They should participate in major decisions, and have access to information immediately. The DOE must encourage and help to develop viable evacuation projects, none of which currently exist.

19-2 DOE bases its estimates for exposure to personnel working on the solidification project on experience at the Hanford waste storage facility in Washington. How can this be considered an adequate base? The data from Hanford is incomplete due to the governmental claim that information released about radioactivity emissions could jeopardize the national security. More information – detailed honest information – must be provided and available to workers prior to their making a commitment to work on this project.

There is a need for constant monitoring by the state and federal governments and by the contractors, and information should be disseminated immediately. A concern of mine is who is to be the people's watchdog? Can we trust the DOE to be its own police? Can we trust the state? Please, DOE, be honest and straight forward.

19-3 The DOE fails to consider the possibility of a major accident at the facility while the radioactive sludge and liquid is being removed and during the solidification process. Utmost caution must be taken, and in fact is required. (Remember the Whale!) No risks should be taken regardless of any time schedule which might not be met in a slowing down. The purpose of this project should not be to prove "something!"

The DEIS does not address the possibility and risks of ~~fissi~~ It disregards the risks and consequences of a criticality accident, assuming a worst case accident would be an air-

19-4 plane crash into 8D2. Please include a study of probability of criticality and its consequences. (All alternatives are subject to risks of criticality.) In addition, designers and operators must know about criticality safety and safety rules. This is imperative!

19-5 The DEIS fails to address the impact on the solidification process of sand lenses, underground springs, swamps, and gravel aquifers at the site, or the hazards associated with leakage from the solidification process or an accident. Contrary to what the DOE asserts, it appears that in fact the soil on site is NOT impermeable. A full geologic investigation of the area around the high level waste tanks is absolutely essential. How rapidly radioactivity can migrate off-site in the event of a leak or accident is central to public health and safety.

19-6 The DEIS does not provide sufficient data regarding expected radiation releases from the project and what subsequently will happen to radioactivity released. Radioactivity will be released to the air at several points during

19-7 the solidification process. High temperature will volatilize cesium and other elements. How effective will the filters and off-gas treatment facilities be in trapping and containing this material? Since there is currently insufficient data regarding the technological capability of capturing these gaseous effluents, and since there are 11 million curies of highly volatile cesium in the high level liquid, the amount that will be released must be answered!

19-8 The DEIS does not take into account the fact that radioactivity will be settling on the ground, on pasture land, and watershed areas, and will then be subject to washing into Cattaraugus Creek and the Buffalo water supply. There must be substantial evidence for the estimates of releases of radioactivity and resultant health impacts before the project is begun.

19-9 I am opposed to the use of borosilicate glass. There will be increased radiation releases resulting from the high temperature process. The heat used for glassification is in excess of the temperature at which cesium volatilizes. It is not known how effective off-gas removal of cesium will be, and, to repeat, significant quantities of cesium could escape, make their way into nearby streams, and eventually migrate long distances. Cesium will be

19-10 hazardous for 300 years!! Glass is incompatible with geologic mediums like salt, which is currently the one favored by the DOE for a final repository. Glass is a permanent form. A final waste form should not be chosen before the repository medium has been chosen. Glassification is an experimental technique and has never been used with the kinds of waste that exists at West Valley.

For all these reasons I am in favor of the use of a calcine. It is an interim form that can be converted, once a geologic medium is selected, into a form which will be compatible with that medium. Calcination has been used for two decades at the Idaho reprocessing facility on fuel from experimental and submarine reactors. It involves lower occupational exposures, lower radiation releases to the environment, a lower volume of waste, and a lower process temperature. The ash produced by the calcination process, if mixed with a binding material and compacted, could then be formed into pellets and transported to a repository without dispersing and leaching.

I feel that the high level waste tanks should not be left in the ground after the radioactive sludge and liquid have been removed. Many thousands of curies of high level radioactive materials, particularly strontium 90, will remain. Strontium will be hazardous for 300 years and will leach into surrounding soil, while the tanks will degrade in 30-60 years. Sand lenses in the area of the tanks have the potential of carrying this poison off site and into nearby streams.

19-11 The tanks must be exhumed!

The final responsibility for the clean up and costs should fall on those who reaped the profits — the nuclear industry. Nuclear Fuel Services and Getty Oil, the corporate polluters, should pick up their portion of the bill. New York State nuclear reactors generated less than 5% of the fuel reprocessed at the facility, and therefore, citizens in other states whose reactors sent fuel to the plant should be asked to pay their share as well. In no way, however, should the price tag of this project interfere with safety standards and the health of the people in the surrounding area.

Perhaps of greatest concern to me is the notion that this "demonstration" project might be used to "prove" that nuclear waste is not a problem. In no way should this project now or ever be used as a public relations project, or as a propaganda device for the military and commercial industries. Nuclear waste IS a problem. The end result of this project will demonstrate that — we still won't know what to do with radioactive waste. No safe disposal methods exist now or in the foreseeable future. It is my deep concern that one great motive underlying this project is to put to rest fears concerning spent fuel waste, to demonstrate a technology that has "solved" all our radioactive waste problems, to prove that nuclear power is feasible, safe, and pleasant. I fear that this project could serve as a boost to the military program and the technology used for weapons. It is absurd to add to the already abundant waste stockpiles. I believe a total nuclear moratorium should be called: no additional construction or operating permits should be granted to nuclear reactors, and the further production of nuclear weapons should be halted immediately.

I hope that you will consider my comments carefully. I appreciate having the opportunity to share my feelings with you.

Sincerely,
K. Joanne Mustard

Letter 20

J. Sam Miller, MSEE
506 Crescent Avenue
Buffalo, New York 14214

October 26, 1981

Mr. James A. Turi
West Valley Program Office
Office of Waste Operations and Technology, NE-320
Nuclear Management and Fuel Cycle Programs
U. S. Department of Energy
Washington, D. C. 20545

Dear Mr. Turi:

Attached to this letter are my "written comments" on the Draft Environmental Impact Statement, (DOE/EIS-0081D), "Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley", July 1981. These written comments are essentially the same as my testimony at the Public Hearing on the DEIS on September 26, 1981 at West Valley, New York.

Please give careful consideration to these matters regarding possible criticality accidents and their environmental consequences in the final EIS. Thank you.

Cordially yours,

J. Sam Miller, MSEE

cc: Honorable Jack Kemp - U. S. House of Representatives

Attachments

WS2P1
September 26, 1981

Written Comments on the Draft Environmental Impact Statement, (DOE /EIS-0081D), "Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley" July 1981.

by J. Sam Miller, MSEE
(Director, Biomedical Engineering Department - Millard Fillmore Hospital, Buffalo, New York)

As an electrical engineer with some formal training in radiation safety and nuclear power plant design operation and maintenance, I would like to express some of my thoughts regarding the safety of the various alternatives presented in the EIS, and ask that the final EIS address these safety points.

20-1 A.) In general, all of the alternatives are subject to the risk of a criticality accident, and neither the risks nor consequences of a criticality accident were addressed in the DEIS.

20-2 B.) Glassification has higher risks than the others, because of the higher temperatures involved, more process steps involved, and problems of final disposal in that form. (It is acceptable for monitored interim storage, but so is the less costly and risky calcination alternative). Glass as a long-term storage medium has not been demonstrated, and it appears to me that the combined problems of decay heat, water ingress, molecular changes due to radiation and stress fracturing need much more research demonstration to answer the uncertainties involved.

20-3 C.) The "do nothing" alternative is also very risky, because of very large total radioactive inventory in tank 8D2, in terms of the form of the tank, and risks of leakage, rupture or a criticality accident. The 1978 inventory shows approximately 2500 Kg of Uranium (the critical mass for a sphere in water is less than 1 Kg), and 29 Kg of Plutonium-239 (critical mass of about 1/2 Kg) for example.

There are other actinides to consider as well. (I would also like
20-4 to note a discrepancy in the listed inventories from the DEIS, total Actinides as 10,000 Ci, compared to the previous report TID-28950-2, which lists 67,000 Ci. When criticality is a possibility, we can't be that loose with our estimates)!

D.) The Calcination Alternative appears best from the standpoint of risk, but if this process leads to costly design or
20-5 implimentation problems, I would suggest another alternative not yet considered, that of storage of the liquid contents of the tank in above ground small containers. Say a thousand or ten thousand small tanks. This would reduce the risk of criticality by assuring that the contents stay rather uniformly distributed, and make the problems of individual leaks or ruptures very easy to handle. The above ground storage building should be of the same double-walled design as reactor containment buildings. (Consideration should be given to double-walled containment buildings for all the alternative operations).

E.) With respect to <u>criticality</u> accidents that could happen for any of the alternatives, I would urge that all personnel on this project read a AEC Report (TID-26286) 1974 "Nuclear Criticality Safety", because it details the principals of criticality, lists the critical mass numbers for the isotopes in question, and even has some discussion about micro-critical mass effects down to quantities as small as 1/2 gram. It also details what happened in nine different criticality accidents, all at facilities similar to what will be seen at West Valley for this project.

Why is tank 8D2 a special criticality risk? Because the RA contents are of sufficient quantity to reach a critical mass if they are not uniformly distributed, we know that chemical and physical processes are at work now such that heavier elements can be concentrated, there is stratification and a very questionable sludge
20-6 forming, and the temperature history indicates that something other than simple decay fission heat processes are at work. If only decay-heat were occuring, then the temperature of the tank should be

dropping at 4° F per year from its present 195° F. Instead, it has been constant or increasing slightly over the last 5-7 years. As in a reactor, the localized reactivity could be increasing. (In a discussion with an engineer from Hanford on 9/26/81 at the Public Hearings, he indicated that they probably were controlling the temperature by the rate of removal of condensate from the tank. I was not aware of any operations of this type, and they also should be examined for possible criticality risks). Another factor is the whirlpool effects that may be occuring in the liquid supernate in the tank - with its dense stratified lower levels. Whirlpools can form in the center or around obstructions as the fluid moves, and some movement occurs as a result of the rotational force effects as the earth rotates on its axis. Any attempts to remove or mix the contents can also produce eddys unless precautions are taken. There is also some risk of the form-factor of the sludge and stratified layers to increase in reactivity if the tank would tilt a few degrees due to an earthquake or ground motion. The area is known for its many swamps and springs (<u>Springv</u>ille is just 3 miles away) that come and go over the years. In other words,
20-7 we must be very careful with tank 8D2. Perhaps a containment structure should be constructed over these tanks before anything else is done at all.

In conclusion, I would urge that all project members be very aware of the risk of criticality accidents during all phases of this project.

Letter 21

THE UNIVERSITY OF ROCHESTER

MEDICAL CENTER

SCHOOL OF MEDICINE AND DENTISTRY · SCHOOL OF NURSING
STRONG MEMORIAL HOSPITAL

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DIRECTOR
H. DAVID MAILLIE, PH.D.

HEALTH PHYSICIST
[illegible] D. GREGORY, M.S.

October 27, 1981

Mr. James Turi
West Valley Program Office
Office of Waste Operations and Technology
NE-320
Nuclear Waste Management and Fuel Cycle Operations
U. S. Department of Energy
Washington, D.C. 20545

Dear Mr. Turi:

Enclosed please find a comment which we feel is of importance with regard to the treatment of the high-level liquid radioactive waste at West Valley. As you will see, we feel that the safest method of handling the wastes may be to merely dry them down in place. This will also be the cheapest technique.

We are three members of the Senior Technical Consulting Board to Argonne National Laboratory in its preparation of the DEIS. We are, however, speaking at this time as individuals and as citizens of New York State not as Board members.

We would be will to meet with you or your designee to discuss this matter.

Please note that in addition to Drs. Taves and Maillie, that Dr. Robert Sweeney also agrees with this statement.

Very truly yours,

H. David Maillie

H. David Maillie, Ph.D.
Associate Professor
Radiation Biology & Biophysics
and
Director, Health Physics Unit

HDM:kf
encl.
cc-Dr. James Edwards,
Secretary of Energy

THE FUTURE OF THE HIGH-LEVEL LIQUID WASTES AT THE WESTERN NEW YORK NUCLEAR SERVICE CENTER, WEST VALLEY, NEW YORK

It is the opinion of the undersigned that no decisions should be made about the high-level liquid wastes at West Valley until further studies have been completed. The available information suggests it may be in the interest of public health, and in the interest of saving tax dollars to reverse the Congressional decision to move the wastes from West Valley. The Draft Environment Impact Statement (DEIS) of July 1981 in general does a reasonable job of comparing alternatives involving moving or not moving the wastes, but the differences in risk are slight and do not provide adequate besis for making a decision. Furthermore, we think there is a better non-removal alternative (safer and less expensive) than either of the two non-removal alternative techniques (solidify in concrete and "no action") under consideration.

Each of the alternatives is examined from the viewpoint of health effects and cost. A health effect is defined as the number of fatalities due to radiation-induced cancer plus radiation-induced genetic defects in the first two generations following exposure of either parent.

Based upon the conclusions of the DEIS, there is little benefit to any alternative when compared to the no action alternatives. Consider Table S.1 taken from the DEIS and appended here. There is no appreciable difference in the six alternatives mentioned in the health effects among workers or the general public withing the first 100 years. The only significant increases occur over the long term (100 to 10,000 years), and even in the worst case the number of fatalities does not exceed those associated with "normal" human activities. The worst case, for example, is the no-action alternative (continued storage in tanks) where there may be up to 96 health effects over the 10,000 year period. There is however, a substantial difference in cost - $60 million dollars for the no-action alternative compared to $700 million for Alternative 2 (Interim form, fused salt).

Alternative 2 might result in a total of 2.2 health effects over a 10,000-year period. This represents the effects on both workers and the population. Alternative 4b (no-action) might result in 94.87 health effects to the same group over the same time period. The difference between these two extremes represents an investment of $6.75 million dollars to avoid a single health effect. This price tag is more than we have been willing to shoulder in other public health measures.

21-1 In addition, there is reason to believe that the estimates of the health effects for the no-action alternative (4b) are inflated and unrealistic. In this alternative, it is assumed that the wastes remain in liquid form which are transferred to new tanks over the 100-year period. After 100 years, the tank is assumed to be unattended. Nearly all of the health effects are assumed to occur within the 100 to 10,000-year period, and are based on intrusion into the tank by some unsuspecting individual or group. This is unrealistic in that reasonably inexpensive methods may be used to prevent such entry into the tank. For example, a concrete cap with suitable warning signs would suffice to substantially reduce this possibility. These protective measures were not considered in the DEIS.

On the other hand, the number of health effects for the solidification techniques may be underestimated. They are based upon methods where the highly radioactive sludge must be pumped from the tank and run through a remotely operated

2

21-1 glass-forming or calcining procedure. This has not been done under the conditions which will prevail at West Valley, and the possibility of an accident with its health effects may not be realistically appraised.

As implied above, the sanest and safest approach may be to leave the wastes in the tank (but, not necessarily as a liquid.) However, there are legitimate questions concerning the geology and hydrology of the area, particularly in the vicinity of the high-level liquid waste tank and between the tank and the nearest source of public water. A thorough study of all of the parameters involving such things as earthquake probabilities and effects, tank leakage, unexpected increases in ground water flow, etc. should be performed. This must be done for any of the alternatives, and it can be done at a fraction of the projected cost of any alternative.

21-2 All reasonable alternatives have not been considered. The simplest, and probably safest method of handling the wastes would be to allow the heat generated by the radioactivity to evaporate the liquids and precipitate the solids. The evaporated liquid would be treated to remove radioactivity. The solid remaining in the bottom of the tank could be left as is for easy recovery of precious metals in the future, or it could be capped with concrete. Of course, this method would be deemed applicable only if the geological and hydrological properties of the site were suitable. This technique has the advantage that the fluid would not have to be moved from the tank, and would avoid those problems associated with sludge movement and remote solidification methods. It would also be much less expensive.

It is recognized that the current national policy on the treatment if high-level liquid wastes is to solidify these wastes in a form which could be amenable to burial in a deep geological formation. It is not the purpose of this statement to negate that policy at the national level. It is felt that the West Valley situation calls for safer, cheaper techniques. Obviously, tank farms containing millions of gallons of high-level liquid waste such as those at Hanford or Savannah River or the wastes to be generated in the future need to be considered on their own cost vs risk evaluations.

While a law has been passed by Congress which calls for the removal of the wastes in some solid form suitable for disposal or conversion to a form suitable for disposal at a federal repository, nothing would be lost and a great deal might be gained by reconsideration. We feel this decision was made without considering all reasonable alternatives, and that moving the wastes from the tank may be more hazardous than techniques which leave the waste in place, particularly as a dried-down solid.

Signed: Donald R. Tevis

Signed: H. David Maillie

October 27, 1981

Table S.1. Quantifiable Environmental Impacts and Costs Associated with the Alternatives

Alternative	Radiological[a] - Occupational: Dose (person-rem)	Radiological[a] - Occupational: Health Effects[d]	Radiological[a] - Population[b], Short-Term (100 years): Dose Risk (person-rem)	Short-Term: Health Effects[d]	Long-Term[c] (100 to 10,000 years): Dose Risk (person-rem)	Long-Term: Health Effects[d]	Nonradiological: Injuries	Nonradiological: Deaths	Cost (million dollars)
1a Terminal form, separated salt/sludge	1,000	0.2 - 1.4	340	0.03 - 0.27	310	0.02 - 0.17	33	0.8	300
1b Terminal form, nonseparated salt/sludge	2,100	0.2 - 1.7	390	0.04 - 0.31	70	0.007 - 0.06	56	1.0	800
2 Interim form, fused salt	2,200	0.2 - 1.8	420	0.04 - 0.34	70	0.007 - 0.06	61	1.1	700
3 In-tank solidification	1,100	0.1 - 0.9	33	0.004 - 0.03	5,000	0.53 - 4.2	23	0.37	300
4a No action, delay for 10 years[e]	80+	0.0008+ - 0.06+	120+	0.01+ - 0.10	NA[f]	NA	NA	NA	10
4b No action, continued storage in tanks	800	0.08 - 0.7	460	0.05 - 0.37	120,000	12 - 96	60	0.42	60

[a] Radiological impacts include both normal events and accidents. To obtain the risk, the consequences of each event is multiplied by the probability of the event. Total risk equals the sum of all risks.

[b] To put population risks in perspective, background radiation doses to the population within 80 km of West Valley (or the regional burial ground) over the respective time periods would be: 15 million person-rem in 100 years and 1.5 billion person-rem in 10,000 years. To put population health effects in perspective, the normal incidence of fatal cancers in that population (based on cancer deaths as 20% of all deaths) would be: 300,000 deaths in 100 years and 30 million deaths in 10,000 years.

[c] For the long-term radiological impacts, it was assumed that there would be no institutional controls, i.e., that the facilities and wastes would be abandoned. There would be no monitoring, maintenance, mitigating measures, or prevention of human intrusion.

[d] Health effects are defined as both fatal cancers and genetic defects (see Section 4.1) and are based on 100-800 health effects per million person-rem.

[e] For alternative 4a, only the impacts for the 10 years of continued storage are given. The impacts from no action alternative would have to be added on.

[f] NA = not applicable. The long-term radiological impact would be appropriate to the alternative chosen after the 10-year delay.

Letter 22

AMPS
Americans for More Power Sources, Inc.
P.O. Box 501
Manchester, New Hampshire 03105

October 27, 1981

West Valley Program Office
Office of Waste Operations and
Technology, NE-320
Nuclear and Waste Management and
Fuel Cycle Programs
U. S. Department of Energy
Washington, D.C. 20545

Subject: Written Supplementary Comment on DOE/EIS-0081D

Dear Sirs:

Attached are supplementary written comments in connection with DOE/EIS-0081D.

Further comment on risks estimated by Sternglass could be provided as well as could be corresponding comment on estimates by Bross and by Goffman. These have been omitted in order to accommodate the October 30 deadline.

Yours truly,

Lucius Gilman
Science Committee

LG:jsl

Attachments

SUPPLEMENTAL WRITTEN COMMENT

on

DOE/EIS-0081D, Draft Environmental Impact Statement

Long-Term Management of Liquid High-Level Wastes

Stored at the Western New York Nuclear Service Center

West Valley

Lucius Gilman
Francestown, NH 03043

October 26, 1981

TABLE OF CONTENTS

Lucius Gilman
Francestown, NH 03043

October 26, 1981

SUPPLEMENTAL WRITTEN COMMENT

DOE/EIS-0081D, Draft Environmental Impact Statement, Long-Term Management of Liquid High-Level Wastes Stored at the Western New York Nuclear Service Center, West Valley

Part 1

My written statement dated September 24, 1981 and my oral statement on October 3 dealt with the interpretations of the numbers given in this Draft EIS as estimates of health effects. The gist of those statements is that, through-
22-1 out, the wording of the Draft EIS conveys the false impression of predicting consequences rather than conveying the correct understanding that

> these estimates are upper limits
>
> that the estimated exposure may actually be incapable of producing consequences as great as these upper limits, and
>
> that, in fact, the estimated exposures may be incapable of producing any adverse health effects whatsoever.

Part 1 of my present statement should be read as a continuation of my statement dated September 24.

Realistic Expectations as contrasted with Estimated Maxima

Table 4.20 in the Draft EIS summarizes estimated maximum risks to the general public, and those numbers are so small that additional explanation might seem unnecessary. However, Tables 4.6 through 4.10 list potential individual doses and estimated population doses for the population associated with the West Valley site. By far the largest of these doses would be consequent to single incidents rather than being distributed over many years.

Accordingly, members of the public who might be exposed will want to know, "If one of these most serious incidents does occur, how would that affect me?"

Fortunately, the most serious incident of all--an airplane crash on one particular, very small area--is so improbable that most citizens would be willing to acknowledge that that accident does not constitute a credible threat. (ref. 5a) Furthermore, at the afternoon session on Methods used in Calculating, an analysis was presented to the effect that the estimated probability of 1×10^{-8}/year is much too high and that the probability of the hypothetical aircraft crash is very much less than the admittedly remote chance of 1×10^{-8}/year as given in the Draft EIS. (ref. 5b)

On the other hand, releases resulting from earthquakes, tornadoes, or sabotage will seem credible, and so maximum individual doses of up to 3 rem should be explained to the public. In addition, sabotage is estimated to be capable of producing maximum population doses of up to 1 million man-rem, averaging 0.67 rem/person and producing maximum individual doses of up to 2 rem.

In this Draft EIS, health consequences have been based on maximum estimates derived from the BEIR III Report. (ref. 1) Since the Department of Energy has chosen to use the linear dose-response model (ref. 1), my "Calculated Values for DOE/EIS-0081D" for exposures of 0.67, 2, and 3 rem were made correspondingly, based on the maximum estimate of the absolute-risk projection, page 193, Table V-2 in the BEIR III Report. (ref. 2) In addition, the Draft EIS uses 20% as the approximate U.S. death rate from cancer in the absence of radiation other than natural and medical. (ref. 3)

average fatalities from cancer in U.S. population	total risk 20.0% (ref. 3)
additional 10 rem per person	
maximum estimated increase percentage points +1.02	maximum total risk 21.0% (ref. 2)

Calculated Values for DOE/EIS-0081

additional dose per person	maximum estimated increase in percentage points	maximum estimated risks
0 rem	0.0	20.0%
0.67 rem	+ 0.068	20.07%
2 rem	+ 0.204	20.2%
3 rem	+ 0.306	20.3%

Accordingly,

cause of added exposure	maximum individual exposure		total risk of fatal cancer
earthquake or tornado	3 rem	maximum of	20.3%
sabotage	2 rem	maximum of	20.2%
sabotage	total population dose, 1,000,000 rem		
	average individual dose, 0.67 rem	maximum of	20.07%
none	natural exposure plus individual medical exposure	maximum of	20.0%

It should be made clear to the public that these are maximum estimates, but that the actual consequences of these exposures may have to be zero, because doses of these magnitudes may be entirely incapable of initiating any cancer whatsoever. The data available thus far do not enable us to know. However, the data available to date do enable us to say (1) that the consequences would not exceed these percentage increases, (2) that the actual increases most probably would be less than these percentages, and (3) that the increases might have to be zero because ionizing radiation in these quantities may not be carcinogenic at all. (ref.4)

Part 2

Part 2 of these Comments dated October 26, 1981 consists of my responses to various oral Comments made by other individuals on October 3 at the afternoon session of the Panel on Methods Used in Calculating Impacts in the DEIS. Part 2 is my response in support or in opposition to Comments by others at that session.

Table of Contents for Part 2

Topic

2A Alternative Estimates of the Risks from Low Level Radiation

Although the estimates stated in the BEIR III Report are those that are the most widely accepted, other estimates are advocated by a more limited number of radiologists. Specifically, Mancuso, Sternglass, Bross, and Gofman estimate the incidence of cancer from low level radiation at about 10 times the rate of the most conservative estimates derived from the BEIR III Report.

It was urged (Sr. Rosalie Bertel) that the the EIS include these higher estimates in order to show the full range of values that are in dispute in the literature. Mancuso's estimates were mentioned specifically.

2A-1 Estimates by Mancuso et al

During 1976-78, Mancuso et al had claimed that Hanford workers exposed to radiation had experienced 26% to 107% more deaths from cancer than had the unexposed Hanford workers. (ref. 15) Others have stated that this is not so. (refs. 16 through 28)

Deaths Among Hanford Workers (ref. 16)

	Group with High Exposure	Group with Low Exposure
total individuals in Group	1844	1975
% with total doses greater than 5.3 rems	67.9%	15:7%
total deaths in Group	185	316
% of total Group	10.0%	16.0%
Deaths compared with National Averages		
total deaths from all causes	0.65	0.76
deaths from cancer	0.92	0.92

It is seen that the Group with High Exposure experienced fewer deaths--from all causes--than did the Group with Low Exposure.

Futhermore, there is a comparison between these Groups which is even more favorable to the High Exposure Group and, at the same time, is more valid, because this more favorable comparison allows for the fact that the High Exposure Group is older and, hence, would have been expected to suffer a greater percentage of deaths.

The lower part of the table compares both total deaths and deaths from cancer with the national average corresponding to each Group. Each group had survived better than its corresponding national average, the Low Exposure Group having experienced only 76% as many deaths as its corresponding national average, and the High Exposure Group having experienced only 65% as many deaths as its corresponding national average.

But the most significant point of all is that each Group suffered exactly 92% of the deaths from cancer which would have been expected for that Group. Thus, it is clear that cancer was no more significant as a cause of death in the High Exposure Group than it was in the Low Exposure Group.

Mancuso stated also that cancer accounted for about 24% of the total deaths in the High Exposure Group but only about 20% in the Low Exposure Group. This is true, but only because total deaths in the High Exposure Group were markedly fewer than in the Low Exposure Group; the same occurrence of cancer deaths--92% of expected in each Group--make the cancer deaths in the High Exposure Group a greater percentage of the smaller number of deaths from all causes.

Mancuso stated his conclusions again in 1977 and in 1978 (ref. 15), but many knowledgeable scientists have refuted the Mancuso analyses, these refutations beginning in 1976 and continuing at least into 1980.

As a matter of fact, a considerable number of scientists--each clearly qualified in his particular field and each professionally competent in a relevant field to judge the Mancuso analyses and conclusions--have rejected the Mancuso claims. These scientists include:

Dr. Sidney Marks, M.D., Ph.D. Batelle Pacific Northwest Laboratories Richland, Washington	ref. 16
Ethel S. Gilbert Statistician Batelle Pacific Northwest Laboratories Richland, Washington	refs. 16 and 17
Dr. Allen Brodsky Senior Health Physicist U.S. Nuclear Regulatory Comm.	refs. 19 through 22
B. S. Sanders Professor of Statistics	refs. 19 and 23
B. L. Cohen Professor of Physics and Chemical Engineering University of Pittsburgh	ref. 24
Dr. J. L. Liverman Assistant Secretary for Environment U.S. Department of Energy	ref. 25

S. Milham, Jr. M.D.
Washington State Dept. of
Social and Health Services — ref. 26

J. A. Reissland
National Radiological
Protection Board (British)
Harwell, England — ref. 18

F. W. Speiers
Bone Dosimetry Research
Department of Medical Physics
Cookridge Hospital, Leeds, Eng. — ref. 28

Most recently, the twenty-five member committee of the National Academy of Sciences--the "BEIR III Committee"--studied but rejected the Mancuso claims. (ref. 27)

Note: Please remove these two paragraphs from this page and enter them as final paragraphs on page 13.

> Further comment on estimates by Sternglass could be provided as could also corresponding comment on estimates by Bross and by Gofman. All of these have been omitted in order to accommodate the October 30 deadline.
>
> Summarizing, it would be a mistake to include the estimates advanced by Mancuso, Sternglass, Bross or Gofman, because these estimates are generally regarded as seriously flawed, and they have not enlisted acceptance by any significantly large percentage of the knowledgeable professional community.

2A-2 Estimates by Sternglass

For about twenty years, Professor Ernest Sternglass has performed retrospective epidemiological analyses of data for a variety of locations and for a number of time intervals. He has claimed to discover that low level radiation is about 10 times more carcinogenic than would be estimated from the BEIR III Report and that clouds of radioactive material can travel hundreds or even thousands of miles in the atmosphere and still produce serious though localized increases in cancer and in infact deaths.

However, in each instance, it has turned out that Sternglass' "proofs" were sham, because he had selected a small amount of the available data to "prove" his point, whereas the total data--taken all together--actually has proved the opposite.

Shippingport, Pennsylvania

Early in 1973, Sternglass claimed that radioactive material released by the Shippingport (Pennsylvania) Nuclear Power Plant had caused a sharp increase "in leukemia, cancer, and infant mortality in the area surrounding the plant".

> "These releases are some 130 to 300 times greater than the maximum permitted by state health regulations, thus explaining the recent sharp rises in leukemia, cancer, and infant mortality in the area surrounding the plant." (Sternglass, ref. 29)

Five different, professional panels (a Committee appointed by the Governor of Pennsylvania, one EPA panel, and three AEC panels) examined these claims and the data which Sternglass cited. All five rejected Sternglass' allegations.

> "The leukemia death rate for the 5-mile area was not significantly different from the State average, nor was there any systematic pattern by distance from Shippingport." "The leukemia death rate in Aliquippa was not significantly different from the State average in any single year during the entire 1961-1971 period.
>
> "Our analyses have failed to find any substantial evidence that the overall cancer death rate for the area within five miles of Shippingport or for the 'on-river' communities was higher than would be expected." (Governor's Committee, ref. 31)
>
> "Dr. Sternglass' charges that the Shippingport Station contaminated the environment, and has resulted in increases in the frequency of leukemia and cancer cases and infant deaths are not substantiated by Staff findings."
>
> "The Atomic Energy Staff finds that his (Sternglass') evaluation is technically incorrect and is an obvious distortion." (Staff of the AEC, ref. 30)
>
> "There is no systematic evidence to support the allegation that radioactive releases from the Shippingport plant have had significant effects on the health of the population in the vicinity of the plant." (Governor's Committee, ref. 32)

Having available a great many items of data, Sternglass had used very few and had selected only those that seemed to support his claims, ignoring the fact that the complete body of information--taken as a whole--did not support his conclusions at all.

For example, he compared radioactivity in the headwaters of tributaries with the radioactivity of the Ohio River down stream from the Shippingport Plant. (ref. 30)

> anomalously
>
> Also, "Dr. Sternglass selected time periods which included the only two anomously-high downstream samples out of 33 samples collected over a six-year period. On the other hand, individual, anomalously-high upstream samples were ignored.
>
> "For example, if one makes a similar analysis of upstream vs. downstream concentrations for the January Sewickley data, one derives the absurdity that the Shippingport Plant somehow removed about 200 Curies from the river during that period." (ref. 33)

The analyses advanced in connections with Dr. Sternglass' allegations were rejected, because they failed to meet the requirements of ordinary logic.

> "Dr. Sternglass' failure even to estimate radiation doses to the tissues in some of the populations for which he is alleging health effects is

a major abrogation of his scientific responsibility. He is unusually qualified to make such calculations, which should be central to his whole thesis. Moreover, his evaluation of time trends of cancer or heart disease rates in relation to possible radiation exposures is inconsistent with the time course of radiation effects derived from studies of a great many other investigators. For these reasons the basis of his evidence of effects on cancer and heart disease rates from radiation exposure must be considered to be spurious."
(Governor's Committee, ref. 34)

Connecticut - In October 1977, Professor Sternglass issued a report stating that the Millstone nuclear power reactors at Waterford, Connecticut had been releasing large amounts of radioactive strontium-90 and that this had caused a sharp increase in cancer in nearby communities, the increase being greatest near the plant and progressively less at greater and greater distances from Waterford, but demonstrable out to about 50 miles. (Sternglass, ref. 35)

Sternglass had had vast quantities of data available to him, such as numerous Annual Reports of the Radiological Environmental Monitoring Program, Weekly Reports of 9 different measures of radioactivity at from 5 to 11 different locations, Monthly Reports of the Radioactivity in Soil, Grazing Grass, and Well Water at several locations each, as well as the EPA Monthly Reports on Milk Sampling throughout New England and the Vital Statistics Records for the entire region.

Out of this, Sternglass had selected limited data which, by itself, seemed to support his claim that cancer was a greater hazard near Waterford and progressively less so at increasing distances.

However, Northeast Utilities then demonstrated that these conclusions depended upon a very selective choice of data and that a different selection of data could be made to show an exactly opposite effect--that the operation of the Millstone reactor had reduced cancer in the vicinity of Waterford. Expressly, Northeast Utilities took a different set of communities and slightly different years for comparison and found a "correlation" which seemed to show that cancer had declined about 40% in Waterford and nearby towns and had increased progressively with distance, showing, for example, +12% in New Hampshire, 120 miles away. (ref. 36)

Of course, neither Northeast Utilities nor anybody else believes these "correlations", because all of the data--taken all together--show trends which are nationwide and are no different in the vicinity of Waterford than elsewhere in Connecticut.

And, in any case, the radioactive strontium which Sternglass tabulated had not come from the Millstone reactors nor from any others; the radioactive strontium present in Connecticut soil, water, and milk had come from the atmosphere, having been put there by past weapons testing in the atmosphere. This is clearly provable by physical tests.

Here's how. Both nuclear explosions and nuclear power reactors produce readily measurable amounts of radioactive strontium and iodine. Of particular significance is the presence of strontium-89, iodine-131, and cesium-134.

	half-life
strontium-90	28 years
strontium-89	52 days
iodine-129	17 million years
iodine-131	8 days
cesium-137	30 years
cesium-134	2 years

Strontium-89 and iodine-131 from a nuclear explosion will disappear rapidly because of their relatively short half-lives, while strontium-90 and iodine-129 will persist.

Cesium-134 is not produced in a nuclear explosion but is produced in a reactor. If the cesium in Connecticut had come from a reactor, cesium-134 as well as cesium-137 would still be present, because its 2-year half-life would have prevented its disappearance.

Strontium-89, iodine-131, and cesium-134 were absent in the Connecticut biosphere, but strontium-90, iodine-139, and cesium-137 were present.

Thus, the radioactive strontium which Sternglass attributed to power reactors had to have originated from weapons testing. This fact was made abundantly clear when strontium-89 and iodine-131 reappeared in Connecticut about October 5, 1977, following a Chinese weapons test on September 26.

Summarizing, the radioactive strontium in Connecitcut was not seriously high, it had been deposited from the atmosphere as a result of Chinese and French weapons tests, and there was no abnormal increase in cancer.

Atmospheric Fallout: Travel Distance and Consequences - More recently, Professor Sternglass has contended that his epidemiological investigations show that radioactive fallout is much more serious than is now generally supposed in causing increased infant deaths. Specifically, he attributes significant increases in infant deaths along the American eastern seaboard to fallout from nuclear explosions in Asia.

Everyone recognizes that readily-measurable increases in radioactivity occur along America's east coast at rather predictable time intervals following large nuclear explosions in China. The question is whether or not this additional radioactivity creates increases in adverse health effects. Sternglass says that his epidemiological analyses show that it does.

However, Sternglass' past epidemiological analyses have been unconvincing, and the BEIR III Committee refers to Sternglass' contentions as unsubstantiated allegations. (ref. 37)

"Part of Dr. Sternglass' presentation alleged that fallout from Chinese bomb-testing in 1976 led to an increased amount of radioactivity in milk in some areas of the United States. He concluded that there was an increase in infant mortality in the eastern-seaboard states from Delaware to New England shortly after these events—an increase that he ascribed to the radioactivity.

"Although Dr. Sternglass stated that his analysis was incomplete, the Committee received no further data on the subject.

"We have concluded that the alleged association did not fit the time course for the radioisotope movement into the cow-milk food chain; nor was there clear evidence of a universally applicable change in the infant mortality rates. Thus, the Committee did not believe that the allegation was substantiated." (ref. 37)

Radioactivity from the TMI-2 Accident - Most recently, Sternglass has published a book, entitled The Secret Fallout, which contends that fallout from the TMI-2 accident had caused something like 350 infant deaths in Pennsylvania and New York by August 1979. (ref. 38) Sternglass presents these as consequences to be expected in view of his own previous "findings" connecting fallout originating in China with increased infant deaths along the American east coast. (ref. 39)

Professor Tokuhata, Director, Division of Epidemiological Research, Pennsylvania Department of Health, denies any increase in infant mortality and states flatly that the records "show that there is no evidence that radiation from the power plant influenced a rise or fall of the infant death rate." (ref. 40) Tokuhata states further that Sternglass is in error, because

1 - some of Sternglass' most important numbers are simply wrong (ref. 41)

2 - Sternglass fails to compare individual numbers with their corresponding averages and standard deviations (ref. 41)

3 - Sternglass failed to distinguish the locations at time of death from location at the time of the TMI accident (ref. 42)

4 - Sternglass "seems to choose isolated data from selected years and/or locations to support his allegations without consistent study" (ref. 43)

Excerpts from Sternglass' book were published by the author in The Nation, February 28 and March 7, 1981, but provide little basis for a knowledgeable evaluation, because the account is a narrative rather than being a report with data and objective facts. However, these excerpts inspire no confidence in Sternglass' assertions.

For example, he assumes that he has proven his hypothesis connecting radioactive fallout from China with increased infant deaths in the United States, in spite of the fact that the BEIR III Committee was unconvinced. (ref. 44) He assumes also proof of his allegations about nuclear reactors in Connecticut. (ref. 45)

Again, Sternglass refers to localized patterns of sharply increased infant deaths and states, "There simply could be no other explanation" than radioactivity from TMI. (ref. 46) It is grossly untenable to hold in logic that one particular answer must be right, because no other explanation is seen as possible.

Further,

Sternglass "examined separately the category of newborn or neonatal infant deaths" because "there seemed to be no obvious change" in infants deaths generally (ref. 47)

"indicating the strong likelihood that it was the effect of iodine 131" producing deaths (ref. 48)

"his own readings" of radioactivity at TMI (ref. 49)

All of these sound very much like the selective use of individual data which many observers have condemned in Sternglass' earlier allegations.

Adverse Health Effects other than Cancer

Comment by Sr. Bertel: Exposure to low doses of ionizing radiation results in increased incidence of heart disease and diabetes and in an acceleration of the aging processes in general. These adverse health effects should have been included in tables 4.6 - 4.10 and elsewhere.

Suggested Response: Some years ago, it appeared that exposure to x-rays might result in the increased incidence of diseases other than cancer and in life-shortening in general.

For example, in reporting on American medical practitioners from 1935 through 1958:

"Mortality from cancer, cardio-vascular-renal disease and all other causes combined were increased ... with high exposure. These findings warrant the inference that occupational exposure to ionizing radiation on the part of physicians has in the past produced a nonspecific life-shortening effect." (ref. 10)

However, other studies have indicated otherwise. For example, reporting on British radiologists from 1897 through 1956:

"A comparison of the observed and expected numbers of deaths from all causes provides no evidence that occupational exposure to ionizing radiations has caused a detectable non-specific shortening of the expectation of life." (ref. 11)

Reporting on Japanese, 1950 - 1972:

"The hypothesis that ionizing radiation accelerates natural aging has been under investigation ... Ionizing radiation does, of course, shorten human life, but its life shortening effect appears to be the result of specific radiation-induced diseases, especially neoplasms. The hypothesis is now much less attractive than it was 10-20 years ago ... " (ref. 12)

Reporting on Japanese, 1950 - 1974, deaths from tuberculosis, cerebrovascular diseases, other diseases of the circulatory system, diseases of the digestive system, and 4,488 other deaths from untabulated diseases:

> "The 14,400 deaths attributed to diseases other than neoplasms ... reveal essentially no evidence of a relationship with T65 dose." (ref. 13)

From the BEIR III Report, 1980:

> "For somatic effects other than cancer and developmental changes, ... the available data do not suggest an increased risk with low dose low-LET exposure of human populations." (ref. 14a)

> "There appear to be no nonspecific effects of radiation at low doses that lead to a shortening of life span, ... " (ref. 14b)

> "There is no firm evidence that exposure to ionizing radiation causes premature aging in man or that the associated increase in incidence of carcinogenesis is due to general acceleration of aging." (ref. 14c)

Emergency Planning Zones

Comment by Sr. R. Bertel: The Draft EIS assumed that adverse health effects will be limited to within 50 miles of West Valley, whereas most of the radioactive material released during an accident would come down with rain and at distances up to 250 miles.

Response: A 50 mile radius has been established in emergency planning for even the most severe reactor accidents. (ref. 7) Unless the maximum accidental release from West Valley could be greater than the release from a maximum reactor accident, a 50 mile radius would seem to be adequate in the EIS.

	maximum reactor accident	maximum accident at West Valley
Curies present	700×10^6	34×10^6
source of heat	radioactive decay	combustion of fuel
temperature attainable	>5200° F.	<3400° F.
heat available	660×10^6 BTU/hr	$<40 \times 10^6$ BTU per ton of fuel
	40×10^6 BTU each 4 mins.	

references:

Curies present: Bodansky and Schmidt, Nuclear Power Controversy, Prentice-Hall Inc., page 31; DOE/EIS-0081D, pp. B-9, B-10

source of heat: airplane crash, DOE/EIS-0081D, page. 4. 6, tables 4.6 - 4.10

temperature attainable: NUREG-75/014, page 22; Chemistry and Physics Handbook, 57th ed., page B-173 (m.p. of uranium dioxide); same, 33rd ed., page 2072

heat available: NUREG-75/014, page 78 (590×10^6 BTU/hr corrected from 788 MWe reactor to 1000 MWe); Chemistry and Physics Handbook, 33rd ed., page 1589

An airplane crash could produce a release of radioactive material either (1) from the heat of burning fuel or (2) as a result of exploding kerosine vapors. From the preceding table, it can be seen that there is no way that burning fuel could release as much radioactivity or at as great a rate as could a reactor accident.

An explosion following an airplane crash could release 153,000 Curies (ref. 8), essentially instantaneously. A maximum reactor accident would release 25% of its total radioactive material during 30 minutes (ref. 9), which would be more than 100,000 Curies per second; within 2 seconds, this radioactivity would surpass the total maximum release from West Valley.

Accordingly, neither a fire nor an explosion subsequent to an airplane crash could produce either a greater or a more intense release than could a reactor. This shows that an emergency plan based on a 50 mile radius is more than adequate for West Valley.

Actually, emergency planning is based on a 10 mile radius within which it is believed that direct exposure to airborne material might be significant, plus an additional 40 miles in which exposure might result from ingestion of contaminated water or food.

It might be contended that the government erred in establishing this 50 mile radius for reactor sites. However, this limit was recommended by a joint Nuclear Regulatory Commission/Environmental Protection Agency Task Force after two years' work (ref. 7), and the panel which is preparing this EIS probably would not feel justified in substituting its own, different judgment on the subject of distances.

As for much greater distances, radioactive material has never been observed to be transported in the atmosphere in significant quantities as far as 250 miles, although, at times, this has been postulated in order to account for allegedly observed health effects. However, the claimed health effects proved to be spurious. Hence, no mechanism of transport need be postulated.

Please enter two paragraphs from page 6.

Lucius Gilman
Science Committee
Americans for More Power
Sources (AMPS)

REFERENCES

1 - Draft Environmental Impact Statement for West Valley, DOE/EIS-0081D, p. 4-36

2 - BEIR III Report (typescript edition), p. 193, Table V-2, middle line

3 - Reference 1, p. 4-37, lines 9-11

4 - Reference 2, p. 187

5 - 5a Ms. Henrietta Gerwitz, Afternoon Panel on Methods Used in Calculating etc.

5b Dr. Donald Taves, Panel as in Ref. 5a

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Lucius Gilman
Francestown
N.H. 03043

October 1978

QUALIFICATIONS

B. S. in chemistry from the University of Illinois; PhD. in chemistry from McGill University, Montreal; Under-Graduate training included introductory courses in electrical, mechanical and structural engineering.

Research Chemist with the DuPont Company for eight years; Supervisor of military research in the U. S. Department of Defense for fifteen years; Research Consultant with the National Academy of Sciences-National Research Council for one year; Research Supervisor with the Monsanto Research Corporation for eight years. Now retired.

For several years have spent most of my time looking into the technical aspects of energy problems. Sources of information have been the professional technical journals, professional technical conferences, and technical reports available both from the government and from non-governmental scientific groups.

My purpose is to provide technical information that will be intelligible to the general, non-technical public--principally through volunteer writing for newspapers, speaking and radio appearances.

LUCIUS GILMAN

Francestown, New Hampshire 03043
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QUALIFICATIONS

Education

B.S. in Chemistry, University of Illinois
Ph.D. in Organic Chemistry, McGill University, Montreal, Canada
Undergraduate training included courses in electrical, mechanical and structural engineering

Employment

Research Chemist: eight years
Central Research Department
Du Pont Company
Wilmington, Delaware

Chief of Plastic Research: fifteen years
Ordnance Corps, U.S. Army
Picatinny Arsenal
Dover, New Jersey

Research Consultant: one year
National Academy of Sciences - National Research Council
Washington, D.C.

Research Manager: eight years
Monsanto Research Corporation
Everett, Massachusetts

Now retired

Qualifications on Energy Topics

For the past seven years, has studied technical and economic aspects of energy supply and demand. Has conducted investigations with rigorous scientific objectivity, relying on original scientific reports, and the most qualified technical and scientific groups and forums.

Contributions and experience in promoting understanding of energy issues include:

* Testified at Federal hearings on nuclear energy topics

* Invited scientific witness at hearings before State legislatures on a variety of energy issues, including technical and economic aspects of nuclear energy.

* Testified as an expert witness on nuclear energy at hearings of the Massachusetts Department of Public Utilities.

* Member of the Citizens' Energy Policy Advisory Group to the New Hampshire State Legislature.

* Co-authored the CEPAG Report, specifically the section on nuclear energy in the main report, Appendix 4, which contains additional information on nuclear energy, and Appendix 5 which is a summary of the CONAES Report. CONAES is the Committee on Nuclear Alternative Energy Systems of the National Academy of Sciences.

* Write and speak extensively on key energy issues, with particular emphasis on explaining such issues to non-technical audiences.

Professional Technical Memberships and Affiliations

American Society for Materials
Chairman, Technical Committee, Materials Advisory Board,

American Chemical Society

American Association for the Advancement of Science

Technical Consultant to
The National Academy of Sciences - National Research Council

Letter 23

JOANNE E. HAMEISTER
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Free-lance writer
Photo-journalist

Area Code 716
655-0849

October 27, 1981

Mr. James Turi
West Valley Program Office
Office of Waste Operations and Technology, NE-320
Nuclear Waste Management and Fuel Cycle Programs
U.S. Department of Energy
Washington, DC 20545

Re: Commentary on July 1981 Draft Environmental Impact Statement, "Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley"

Dear Mr. Turi,

The DEIS is an impressive document and should be applauded for the amount of information and numbers of topics that it places between two covers. It is also obvious that it adhered to the spirit and intent of NEPA.

The DEIS is not without some serious presentational and hypothesizing faults. I hope the DEIS preparers, criticism-receptors, will accept my critique with the motivation to (1) make the EIS a more understandable and believable assessment of the impacts to be generated by the West Valley project and (2) insure that the FEIS will be an aid to an objective decision-making process.

Comment: The computational emphasis of the DEIS over-quantifies the environmental impacts.

The DEIS assumes that the impacts of the project are the probabilities of certain events, when, in fact, the impacts are the consequences.

The DEIS computes the probability of a "worst" case, proves its insignificance and thereby dismisses summarily thorough discussion of the primary, secondary and chaining consequences.

Recommendation: A more honest, readable, understandable, identifiable and considerate approach to risk discussion would be to acknowledge the impacts and then discuss and develop the probability of occurrence.

Reverse the emphasis and direction of the risk quantification.

The DEIS risk presentation appears as follows:

GIVEN: A worst case event
TO DO: Determine the probability that it will occur.
If significant, determine the impacts.

I would rather see the hypothesis statement reversed, ex.,

GIVEN: An impact
TO DO: Determine the events which will produce this impact.
Determine the probability of each event and the cumulative probabilities of all germane events.

The results and conclusions may be the same, but the non-quantifiable benefit of showing regard for the quality of human life would be an undeniably considerate addition.

Comment: The DEIS blatantly ignores the non-fatal impacts. Although the use of the term "health effects" would imply broad spectrum effects, the definition of "health effects" is given as fatal cancers or genetic abnormalities affecting future generation. Not only is this definition too narrow, but it is not offered until page 35 of Chapter 4.

The degree of dose-response effect of radiation is an acknowledged controversy. The effects are not controversial, however, and are not limited to death and gene-pool damage. If the risk of death is computable, then the risks of non-fatal cancers and other ill effects are also.

23-1 Recommendation: Since death is presumed (I assumed) to be the "worst" case, the probability of less-than-worst-case effects must be much higher and, therefore, in terms of quality of life, such risks must be evaluated as significant impacts.

Comment: Most readers of the DEIS do not have ready access to NRC Guidelines, nor do they know intuitively what values, vectors, parameters, formulae or models were used in the calculations.

23-2 Recommendation: Include in the text these more specific aspects of the quantification development. You may have underestimated how much even non-technical people can glean from such offerings. If they do not understand the mathematical process or relationship, they can comprehend what areas of their concerns were included as factors.

Comments: The risk assessments, in general, lack credibility since the input probabilities were not justified or supported. This omission may be interpreted as a presentational oversight or as a deliberate attempt to avoid more areas of controversy.

Where development needs are discussed, particularly in Appendix B, relative to occupational doses, it is difficult to extract understanding of how these unknowns were evaluated and factored into the risk to the worker.

On page B-16, with respect to waste retrieval occupational dose range of 28-35 person-rems for the alternatives, the DEIS states that, "Within the accuracy of these estimates, there is no significant difference among the alternatives." If the estimates of the 4 alternatives are treated as a statistical group (implied by "among"), this statement should be expanded to explain this conclusion based on "among", rather than "between".

In this particular case and without knowing what judgment criterion was used, it is not obvious or supported that there is no significance associated with the value for Alternative 3, which is exactly half of the values for the other alternatives. In any event, the range of 28-35 person-rems, lacking significance, implies the use of a huge confidence level about the estimation accuracy.

These comments exemplify the intellectual forebodings I suffered reading Chapter 4 and Appendix B. I was not offered sufficient information, assumptions, explanations to reconstruct the process used by the writers to achieve conclusions. These forebodings and questions breed skepticism, not believability.

23-3 <u>Recommendations</u>: The Final EIS should address in general and specific instances the degrees of confidence surrounding the assumed estimates.

Qualitative and quantiative assumptions should be stated. "Conservative" does not tell me enough.

Any well-written scientific document enhances its objectivity by supporting its hypotheses. Therefore, plan on enhancing the FEIS' objectivity.

<u>Comment</u>: The comparison of the magnitude of the West Valley project releases, non- and radioactive, to background radiation or to coal-fired or other operations is presuming that background and other emissions are acceptable.

23-4 <u>Recommendation</u>: This comparison technique should be handled more honestly by evaluating the impact of the comparison emission and equating the relative impact of the West Valley release.

The comparison should be between impacts caused by the releases, not between the amounts of releases.

The over-all impression of the attempt to convince dose-receptors of project safety, based on very low risks of death, is flim flam and over-sell. The use of a definitive number of deaths as a judgment criterion and the omission of consequences other than death produces the effect in the reader of viewing the document as dehumanizing, morale-mitigating and depressing. By cultivating such a jaunticed attitude in the reader, the criticism-receptors place themselves in a serious debate to justify their credibility.

I may be willing to accept higher risks if I have faith in the risks' veracity and can be assured that a Thing, called the DOE, will regard human life as something more than 1 in $1.5x10^6$ population.

An impact can be evaluated either as a cause and effect or as an effect and cause. Did a design flaw sink the Titanic or did 1517 people die because of imprudent optimism (not enough lifeboats, lack of precaution in an iceberg field, etc.)?

This Titanic example admittedly is an emotional argument; but since emotion is a uniquely human trait and since human beings will be the primary impact-receptors, I urge the criticism-receptors to alter their EIS treatment attitude. Do not

23-5 insult the $1.5x10^6$ population by removing identity to a number and disregarding attributes of sensitivity, intelligence, purveyors and enjoyers of life.

The West Valley project must proceed with all prudent and safe speed. The best option to employ will be determined by the decision-making mechanism of the EIS. I pray that the impact assessment in the FEIS will be sufficiently improved to insure its understandability and, therefore, consideration by ALL the decision-makers.

Sincerely,

Joanne E. Hameister

Joanne E. Hameister

Letter 24 - No response required

110 Barnett Drive
West Seneca, New York 14224
October 27, 1981

West Valley Program Office
Office of Waste Operations and
Technology, NE-320
Nuclear Waste Management and
Fuel Cycle Programs
U. S. Department of Energy
Washington, D.C. 20545

Gentlemen:

We urge you to choose Alternative 3 to clean up the radioactive waste at West Valley but contrary to your proposal to entomb it forever, we propose that it be monitored and periodically inspected to ensure its continued safety.

Sincerely

Donna Breen
Ms. Donna Breen

Mrs Joyce Breen
Mrs. Joyce Breen

Letter 25

3994 Big Tree Road
Hamburg, New York 14075
October 27, 1981

West Valley Program Office
Office of Waste Operations and
Technology, NE-320
Nuclear Waste Management and
Fuel Cycle Programs
U.S. Department of Energy
Washington, DC 20545

To Whom It May Concern:

I am responding in great concern over the West Valley radi active waste dilemma. I have done researching on this subject and also kept aware of the latest news developments.

My utmost concern is the time element. It has been reported that there is already leakage occurring from an unknown source, and I find it absolutely unsatisfactory to be told we have to wait until 1984 for a decision to be made on the specific waste form and process to be used. The proposed startup dete, 1987, is much too far in the future. I am sure time would be beneficia if we had it, but we obviously plain and simply do not have the time. It is crucial that this potential disaster be eliminated as quickly and efficiently as is technologically possible, even if we have to use an intermediate proced-ure as a temporary solution. As each hour passes and this decision sets on your desks, the cancer moves closer and closer to our lives. It may be quiet and unseen but there can be no exaggeration of the impending atrocities the movement of this radiation can cause, not to mention what could happen if a natural disaster such as an earthquake occurred (which is certainly not un-likely).

I am totally amazed that it was approved to have potential life-destroyi elements placed so close to our life-giving lakes. Were the decision makers minds out to lunch when this was approved? There was not an ounce of common sense and care for health used to let these wastes be placed so close to our Great Lakes. It is obvious that we can no longer let greed-blinded corporate owners make decisions as far as our health is concerned: They tend to "bite off more than they can chew". I am aware that often times gambles are made in the name of progress, however, you cannot gamble with radioactive wastes. If so, you are also gambling with ours and our childrens lives, and our environment.

In reference to the DEIS and the alternatives, in my opinion, alternativ #2, an interim form would be the most suitable due to the fact that, being there is no federal repository in existence as yet, the wastes would be flexi to suit the geology of whatever the assumed repository's geology is. I feel this flexibility is very important. As soon as these wastes are able to be shipped, the entire facility should be thoroughly decontaminated, dismantled, and closed up never to be used again. It is much too great a threat to our environment in general. Due to there being an increase in transportation if this alternative is chosen, the utmost in transportation care should be used.
25-1 All along the transportation routes there should definitely be evacuation preparedness wherever there are people, should there be a possible accident. Also, in general, clean up preparedness.

(cont.)

(cont.)

25-2 Another major concern is the workers. The workers involved in any phase of this operation including transportation should be thoroughly aware of all the implications involved in working with radiation, and protected in every way possible. I also think they should all be specialists in this field, which would lower the risks of accidents and technical incompetency.

Please take my statement into consideration and all of the public's concern. I do not only speak for myself. I know so many people feel helpless, but more people are becoming aware and will hopefully learn that they can make a difference. This is truly a national concern. Why should we taxpayers keep having to pay for these ridiculously expensive mishaps when we did not approve of these things to begin with? Why should situations such as this get to the critical point before something is done? What are we doing producing nuclear wastes when we have no safe solution to them? What good does cheap energy and military expansion do us if the quality of life has to be lowered to mutant form because of it? I don't know where the producers of these wastes expect to get their clean water to drink and bathe in. They are human beings, too. Do you feel our lakes and children are expendable? I believe these are legitimate questions. Please hear us and initiate action as soon as possible. Thank you!

Deeply concerned,

Donna Hammell

Letter 26

COMMENTS ON JULY 1981 WEST VALLEY DEIS

October 27, 1981

Raymond C. Vaughan (Coalition on West Valley Nuclear Wastes)

135 East Main Street
Hamburg, N.Y. 14075

COMMENT 1: The DEIS ignores my February, 1980, scoping comments (both oral and written, particularly p. 8 ff. of my written comments) regarding the possible movement of radionuclides in Lake Erie.

26-1 First, the DEIS improperly assumes that there can be no impact on Lake Erie (unless airplanes or saboteurs hit the wastes), instead of making an assessment in good faith of the possible impacts and probabilities. Second, the final 3 sentences of section 3.1.3 of the DEIS (page 3-9) express a very simplistic view of Lake Erie flow patterns, without showing any awareness of my scoping comments (pp. 10-12) or the views of lakes researchers referred to therein (my references 17 and 18). The only two references cited in the DEIS for Lake Erie flow patterns are an NPS report (!) and an Argonne report. The EIS should address the issues I raised in my scoping comments. If the EIS authors disagree with my comments and references, let them say so and say why.

26-2 COMMENT 2: I will have no opportunity to comment on the way in which the EIS assesses the impact of possible Lake Erie drinking-water contamination, in view of the fact that the DEIS ignores my scoping comments and does not address the issue.

26-3 COMMENT 3: Judging from figure B.8 (page B-27), there would be an explosion (i.e., violent conversion of water to steam) if the feed nozzle of the spray calciner failed, allowing a stream of HLLW to flow through the calciner and hit the molten glass below. More generally, the same problem can occur if the flow-restricting device fails in any high-thermal-mass furnace with HLLW input. The EIS should consider this problem and possible safeguards.

26-4 COMMENT 4: Seismic information on page 3-8 (Otway) and on page B-51 (NRC; also Tera Corporation) should be consolidated. The EIS should make it clear that, during the 15-year estimated project period, the probability of an earthquake resulting in 0.2 g ground acceleration is in the neighborhood of 1 chance in 200 (i.e., 15/3000, based on Otway) or 1 chance in 1000 (i.e., 15/16,000, based on NRC), while the probability of a quake resulting in 0.14 g acceleration is roughly 1 in 67 (i.e., 15/1000, based on Tera Corp.). As noted on page B-51, partial failure of the existing building would be expected in the 0.14-0.20 g range. The EIS should also review any effects on the waste tanks and fuel pool that are identified in past seismic studies of structures on the site (several studies have been conducted for the NRC).

26-5 COMMENT 5: According to the report of Nuclear Safety Associates (1980), page III-7 and also Table III-11, the estimated probability of a 0.2 g earthquake is 1.6×10^{-4} per year, which implies a recurrence interval of 6250 years. Since this is a report on which much of the DEIS is based, the EIS should make it clear whether this earthquake probability is a valid interpretation of the data; if so, ~~it~~ the value should be mentioned in the EIS along with the values discussed in my preceding comment.

26-6 COMMENT 6: The DEIS is too optimistic about the percentage of the wastes that can be removed from the tanks; Table 4.3 (page 4-15) assumes that 1% of the activity will remain, while Table 4.4 (page 4-18) suggests that only "0.1% of total waste inventory" will remain in tanks. The EIS should consider less optimistic possibilities, as discussed by Janicek, "West Valley Waste Removal System Study", April 1981, RHO-LD-146, pp. 57-59.

26-7 COMMENT 7: The EIS should provide a clear statement of what entombment of the empty tank 8D2 will mean. In particular, most of the residual radioactivity would be at the bottom of the tank, underneath about a million gallons of solidified cement. While this would be a relatively effective barrier to human intrusion, it would also be very difficult or impossible to remove if it turned out not to be a satisfactory way of decommissioning the tank. The EIS should also emphasize that there would be no barrier below the residual radioactive waste except for the silty till and possibly the existing concrete vault. Directly below the residual radioactive material would be the steel tank bottom, which would become permeable within a couple of decades as it rusted through. Below this is a 15-inch-thick, 72-foot-diameter permeable layer of perlite blocks and gravel. Below this is the steel pan, which already has a leak in it and will become more permeable as it rusts. Below this is a 3-inch-thick layer of gravel, and then the floor of the existing concrete vault. It remains to be seen whether the vault will survive the change in stress (as the HLLW is gradually removed, then replaced by twice as much weight of cement) without cracking. If cracks develop in the existing vault, then groundwater is free to move through

the permeable layers underneath the residual wastes, so that the silty till would be the only barrier. This is not an encouraging prospect, especially in view of the inadequately explained water problems at other parts of the site. For example, if contaminated water started percolating upward around the entombed tank (whether from a "bathtub effect" or an underground spring), it would be a very difficult problem to remedy.

26-8 COMMENT 8: The EIS should indicate whether additional engineering work could provide remotely-operated equipment for dismantling the empty tanks, such that the 230 person-rem occupational dose could be reduced.

These comments and the recommendations contained therein are submitted for consideration in the final EIS.

Letter 27

3164 Main Street Buffalo, New York 14214 (716) 832-9100

COMMENTS BY THE SIERRA CLUB RADIOACTIVE WASTE CAMPAIGN

ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

LONG-TERM MANAGEMENT OF LIQUID HIGH-LEVEL RADIOACTIVE WASTES STORED AT THE WESTERN NEW YORK NUCLEAR SERVICE CENTER, WEST VALLEY

Marvin Resnikoff
September 3, 1981

Because of the potential threat to the land and the drinking water of 1.8 million persons in Western New York, the Sierra Club has, since 1974, supported the removal and solidification of the high level liquid wastes from the NFS/Getty tanks. The number of potential cancers contained in the high level waste tanks is enormous and the possibility of leakage to the Cattaraugus Creek watershed real. The radioactive waste legacy remaining from the NFS/Getty operation and the history of this entire operation must rank it as one of the most outstanding regulatory and economic failures in 20th Century America. Though we have never agreed that NFS/Getty Oil should leave this legacy without paying a dime of clean-up costs, we are pleased that with the issuance of the Draft Environmental Impact Statement (DEIS), the Federal Government is beginning the clean-up of this potential threat to the health and safety of New York State residents.

The scope of the DEIS is necessarily quite wide-ranging and the Department of Energy (DOE) has made a good attempt at covering the ground. The no-action alternative, leaving the wastes in the tank, must consider the health effects and environmental costs from now to eternity. The other alternatives must similarly consider the outcome of waste operations for all time. The other alternatives include removing the liquid radioactive waste from the NFS/Getty tanks and solidifying them into a final (glass) or interim (calcine) waste form, or mixing the wastes with cement and returning them to the tank. Any of the action alternatives, [1] through [3], must also consider the low level and TRU wastes, including the environmental effects of these wastes in surface burial grounds and underground TRU repository. For all alternatives occupational exposures and radiation doses to the general population due to radiation releases to the environment and transportation are also included.

sierra club
radioactive waste
campaign

The basic conclusion of the DEIS is that the greatest environmental impact will arise from doing nothing, alternative 4. We agree with that conclusion though not for the same reasons. Our greatest concern over the short term, within the next 25 years, is that the NFS/Getty tanks will leak and the radioactive material will migrate rapidly through sand strata into the Cattaraugus Creek watershed, affecting the water supply of 1.8 million persons and the use of Cattaraugus Creek for years to follow. The DEIS, incredulous as it may seem, is more concerned with airplanes crashing into the NFS/Getty tanks.

For several reasons, discussed in the next section, the preferred option must be conversion of the high level liquid wastes to an interim waste form, an agglomerated calcine. This is a variant of alternative 2. The DOE preference is conversion of the liquid wastes to a borosilicate glass. The agglomerated calcine alternative produces a solid form in the least number of canisters, with therefore the least number of high level waste shipments. This solid is produced at low temperatures so that radioactive materials are not unduly volatilized in the solidification process. Further, this process has a substantial engineering base. The interim form can subsequently be made into a final waste form at Hanford or Savannah River where a large volume of high level waste also awaits processing into a final form.

We see no alternative to solidifying the liquid radioactive wastes into an intermediate form at this time. The wastes must be removed from the tank and solidified, but the final form will not be known until the geologic medium is known for a final waste repository. The DOE preferred alternative, borosilicate glass, is a final waste form which may be incompatible with the geologic media selected. In that case the solid waste may not be removed from the West Valley site, making the site a de facto waste repository. The geologic media will be chosen in the mid 1980's, too late to factor the information into a decision on waste form. Since the environmental effects and economic costs of producing and transporting agglomerated calcine are less than alternative 1a, borosilicate glass, there should be no hesitation by DOE in moving forward with the calcination option.

The DEIS, for all its breadth, lacks depth. We are impressed that this DOE document honestly presents the uncertainties and problem areas rather than glossing them over as in the previous work by Argonne. Nevertheless, many of the conclusions lack supporting data and are simply based on engineering judgment. Data for radiation releases are lacking. How much cesium, for example, will be volatilized during glass or calcine making? The amount of volatilization is one factor in how much of the radioactive cesium will be released. Data for the occupational exposures is based on experience at the Hanford government facility when it is clear that the NFS/Getty facility is substandard by comparison. Thus the basic data on the two most important matters of concern to WNY'ers, environmental releases and occupational exposures, are deficient. These flaws must be corrected in the final EIS. This information and much more was requested by the Sierra Club and NRDC in the scoping process and was not included in the DEIS. We review these earlier requests and attach our previous scoping comments (Attachments B,E).

Our conclusion is that the wastes should be removed from the tank as rapidly as possible and be made into an interim waste form, an agglomerated calcine. We believe that the radiation releases and effects will be much greater than posited by DOE, both in the near term and the distant future. Occupational exposures will also be greater. We believe that DOE has greatly underestimated the potential for migration of radioactivity off-site by neglecting sand strata and fractures within which water can move. We believe that the high level waste tanks and the State and NRC licensed burial grounds should be exhumed. All "low level" and TRU wastes generated by the project should be stored in above ground bunkers or transported to a safe and publicly acceptable burial ground. Finally, we point out that DOE has not addressed the implementation of this project and its effect on environmental releases and occupational exposures. We bring up for DOE response criticisms of DOE supervision of DOE contractors by the Government Accounting Office July 21, 1981.

AGGLOMERATED CALCINE IS THE PREFERRED OPTION

Calcine from high level liquid waste has been routinely produced at INEL at Idaho Falls, ID since 1963. Fuel from experimental and submarine reactors is reprocessed at INEL and the liquid wastes are converted to a fine ash by roasting this liquid waste in an oven. INEL has not had a history of leaking high level waste tanks as at the Hanford and Savannah River government facilities where the wastes have remained as a liquid. INEL has calcined over 50 million Ci of liquid waste, much more radioactivity than will remain in the NFS/Getty tanks in 1987 when the radioactive wastes will be solidified. The Idaho liquid wastes have been left in acidic form similar to the wastes in tank 8D4 at West Valley, though neutralized wastes have
27-1 been calcined at Hanford in an experimental program. The technology for producing a calcine is therefore more developed than glass.

However, calcine is a powder which can be easily dispersed in case of an accident, and is leachable. It therefore is not appropriate for transportation or as a final waste form. In order to put calcine into a form in which it can be transported, an additional step is required. The calcine must be compressed, with a binder, into round pellets with a machine called a disc pelletizer. This machine is already a "well-developed technology" according to DOE (p.8-40) and the use of the binder goes back to 1952. We are therefore satisfied that this technology is sufficiently proven and reliable compared to borosilicate glass. A comparison between DOE's preferred alternative, borosilicate glass, and agglomerated calcine, is summarized in the table on the following page.

The over-riding reason for producing an intermediate rather than a final waste form at this time is that the geologic media for a deep underground repository has not yet been selected, and will not be selected until the mid 1980's, too late to factor into the decision on final West Valley waste form. The final waste form must be compatible with the geologic medium. The Interagency Review Group, the collection of 14 Federal agencies reviewing the Federal nuclear waste program, recommended that the waste form, containment, overpack and geologic medium, all serve as an integrated system, providing a multi-barrier defense against radiation release to the biosphere. If DOE

decides on borosilicate glass at this time, it may be incompatible with the geologic medium and therefore may not be removed from the West Valley site until well into the 21st Century.

27-2 DOE further assumes that the borosilicate glass would go into a waste repository in salt. There are important reasons why salt is inappropriate as a geologic medium. These reasons are contained in the attached fact sheet by the Sierra Club Radioactive Waste Campaign, "Salt Will Not Work". Salt is a corrosive medium and contains water inclusions which migrate towards the heat put out by the high level waste. The high level waste may be leached out from the borosilicate glass in a short period of time, tens of years. References to these assertions are contained in the attached fact sheet (Attachment A). Further, according to DOE-sponsored research, it is possible that the health effects due to human intrusion of a salt dome could be very high. Calculations by PNL show that up to 29 million cancer fatalities could occur over a 50 year time period (PNL-2955, Dec., 1978), and 20 times higher if the dose/effect relationship reflected Mancuso's data (discussed below). These health effects arise from solution mining for table salt. Obviously only a fraction of these cancer deaths would be due to West Valley wastes. Nevertheless, there appears to be good reasons why borosilicate glass and a salt geologic medium are incompatible. Since the environmental consequences are less and the state of technology superior, there is no question in our mind that an intermediate form, agglomerated calcine, should be selected at this time. If at some later date it is decided that borosilicate glass is compatible with the geologic medium of the final waste repository, the agglomerated calcine can be converted to the borosilicate glass form.

TABLE. COMPARISON OF BOROSILICATE GLASS AND AGGLOMERATED CALCINE OPTIONS

Borosilicate Glass Alternative 1a	Agglomerated Calcine Alternative 2	Parameters
300	165	No. of high level waste canisters
6656	same	No. drums salt ca (55 gallon drums)
1050 °C	550 °C	Process Temperatu
higher	lower	Occupational Exposures
higher	lower	Radiation release to the Environmen
thorex waste will separate from borosilicate glass	reliable remote operation of equipment (disc pelletizer)	Technical problem
need for storage area at WV	no need for extensive storage, calcine removed as made	
higher operating temperatures imply greater breakdown possibility more radiation release, exposures	equipment more easily fits into NFS cells	
Geologic media for waste repository unknown	Allows time to fashion waste form to geologic media	Policy Issues

As the Table also points out, agglomerated calcine will produce many less canisters of high level waste which must be transported. These canisters of agglomerated calcine would be transported to Savannah River or Hanford, wherever a final waste form will be manufactured. The West Valley portion would constitute less than 1% of the volume of those wastes.

The environmental releases and occupational exposures will also be less with agglomerated calcine because the process temperature is much lower, 550 °C
27-3 versus 1050 °C for borosilicate glass. Since the volatilization temperature of cesium is about 670°C, cesium and other radioactive materials will be volatilized in the production of borosilicate glass, but not in the production of agglomerated calcine. These radioactive materials which are boiled out of the glass would have to be contained with an off-gas system. The DEIS admits that the "off-gas control would be less difficult" for calcination (p.2-16). This implies that more radioactivity will be released to the environment and more radioactivity will be captured by the off-gas system in producing a borosilicate glass as compared to a calcine. Changing filters and other tasks in a higher radiation environment imply that occupational exposures will be greater in producing a borosilicate glass.

In sum, the environmental impact and economic costs will be lower to produce an agglomerated calcine than a borosilicate glass. Given the additional fact that it is premature to choose a final waste form now, and <u>also will be in 1984</u>, DOE must choose the interim form.

Our position in this matter could possibly be different if the technology of producing a borosilicate glass were better developed, if the West Valley facility were better designed, if the exclusion area around the facility were much larger, and if 1.8 million persons did not depend for their drinking water on Lake Erie downstream from the outfall of Cattaraugus Creek. But this is not the case.

INADEQUATE DATA BASE TO PREDICT OCCUPATIONAL
EXPOSURES AND RADIATION RELEASES TO THE ENVIRONMENT

In our comments on the scope (Attachment B) and our recommendations to the team of Argonne consultants, we requested "a comparative analysis of the environmental effects and occupational exposures of the different solidification processes" (point E, Scope Comments). We also requested that the EIS "include a detailed basis for the conclusions reached; all previous experience must be listed" (point F, Scope Comments). This has not been done.

27-4 For radiation releases to the environment, the DEIS must show how much of each of the important (from a health and safety viewpoint) radionuclides is vaporized, describe fully the containment equipment, and the decontamination factor for each of these radionuclides. The data base for the vaporization and decontamination factors must be laid out. It is not sufficient to cite a reference which is essentially unavailable to the public. As the DEIS is presently written, the numbers come from the sky, with no support. We have no information as to which radionuclides are vaporized. For example, how much cesium is vaporized, based on what experimental information? How much tritium will be vaporized and released? The only information is that the concentration will be 2×10^{-6} Ci/l (p.B-28).

27-5 The Sierra Club and the West Valley Program Committee requested, in Spring '81, that all pertinent references to each chapter of the DEIS, be sent to one library in the WNY area. This has still not been done and it is one indicator of the low regard with which DOE holds citizens in the WNY area.

27-6 Since the specific radionuclides released from the low level waste treatment facility do not appear in the DEIS, it is impossible to verify the population radiation exposures. For example, the DEIS states (p.2-10) that the public will receive 340 person-rems exposure due to the production of borosilicate glass, Alternative 1a, and that 85% of this is due to exposures from transportation, and 1% from accidents. We assume that the remainder is due to normal radiation releases. Though the computer models and methods of analysis are discussed, the basic release data is missing.

27-7 The estimates for occupational exposures are done very superficially. The occupational exposures are based on Hanford experience of 0.65 rems/worker/year (p.B-16). Multiplying this Hanford number by the number of worker-years to complete the West Valley project, the DEIS arrives at 1800 person-rems for Alternative 1a. However, the West Valley high level liquid wastes are at least five times more radioactive than the Hanford wastes and the reprocessing building is much more contaminated. The DEIS assumes that the NFS cells
27-8 can be decontaminated down to exposure rates of 10 millirems per hour. We have serious reservations whether DOE can achieve this level in the NFS building (for difficulties in decontaminating concrete, see "Decontamination of Conrete Surfaces in Building 3019", by Parrott, JR, CONF-800542-5(Draft)). Thus, we have serious reservations whether DOE can achieve 1800 person-rems occupational exposure to produce borosilicate glass.

27-9 As another method of estimating occupational exposures, DOE might consider the total exposures obtained by reprocessing the 640 MT of irradiated fuel and producing the high level liquid wastes. This amount is about 7500 person-rems. Assuming that the high level liquid wastes have decayed an average of 18 years (to the year 1987) and have a 30 year half-life, and that the occupational exposures to produce a borosilicate glass at West Valley are about equal to those of producing the liquid wastes (an uncertain assumption), we estimate that the occupational exposures will be closer to 5000 person-rems.

A more exact study of occupational exposures is required in order to compare the alternatives. More realistic estimates on decontaminating concrete are needed. What if the exposure levels in the hot cells are 1 rem/h rather than 10 mrem/h? What then are the total person-rems under alternative 1a? What are the exposures in changing filters, in alt. 1a and alt.2? Under what conditions would DOE construct a new building rather than use
27-10 the present contaminated reprocessing building? A full cost/benefit analysis for a new reprocessing building ought to be performed (point F, Scoping Comments).

EFFECTS OF RADIATION RELEASE ARE UNDERESTIMATED

27-11 The effects of radiation release from the solidification operations are underestimated because the models and assumptions are incorrect. Because the new low level treatment facility will not release liquid effluents (p.2-5), the model does not include ingestion of radionuclides through drinking water (Fig. 4.2). According to DOE, "the new low level waste treatment facility would be designed to have no liquid effluents. Thus, there would be no impacts to the aquatic environment." (p.4-44) DOE exhibits here a very poor understanding of the effects of radiation on the environment. Apparently, the low level waste treatment facility will volatilize the slightly radioactive water from evaporation of the salt cake and from the secondary evaporator. What happens to this radioactive water?

The radioactivity from the LLWTF will first be inhaled by nearby residents. It will also be inhaled by cows. This is important because the dairy industry is the economic base of Cattaraugus County. This airborne activity will then settle on the ground and become incorporated into vegetable matter or, more likely, be washed into Cattaraugus Creek, into Lake Erie, and into the water supply for 1.8 million persons. This pathway is ignored in the DEIS. Since water from Cattaraugus Creek flows directly to the Niagara River (p.3-9), it cannot be neglected.

Evaporating low level radioactive water, as opposed to releasing liquid effluents directly into Buttermilk Creek, increases the exposure to West Valley residents who will inhale the airborne activity. It will not lessen the total person-rems of Western New Yorkers by aerosolizing this radioactivity. DOE should more closely examine this issue.

27-12 The model which predicts the health and genetic effects from the population exposure underestimates the total number of health effects. DOE assumes a range 100 to 800 health and genetic effects per million person-rems exposure (Table 4.17). Based on the analysis of Hanford workers by Mancuso and the reanalysis by Dr. John Gofman (Health Physics, 1980), the number of latent cancer deaths, excluding genetic effects, will be 3770 per million person-rems, or a factor of greater than 4½ times the high DOE estimate, which includes genetic effects. Thus, according to Gofman, 1800 person-rems to occupational personnel will produce almost 7 latent cancer deaths, over and above the number produced by other environmental causes, of course.

27-13 DOE compares the additional number of cancers caused to the total number which will occur due to natural causes (p.2-10). We find this method of comparison objectionable. Imagine the following. A grocery store owner is shot by a robber. It is only one death out of thousands. Why all the fuss? Yet it occupies front page headlines in the local newspaper. Nuclear power is an industry that many people in WNY believe we can do without; electricity can be generated by other means. The additional cancer deaths are therefore considered unnecessary. It is a value judgment among citizens of WNY.

27-14 The effects of radiation release due to an accident at the high level waste tanks could be much greater than estimated by DOE. This is because DOE has not correctly taken into account the possibility of radionuclide

27-14 migration from the West Valley site. At a presentation before the Argonne consultants by Mina Hamilton, the possibility of sand strata within which water could migrate more rapidly was laid out. We don't believe this information was taken into account by Argonne. We have therefore attached to these comments the Hamilton presentation (Attachment C). We have also attached a copy of the fact sheet, "Insecure Landfills: the West Valley Experience" (Attachment D). The presence of sand lenses and fractures would provide a more rapid pathway for water migration off-site and would serve to increase the number of health effects due to accidents at the high level waste tank. It would also greatly increase the exposures arising from alternatives 3 and 4.

The Hamilton presentation to the Argonne consultants (Attachment C) makes the following points which need to be addressed in the EIS. Water is migrating into the trenches of the State-licensed burial grounds (Att.C, p.2). Why is this occurring? The previous understanding of this phenomena, stated in the DOE Companion Report, is that water infiltration occurs through the trench cap, through cracks and settling of the cover. This understanding, however, appears to be contradicted by the facts. The water levels in the newest trenches 11-14, are rising most rapidly. By the DOE theory, one would expect the older trenches to have the most water. The trenches seem to fill with water sequentially: the water levels in the most westerly trenches (5,14) fill up to a certain level, followed sequentially by the next westerly trenches (4,13), and so on, though trenches (2,1) and Southern trenches (8,9,10) do not seem related to this phenomena. It appears that the Southern trenches 11 through 14, and Northern trenches 3 through 5 are connected, respectively, with sand strata which extend through the walls of the trenches, but that trenches 1,2 and 8,9,10 are not so connected. What theory other than sand strata and underground migration of water explain this sequential filling of trenches, from the west to the east, from the newer to the older? Can DOE explain quantitatively how 3 million plus gallons of water could have leaked through four to eight feet of clay cover?

In the DOE Green report, previously written by Argonne, it was stated that "experience with the southern trenches would indicate that filtration through the caps should now cease and erosion should be prevented" (p.3-53, Companion Report). Since the Southern trenches have over a million gallons of water which needs to be pumped out, Argonne's confidence was clearly misplaced. In fact, as Argonne was writing the Comapnion Report, NFS was in the process of pumping the Southern trenches. In researching the Companion Report, Argonne visited NYS Department of Environmental Conservation but neglected to search the NYDEC files on water infiltration.

It is not only the State-licensed burial grounds which appear to be having water infiltration problems, but the NRC-licensed burial ground as well. In a presentation before the Argonne Board of Consultants, the New York State Department of Health pointed out suspected seepage of tritium from the NRC-licensed burial ground. The Department recommended that the NRC-licensed burial ground be exhumed. It appears that permeable sand strata may exist in the NRC-licensed burial ground as well. The NRC is presently sponsoring research by the NYS Geological Survey into this question. The Argonne theory that the West Valley site contains only a"few discontinuous layers of silt, sandy silt and gravely silt" (p.3-40, Companion Report) does not appear to hold water.

The Hamilton presentation (Attachment C) goes into great detail on the presence of sand strata underlying the site. Our quotes on this subject refer to the inadequate treatment given this subject by the Companion Report because the DEIS treatment is more cursory, superficial and inscrutable. It is clearly deficient in presenting the geology of the West Valley site and needs to be written. We would say "rewritten", but so little appears in the DEIS on this subject that an entire section of the EIS must be included on the subject. It is pertinent to the West Valley Waste Solidification Project because the effects of leakage from the waste tanks would have much greater impact if sand strata also underlay the area near the high level waste tanks. Alternatives 3 and 4 would have much greater health consequences if radioactivity migrated much more rapidly. In addition, radioactivity from the emptied tanks would enter the water supply of 1.8 million WNY residents. Thus, proper accounting of sand strata implies that the waste tanks should be removed.

27-15 The DEIS does not estimate the probability that the high level waste tank will leak? We believe that the probability is high that the liquid wastes will leak from the tank within the next 25 years. What probability is assumed by DOE? What is the basis for this probability? Apparently, DOE believes that the probability is small. "Risks from leaching and migration of radioactivity in groundwater would be comparatively small" (p.2-22). How is this calculated? The DEIS goes on to say that "West Valley would continue to bear all the risks". We disagree that West Valley does bear all the risks since radionuclides can get into the water supply for 1.8 million residents.

We believe that the probability is high that an accident can cause the high level waste tank to leak. If the sludge is flocculent, then the contents of the high level waste tank can be homogenized and the wastes removed with low pressure sluices. But if the sludge is more the consistency of concrete, will DOE use high pressure sluices? Does this increase the probability that the walls of the tank will be loosened and that the tank will leak? The probabilities should be set down and the basis should be explained.

BURIAL GROUNDS AT WEST VALLEY MUST BE EXHUMED

Because of the presence of sand strata within which water and radioactivity can migrate rapidly the Sierra Club Radioactive Waste Campaign believes the present NRC and State-licensed burial grounds must be exhumed and placed in above ground bunkers. We believe that the sand strata have served as an avenue for water in-migration into the burial grounds accounting for most of the three million gallons of water which have entered the State-licensed burial ground. Needless to say we oppose the further use of the burial grounds for additional burial of radioactive waste material from the project. If no regional burial ground is located, and it may be that no safe surface burial ground can be located in the Northeast, the low level waste materials from the project should also be stored in above ground bunkers along with the exhumed waste materials. As the DEIS points out, the condition of the burial grounds will be the subject of the Federal court case, NYSERDA v. NFS and Getty Oil, which the Sierra Club has petitioned to enter. We will oppose further use of the West Valley burial grounds until the court case has established the responsibility of NFS/Getty for clean-up costs.

We do not believe that it is the responsibility of the State of New York to locate a regional burial ground for the low level waste material from the project. The waste materials at West Valley were generated from out-of-state and military wastes almost exclusively, and not from wastes generated in New York State.

HIGH LEVEL WASTE TANKS MUST BE DISMANTLED
AND REMOVED

All DOE options assume that the high level waste tanks will be decontaminated, filled with cement and remain on-site. The levels of contamination remaining in the tank after decontamination have not been specified in
27-16 the DEIS. The DEIS should present a range of values for the percent of radionuclides remaining after the high level waste cleanup, the methods of decontamination, and the expected contamination levels remaining. We assume that the percent of radioactivity remaining will be dependent on the physical and chemical characteristics of the sludge which are not known at the present time. However, DOE can specify a range of values now.

If the tank contains 5% of the sludge radioactivity, or 500,000 Ci, this would be more radioactivity than presently contained in the burial grounds. The concrete and tank itself will degrade. This radioactivity will then migrate towards Buttermilk Creek. The Club believes that the tank should be decontaminated and dismantled, then placed in an underground Federal rep-
27-17 ository along with the high level waste materials. We might also add that it is probably inconsistent with Federal policy to leave a high level waste tank on the site, creating thereby a de facto Federal waste repository. It will also require the approval of the New York State Legislature. Existing facilities at West Valley were exempted from the State legislation, but several State legislators would argue that altering the existing facilities at West Valley brings them under the purview of the State law. This argument similarly applies to the reprocessing building. We might add that entombment of the reprocessing building is inconsistent with developing NRC policy on decommissioning. How long will the reprocessing building be entombed? Till what radiation levels are reached?

"BETTER OVERSIGHT NEEDED FOR SAFETY AND HEALTH
ACTIVITIES AT DOE'S NUCLEAR FACILITIES"

Questions have been raised by the General Accounting Office regarding DOE's ability to oversee its contractor activities (EMD-81-108, July 21, 1981). GAO attempted to answer the following questions: "Is DOE's program adequate to assure that employees at DOE's nuclear facilities are provided with safe and healthful working conditions? The short answer is 'no'." "Is DOE providing adequate emergency preparedness guidance and assuring that DOE facilities are prepared to respond to nuclear accidents? The short answer is 'no'". "What actions is DOE taking to assure that its older facilities meet current safety criteria and standards? The short answer is 'Very limited, if any'". "How does DOE assure itself that information concerning radiological releases from DOE's nuclear facilities is accurate and reliable? DOE has little assurance." These matters affect how much radioactivity will be released from the West Valley facility, and how great the occupational exposures will be.

27-18 GAO has recommended that DOE has to increase their oversight of worker protection programs. DOE, in particular, has not been responsive to employee complaints. Complaints anonymously presented to DOE have been turned over to the contractor, placing the employee in jeopardy of being fired. DOE has not aggressively sought to have safety and health violations corrected.

27-18 DOE does not have a systematic plan for emergency preparedness and has not placed the matter on a high priority. DOE has not used safety analysis reports effectively in order to correct hazards at older nuclear facilities. This failure is particularly important at the NFS facility. DOE has to prepare a safety analysis report for the Nuclear Regulatory Commission before work on the project can begin. The SAR must be available to the general public. Finally, DOE had not always verified monitoring data obtained from its contractors. Unless DOE can present a plan to meet GAO's criticisms, DOE will not effectively oversee Westinghouse's actions nor develop a satisfactory interface on emergency preparedness with local governments and officials. Does DOE have a response to the GAO report and its implications for the West Valley project?

SPECIFIC COMMENTS

27-19 1. DOE claims that the total radioactivity remaining in the salt cake will be approximately 6500 Ci. There is no support for this value. Can DOE provide the basis for this number?

2. In Chapter 2, alternative 3, DOE discusses the option of removing the high level liquid wastes from the tank and mixing it with cement. We believe that the State Legislature would have to approve of this option, in addition to the need for revising the Federal legislation which established the West Valley project. The DEIS also claims that "all the risks would remain at West Valley". This is only true if the concrete does not degrade and the radioactive materials do not migrate rapidly to Buttermilk Creek. We disagree with the DOE assertion because, as pointed out above, we believe that DOE has not taken proper account of the sand strata on the West Valley site. Could DOE please provide the supporting data for their position?

27-20 3. In Chapter 3 (p.3-11), there is no complete discussion of the economic base of Cattaraugus County, the dairy industry. The environmental effects on the dairy industry must be included in the EIS.

4. In Section 4 which discusses the environmental effects of the project, the full environmental effects of no action have not been taken into account.
27-21 We note from Figure 4.1 that the radionuclide neptunium-237 has not been included. This radionuclide will produce health effects in the long term. Reports ICRP 30 and BEIR III together imply that the health effects due to Np-237 will be about 760 times greater than previously supposed for dose to the liver. Increases to other organs, and increases in health effects caused by other actinides such as Pu and Am, also increase the long-term health hazard of the high level wastes, and the hazard of leaving the tank on-site.
27-22 The DEIS artificially takes a cutoff time of 10,000 years in calculating health effects. Longer periods would increase the health effects caused in
27-23 Alternative 4. Further, the plutonium hazard does not include the fact that plutonium mixed with chlorine, as occurs in city water supplies, increases the toxicity of that material because it becomes more soluble.

27-24 5. The worst case accident which might occur has not been properly evaluated in the DEIS, namely, the possibility of explosion such as the one which occurred in Russia in 1957 and devastated almost 1000 square miles of area. The Russian accident occurred in a high level waste storage area or processing area. There appeared to be almost a complete lack of Sr-90 detected indicating that that radionuclide had been or was in the process of being removed when the accident occurred. Because Sr-90 will also be removed at West Valley, there is a correspondence with the Russian accident that must be addressed by DOE. If DOE believes that this type of accident cannot occur at West Valley, it should explain its reasoning.

27-25 6. If the sludge is firm, what methods will be employed by DOE to homogenize the high level wastes? We note that DOE will be using a bottom section mixed-flow pump (p.B-13), but if the sludge is like concrete, this pump will not draw in the sludge. In that case, what will DOE do?

27-26 7. The final disposition of the salt cake has not been properly addressed. It has been noted that the nitrates will produce chemical pollution. How will this material be disposed of?

8. The scoping comments of NRDC (Attachment E) have also been attached. Many of the points addressed in their comments have also not been included in the DEIS.

9. It has come to our attention that DOE will be testing high level liquid waste samples from the West Valley tank at Hanford, Washington rather than at West Valley. This surprising development, the shipment of a high level liquid waste sample across the country, is not mentioned in the DEIS, nor is the environmental impact versus the alternative of analyzing this material at West Valley, evaluated. If it is safe to ship a sample of high level liquid waste across the country, then perhaps it is also safe to ship the entire contents of the waste tanks across the country as well and not to produce a calcine or glass at West Valley. The Sierra Club is not advocating this approach until
27-27 a fuller exposition is laid out, however, we believe that this alternative, of shipping the entire contents of the West Valley tanks as a liquid must be considered in the DEIS. Apparently the technology - specially designed shipping casks for high level liquid wastes - is being developed by Sandia Labs

ABSENCE OF DATA TO SUPPORT DOE CONCLUSIONS ON OCCUPATIONAL EXPOSURES AND RADIATION RELEASES TO THE ENVIRONMENT IS FATAL FLAW IN DEIS

We wish to underscore the position stated on page five that the DEIS lacks supporting data for its conclusions about the levels of occupational exposures and radiation releases to the environment, and for a comparison between the alternatives. This also includes information regarding sand strata on the West Valley site. Without this information, which we consider basic to a choice between one alternative over another, the DEIS is incomplete. We regard this as a fatal flaw in the DEIS which must be corrected in the final EIS.

Attachment A

SIERRA CLUB

radioactive waste campaign fact sheet

salt will not work

salt is the wrong geologic medium for a waste repository

The United States Department of Energy has proposed that highly toxic radioactive wastes be placed 1000 feet to 3000 feet below the ground in salt formations. Many areas of the country would be affected by this ill-advised proposal: the populous Northeast, including the Finger Lakes region of New York State, gas and oil-producing regions of the Gulf Coast, and Western states of Utah and New Mexico (see Figure 2). The underground area of the waste repository would be 2,000 acres and would hold 66,000 to 106,000 tons of radioactive waste, or all the highly irradiated used fuel generated in all commercial nuclear reactors between 1970 and the year 2000. This highly radioactive material from operating U.S. and foreign nuclear reactors would be trucked into these regions for burial. The total amount of radioactivity in the waste dump would be truly prodigious, on the order of 11 to 18 billion curies of cesium and strontium, corresponding to the cancer potential of trillions of bone, muscle and thyroid cancers and genetic effects to future generations. These wastes will stay toxic and pose a threat to humans and the biosphere for millions of years.

One measure of the toxicity of this material is the amount of water needed to dilute radioactive wastes to what the Federal agencies consider a safe level. (In fact, there is no safe level of radioactivity; each amount of radioactivity increases the chances that a cancer or genetic effect will occur.) The amount of dilution water required for each high level waste dump is almost double that of the fresh water in global storage in lakes, rivers, ground waters and glaciers, or about 4% of the oceanic volume (USGS, p. 2). It follows that mistakes must not happen. The geologic medium must be perfect. DOE intends to investigate many types of geologic media including granite, basalt, and tuff, but investigations are furthest advanced for salt and it, unfortunately, appears to be the first in line to be selected.

salt will not work

Salt should not be considered the preferred medium. Salt is extremely water soluble, is highly corrosive, and does not hold the radionuclides effectively. When salt is heated, water is attracted to the heat sources, such as canisters of radioactive waste. Water moving through the salt becomes brine. When this brine reaches the radioactive waste materials, the glass or ceramic waste forms will break down and the radioactive materials will leach out. It has only recently been recognized that this leaching can occur in months, rather than thousands of years, as had been previously assumed.

salt and valuable mineral deposits

Salt frequently occurs near valuable mineral deposits, e.g., potash

2

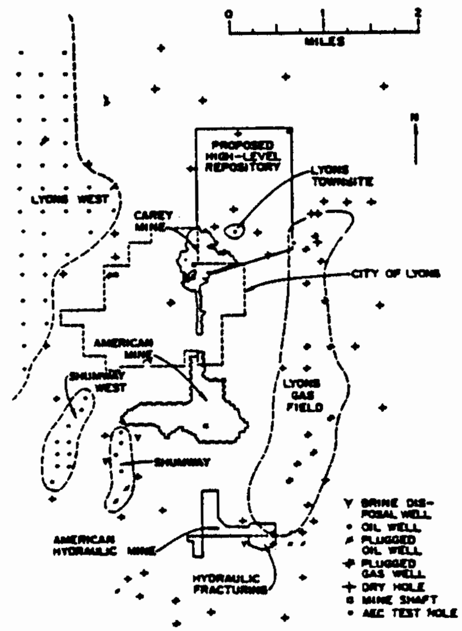


Fig.1. Location of a proposed high level waste repository near Lyons, Kansas, containing numerous drill holes.

in Southeastern New Mexico, natural gas in the Louisiana Salt Domes and the Finger Lakes region of upstate New York. Extensive drilling has taken place in these formations in the past; there are numerous uncapped and recorded wells in upstate New York. A Lyons, Kansas site, proposed for a high level waste dump in 1971 by the Atomic Energy Commission, resembled Swiss cheese it had so many recorded drill holes (see Figure 1). All drill holes are an avenue for both surface and underground water to enter the salt formation (USGS, p. 5). Even if all the drill holes could be located, which is problematical, the technology for plugging these holes to prevent water intrusion over the time periods required, millions of years, is not available.

Further, drilling is likely to occur in the future in any region where there are resources perceived as economically valuable. Location of a repository in such a geological medium would be contrary to the proposed EPA criteria on radio-active waste which state that "institutional controls should not be relied on for greater than 100 years." Without institutional controls, such as fences and guards, drilling would occur near any salt formation in the future just as it has in the past. As an example, out of 150 salt domes in the Gulf Coast region potentially usable for high level waste dumps, 95 have already been mined or drilled in 100 years of recorded exploration in that region (Johnson & Gonzales, p. 174).

drill holes and water in-migration

If water were to enter a salt repository (through shafts, bore holes, or other means), the integrity of the salt formation would be undermined. Salt has a high solubility compared to other materials such as granite. Further, scientists have a limited ability to predict future changes in groundwater flow regimes, climate or possible accidental flooding. For example, according to the EPA (p. 18), in a proposed salt repository in Lyons, Kansas, "considerable volumes of water migrated in an unpredicted manner. . .as a consequence of dissolution of salt by ground water seeping into the repository. Seepage was along an abandoned drill hole that, like most, had not been cased and plugged. This puts a premium on picking a site where precise locations of all abandoned drill holes or old underground workings are known."

Until it is known how to plug such drill holes, the act of exploratory drilling itself, in order to determine the extent of the salt formation, may be sufficient to render a repository useless for high level waste burial.

In addition to in-migration of water, salt crystals themselves contain significant amounts of water as brine pockets and along intergranular boundaries. According to the EPA (p. 8), the contained water may be in excess of 1% of the salt. As the USGS (p. 5) has indicated, water may be present in "brine pockets such as those that were found (unexpectedly) in one salt deposit."

hot brine moves toward hot waste

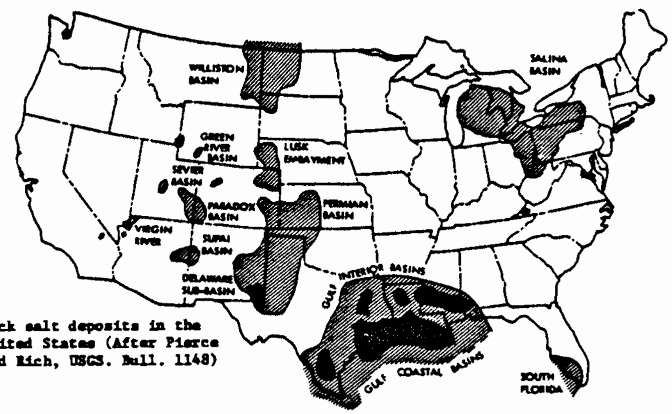
The temperature within the repository may reach 300°C. Water, in the form of liquid and vapor is drawn towards the heat source in a salt repository, as opposed to other geologic medium where water moves away from the heat source. This hot brine solution is acidic and very corrosive. According to the EPA (p. 7), the canisters would be breached in a decade or less. Under these conditions, only the geologic medium can be relied on to affect any significant retardation for times longer than a decade. Surprisingly, no corrosion tests have yet been undertaken of containers exposed for decades to salt solutions, at temperatures up to 300°C, (EPA, p. 20).

salt is corrosive

Two high level waste forms would be placed within a geologic repository, spent fuel or the high level waste from reprocessing. If spent fuel is reprocessed, the favored waste form would be glass. In the presence of steam, salt and acid, the glass would "deteriorate rather completely. . .in a matter of days." (NAS, p. 116) The spent fuel may be disposed directly after placing it in a container. Little R&D has been devoted to spent fuel within a salt formation, under the temperature and pressure conditions which would exist within a salt repository. The exact chemical composition of spent fuel, and the type of container for the spent fuel have not yet been defined. Studies of leachability and interaction between spent fuel and salt have not been carried out (NAS, p. 161).

salt will not "fix" radioactivity

Once the containment is breached, and the radioactive materials leach into the salt formation, the salt itself will not "fix" the radionuclides. This is a major disadvantage of salt. According to USGS (p. 5), "the capacity of salt to 'fix' or absorb the nuclides from the waste in insoluble form is apparently low." This is to be contrasted with shale and other formations where the waste material attaches itself to the geologic medium. (These other media, however, have not been studied sufficiently.)



Rock salt deposits in the United States (After Pierce and Rich, USGS. Bull. 1148)

repository will weaken

The presence of brine and increased temperatures would undermine the structural integrity of the salt repository. According to the USGS (p. 6), "Increased temperatures in salt would further decrease mechanical strength of the salt-brine mixture and would increase the creep rate of dry salt."

difficult to retrieve wastes

The movement of salt under increased temperatures means that it would be almost impossible to keep the repository open for extended periods of time. According to the EPA (p. 3), it is unlikely that spent fuel rods could be safely recovered from a salt repository "more than a few tens of years after emplacement and backfilling, for by then the salt would have completely sealed the openings." Thus salt is not the medium if retrievability is desired.

hot wastes will sink

As the salt is heated and becomes more plastic, it is expected that the canisters would begin to sink (USGS, p. 17). Simultaneously, the canisters will corrode and leach. As the canisters move downward, the canisters would also move laterally towards the center of the repository where the temperatures are greater compared to the outer extent of the repository. As the canisters moved towards each other, the center would become still hotter and the salt more plastic. As the salt becomes more plastic, the structural integrity of the repository would be further reduced. Most salt formations overlie permeable limestone formations. The canisters could thereby move downward to the limestone formation and possibly enter the groundwater. The heat will also cause the salt to expand and rise, placing upward pressure on the above-lying earth cover, forcing the salt into available cavities and further re-arranging the hot wastes. Long-term predictions for waste movement are probably impossible.

radioactivity may enter groundwater

The wastes could be moved to the biosphere either by some process that transports the wastes to the biosphere such as water movement, or the wastes could be directly exposed to the biosphere through some geologic process such as earth movement (earthquake), or erosion. Another process may be glaciation. Glaciers scoured upstate New York and produced the Finger Lakes about 10,000 years ago, scratching a depth of 2000 feet in places. Since upstate New York is subject to earthquakes, and in the longer period, to glaciers, containment cannot be guaranteed over the hazardous lifetime of the radioactive materials, which extends to millions of years.

The most direct pathway to the food chain is by human intrusion. Calculations by the DOE show that the number of potential cancers could be very high. If solution mining for table salt occurs in a salt dome containing 100 year old waste, the population could receive a dose of 160 billion person-rems, causing 29 million cancer fatalities over a 50 year period (Batelle-Northwest). The number, in fact, could be 20 times higher if the relationship between dose (person-rems) and cancers actually observed among government workers at Hanford, Washington were used. These numbers are admittedly the worst case scenario, but they indicate the seriousness which citizens should view disposal of wastes in salt.

avoid populous areas with large rainfall

Upstate New York is a heavily populated region of the country (55% of the country's population is within 400 miles of Steuben County, one of the proposed locations for a dump. Because of its population, this region fails EPA criteria for radioactive waste, which states that "locations for radioactive waste disposal should be chosen so as to avoid adverse environmental and human health impacts." Obviously, placing radioactive wastes in a populous area does not avoid adverse human health impacts, but encourages them.

Regions of the country which contain large aquifers or high rainfall should likewise be avoided. For example, the El Capitan reef, charged by the Pecos River, near a proposed high level waste dump in Southeastern New Mexico, is one such aquifer. Regions with large annual rainfall such as New York State (greater than 40"/yr) and the Gulf Coast (greater than 60"/yr) likewise present a potential for radioactivity entering the waterways.

transportation is risky

Transportation of radioactive wastes <u>into</u> populous regions from all parts of the U.S. and foreign countries maximizes the risk to the population. During transportation, the wastes are closer to larger numbers of people and "risks of accidental dispersal of radioactive material are greater. . .than during either processing or emplacement" (NAS, p. 30). Shipping casks are far from fail-safe and serious shipping accidents are possible (for more on this subject, see Radioactive Waste Campaign fact sheet, "Shipping Casks: Are they Safe?").

All persons along shipping routes would be potentially affected.

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2/21/81

Attachment 8

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SIERRA CLUB COMMENTS

ON THE SCOPE OF THE ENVIRONMENTAL IMPACT STATEMENT

FOR THE SOLIDIFICATION OF THE HIGH LEVEL LIQUID WASTES AT WEST VALLEY

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Nuclear Subcommittee of the
Energy Policy Committee
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The Sierra Club is pleased to present these comments on the scope of the environmental impact statement for the solidification of the high level liquid wastes at West Valley. The Club has been concerned about the high level waste situation since 1974 and has strongly advocated the position that the wastes should be removed from the tank and solidified. We look forward to the resolution of this very dangerous situation.

On the other hand, we are quite disappointed that Argonne Labs had been chosen to write the EIS. Argonne Labs performed the work on the study on decommissioning options for the West Valley site. The work was substandard. In particular, errors of fact were pointed out to DOE at the public meeting in Buffalo, New York, January 13, 1979. Further, many suggestions to Argonne made at the March 18, 1978 meeting were never included in the Final Report or the Companion Report. We have enclosed Sierra Club White Paper #1 which shows 32 separate items we thought should be included in the Final Report done by Argonne. These items were not included, or were examined in a very superficial manner. Since this EIS must satisfy the requirements of NEPA, we assume that DOE will more closely scrutinize the work.

As one specific example of the poor work by Argonne, we cite the following. On March 18, 1978 at West Valley, the Sierra Club requested that Argonne examine the prospects of a wood alcohol and engine engineering facility for the West Valley site. We discussed the fact that Western New York had trees and skilled craftsmen. We thought that the industry would be more natural and healthier for the area than a radioactive waste dump, or more radioactive wastes, as proposed in a secret deal between Schlesinger and Larocca. However, Argonne did not objectively analyze this exciting possibility. It devoted one paragraph to the matter while devoting almost all its attention to further nuclear uses of the West Valley site. Clearly Argonne was not interested in this attractive industry for Cattaraugus County. However, contrary to Argonne's assertions that an alcohol industry is not feasible in Cattaraugus County, we have now learned that one company is thinking of locating near Franklinville. The County Industrial Development Agency is helping this wood alcohol industry get established. We think that this industry should locate on the West Valley site, to help West Valley with its tax problems, and that NYSERDA should aid this industry. This is a clear illustration of Argonne not examining a reasonable recommendation. There are many others on the attached White Paper #1. We have asked each person who has had input to this EIS process to keep a copy of his/her presentation and to compare it to the draft EIS when it appears.

The Sierra Club believes that the following topics should be considered in addition to the list circulated by the DOE. On all topics listed below, we expect Argonne to honestly state the uncertainties and previous experience so that citizens can know honestly what the full environmental impacts of the proposed operation will be.

A) We disagree with DOE that the reference process should be vitrification of the liquid high level wastes. The reference process, according to the 1980 DOE Authorization should be calcination, since this is the most effective technology presently known. The legislation explicitly states "vitrification or best available technology at the time". By far, the most experience nationally and worldwide has been with calcination, primarily at Idaho, but also at Hanford. There has been little experience with borosilicate glass. Citizens of Western New York are not looking for further experimentation.

B) Calcination must be the chosen form since a final geological medium has not yet been selected for a waste repository. In keeping with the IRG report and its system approach to Waste management of high level wastes, the waste form, container, buffer material and geologic medium must form an integrated system to prevent leakage to aquifers and the human environment. Since the geologic medium is not presently known, it is not possible at this time to state what the final waste form will be. For this reason, the final waste form must be an intermediate stage, which calcination is. The calcine could later be converted to a glass, or be mixed with cement. Preliminary results seem to show that supercalcine, mixed with cement, has a leach rate comparable to glass. However, glass is an irreversible final waste form.

C) The EIS must include a discussion of the environmental effects of final disposal of this solid high level waste form.

D) Calcination should also be chosen as the reference case because its environmental effects will be less than those of producing glass. Calcination is a lower temperature process than vitrification and most probably would lead to smaller environmental releases and lower occupational exposures. The EIS must include a comparative analysis of the environmental effects and occupational exposures of the different solidification processes.

E) Regarding the mechanics of removal of the high level waste from the tank -- what will be the impact of cutting into the tank, sluicing the sludge and pumping out the material, on the interior structure of columns and on the integrity of the tank itself? What sluicing pressure can the tank withstand?

F) What will be the hazard to workers involved in this process? What will be the hazard to workers involved in using parts of the old contaminated reprocessing building for this work? Because the reprocessing building is so contaminated, and the levels of radiation in certain cells so high, we advocate the construction of a major facility to surround the high level waste tank, in which all operations can be done remotely. The Club is greatly concerned about employing the present reprocessing building. The EIS must evaluate the full costs and benefits of a completely remote operation relative to other less economically costly options, such as using the present reprocessing building. In all cases the EIS must include a detailed basis for the conclusions reached; all previous experience must be listed.

G) What will be the health impacts on surrounding communities? What will be the impact on agricultural and dairy activities in the region, due to normal and accidental releases? What will be the effect of a tank rupture during sluicing operations? What will be the effect of tornadoes, earthquakes on the integrity of the tank, especially if cutting into the tank has already been initiated? How will the lethal material within the tank be contained in that eventuality?

H) What will be the impacts of dismantling the high level waste tank after the contaminated sludge has been removed? Where will the contaminated tank be taken? If the tank remains on site, detail the institutional arrangements which will provide continued maintenance and surveillance. State what the expected time periods for maintenance and surveillance will be.

I) What are the potential impacts of this project on Erie, Niagara and Cattaraugus Counties? In particular, what will be the impacts on support and emergency services -- hospitals, fire and emergency preparedness--if there is an accident during the removal of high level liquid wastes?

J) What will be the impact upon underground aquifers, water tables, etc. if an accident occurs? (DOE only mentions the effects of the project on surface streams such as Buttermilk and Cattaraugus Creeks. There is no mention of subsurface waters.) We feel that there needs to be further investigation of the location of underground lenses of sand before work on the project begins. The complete hydrogeology of the site must be known.

K) What will be the impact of the operation on the downstream Cattaraugus Indian reservation? What amount of water is being used by the Indians, for what activities?

L) What will be the impact of the tank clean-up on other activities on the site? Will the tank decommissioning operation delay exhumation of the burial ground, or the reprocessing building?

M) Where will the low level wastes generated during the clean-up process be disposed of? Will they be buried on-site? Will the radioactive liquids be put through the low level treatment facility and dumped into nearby streams? We feel no additional radioactive material should be buried. If any material is kept on site it should be stored in above ground concrete bunkers or steel bins. We do not want this operation to become an excuse for re-opening the burial grounds.

N) What will be the socio-economic impact of the operation? impact on farming, tourism, tax base and utility rates? What will be the effect of the operation on the West Valley tax base?

O) What is the impact of this project moving forward without proper authorization by Congress? It is not our purpose to delay this project, but if at a later date, DOE moves to initiate reprocessing without proper authorization, we do not want this project to serve as a legal handle for further unauthorized projects by DOE. It is our understanding that no construction contracts can be let until monies have been both authorized and appropriated by Congress.

P) What are the guarantees that this facility will not be used for the northeast's wastes, high and low level?

Q) If the Cs and Sr is removed from the liquid high level wastes before solidification, the EIS must address the long term safety and institutional considerations for these hazardous materials.

ATTACHMENT C

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PRESENTATION BEFORE ARGONNE ADVISORY PANEL ON OCTOBER 21, 1980

by Mina Hamilton, Co-Director, Sierra Club

Radioactive Waste Campaign

In this presentation, we shall cover a Description of the Burial Grounds, Specific Structural Problems, What is the Geologic Profile of the Area, What is in the Burial Grounds, "Good Condition" and How it Pertains to the Burial Ground.

Description of the Burial Grounds

There are two burial grounds, a state-licensed and a NRC-licensed burial ground.

The state-licensed burial ground consists of 22 acres of which about 7 acres have been utilized thus far. This burial ground is on a plateau that drops off rapidly on three sides. It is drained by Frank's Creek (on the East side) and a tributary of Frank's Creek (on the North and West side).

state-licensed
The burial area can be divided into two parts: the north area and the south area.

The north area includes trenches 1-7 and was used between 1963 and 1969. According to the Department of Energy report "Western New York Nuclear Service Center Study" (TID-28905-2)prepared by DOE in 1978 (henceforth referred to as DOE Green) "There are no records of original site preparations", page 3-42. The trenches are thought to be about 20-30 feet deep and are about 600 feet long. The space between the trenches is three feet and the trench caps originally were about 3 feet.

The south area includes trenches 8-14 and was developed between 1969 and 1975. The space between the trenches was increased to over 9 feet and the trench caps increased to almost 8 feet.

Specific structural problems at the state-licensed burial ground

Erosion. This is mainly a problem at the north end. In a study by the EPA "Summary Report on the Low Level Radioactive Waste Burial Site, West Valley, N.Y., 1963-1975 EPA-902/4-77-010 (henceforth referred to as EPA-902) it is stated on page 13 "During times of heavy rainfall, rapid surface water runoff has caused significant soil erosion to these slopes" and on page 23 "the area needs to be protected from further gullying, so that the meager mass of silty, clayey earth between the radwase burial trenches and the ravines is not further notched and diminished". Additionally, DOE green notes that "the channel draining the northern end has deepened by 2.5 to 5 cm during the past year".

Since there are not original trench preparation records in existence and as stated in DOE, green, 3-45 the "Location of end of trench is uncertain", there is concern regarding this erosion activity eventually intersecting with the excavated trench. This would provide a route for off-site migration of radioactive materials.

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Indentations on cover. A problem with both north and south trenches. In 1979, Thomas Cashman of the Bureau of Radiation reported indentations two feet in diameter on the south trenches--the trenches with eight feet of cover. These indentations will break the integrity of the trench cover, provide a route for water infiltration. This process will continue for an unknown length of time as materials inside the trench compact, settle, various containers many of which were cardboard, split open and shift. The relationship between these indentations and water infiltration into the trenches is not fully understood but is a key to long-term prospects in terms of maintenance at the site.

Water infiltration. This is the most serious structural problem at the site. Water has been getting into the trenches from the beginning of operations. As yet it is unclear as to where the water is coming from. Is it seepage through indentations, cracks and fissures on the trench tops? or is it migrating horizontally along sand lenses underground? Or is it a combination of both horizontal and vertical migration of water? This important question needs to be answered to understand the maintenance problems to be expected in the future at the site.

North tren ches infiltration Infiltration was detected shortly after filling. Within two-three years there was 5-10 feet of water present in all northern trenches. Water level remained constant in trenches 1 and 2 but in 3,4 and 5 continued to rise. In March 1975 water broke through trench #4 (the trench containing 15,000 curies of Strontium 90). Pump out of trenches 3,4,5 occured in March 1975 (1 million liters), October-November 1975 (1.6 million liters) July-October 1976 (3.8 million liters) and then semi-annual pumpouts til 1978. At this time, several additional feet of cover were added to the trenches.

It was assumed by DOE, NFS and others that additional cover would prevent further infiltration. thus DOE, green, page 3-53 stated "experience with the southern trenches would indicate that filtration through the caps should now cease and erosion should be prevented". The experience referred to was the lack of water accumulation in the southern trenches, as of 1978. But this situation was to change in 1979.

South trenches infiltration- In the fall of 1979, citizens learned from the Bureau of Radiation that the south trenches--11-14 now had such increased water levels that a pumping operation would be necessary in the Spring of 1980. We do not know how many gallons were pumped out during this operation. But the key point is that the eight feet of cover, frequently described as Improved trench design, is not working to prevent infiltration of water. How much cover will work? ten feet fifteen feet, twenty feet? This question once again forces us to examine the question of what is the route for access of water to the trenches?

Is water migrating horizontally into the trenches?

What is the geologic profile of the area?

It is the position of DOE and NFS that although the silty till in which the trenches were located are water saturated, the area is not an aquifer because there are only a "few discontinous layers of silt, sandy silt and gravelly silt", DOE, green, 3-40.

This assertion is based on extremely limited geologic borings in the area. Most of the original geologic drillings on the site conducted before construction back in 1963 were conducted in the immediate vicinity of the reprocessing building with only 3-5 drillings in the "vicinity" of the burial ground, EPA-902, page 10.

The burial ground in this reference includes both the state-licensed and the NRC-licensed burial ground. These original drillings were only to 40 feet which is of particular importance in the instance of the NRC-licensed burial ground where burial holes were sunk to fifty feet. Furthermore, samplings were taken at five foot intervals. Sufficiently large intervals to allow for existence of sandy strata between these intervals.

The Environmental Protection Agency noted in the 1977 report that "the extent and location of sand lenses should be fully investigated", page 64. This recommendation has not yet been acted upon. The EPA was particularly concerned by the matter of sand lenses because during a field investigation two EPA staff noted a sand lense 2 feet by 65 feet in trench #12. The trench was open at the time. EPA noted that the lense disappeared into the walls of the trench. "To the east, west and south, it is approximately one foot thickwith no sign of thinning as it disappears into the sidewalls and end of the trench", page 51. Because trench #11 was not open at this time, EPA could not determine if this sand lense penetrated the adjacent trench or not. Clearly, this EPA field observation calls into question the assertion by DOE and others that there are only a "few discontinous layers" of sand len ses at the site.

Supposedly, one of the checks against construction of the trenches in areas penetrated by sand lenses was visual checks by bulldozer operators. This check did not work in the case of trench #12 which was in the process of being filled when it was examined by EPA staff. Visual inspection by operators untrained in geology is an inadequate substitute for careful, methodical core drillings.

Underground migration of nuclides

After trench construction and filling more extensive borings have been conducted in the area of the state-licensed burial ground. About 250 drillings were conducted at about 5 meters from the burial area. These borings showed fairly consistently a fine sand strata at elevation 1339 to 1351 feet. This elevation is below the bottoms of the trenches if they are actually 30 feet deep (it must be remembered that this depth is an estimate because of lack of records of site preparation) but within the depth of the NRC-licensed burial ground where the burial holes are considerably deeper—to a depth of 50 feet.

These 250 borings were completed in connection with a USGS study on outward migration of tritium at the site. In the USGS study entitled " Ground Water Hydrology and Subsurface Migration of Radioisotopes at a Low Level Solid Radioactive Waste Disposal Site, West Valley, New York", Open File Report 77-566 (henceforth referenced as USGS 77-566), there has been significant outward migration of tritium from the site. The lateral migration has been 8 feet outward in the instance of boring E and D and 39 feet outward in the instance of bering B. The pathways for this migration are not known. But according to USGS 77-566 on page 16 "the anomalies are due to outward and downward migration of tritium from the burial trenches, probably <u>in part along lenses of silt whose permeability permitted more rapid flow</u> and whose orientation may have favored lateral movement". Clearly, the past tense is inappropriate here. If material has moved along lenses, it is still moving along undected and unknown strata of greater permeability than that which has been assumed for the site.

The USGS report underscores the importance of following through with the EPA recommendations that the extent and location of sand lenses must be thoroughly investigated.

The NRC-licensed burial ground.

This burial ground covers.5 acres. Material buried here is of a higher level--including fuel hulls, contaminated equipment and unreprocessed fuel assemblies. All of the concerns we have expressed in the discussion of the state-licensed burial ground. Holes here are 50 feet deep and the area is not surrounded by monitoring wells.

What is in the burial ground?

The phrase "low-level" is misleading. A lot of material located in the state-licensed burial ground is high level. There are, for instance, 15,000 curies of Strontium 90 in trench #4 plus 12 lbs of Plutonium 238 and 239 in trenches 5,8,9,10,11. This burial ground also includes large amounts of cobalt 60, a strong gamma emitter. Because of the large inventory of these isotopes in a burial ground plagued by the problems identified in the first section of the presentation, the Sierra Club believes that trenches 4,5,8,10, and 11 should be exhumed. There are a total of 710,000 curies of material in the state-licensed burial ground.

In the NRC licensed burial gournd there are 550,000 curies of material, including 41,500 curies of Cesium 137. There is a particularly high inventory of this isotope because of its presence in nuclear fuel hulls. Fuel hulls left over after the chopping part of the reprocessing operation were dumped into this burial area as well as ruptured fuel assemblies from the Hanford reactor--these damaged fuel assemblies could not be processed and were dumped into the ground and surrounded by concrete. Clearly, these concrete encasements will not last the lifetime of the hazardous isotopes present such as Cesium which will be hazardous for at least 300 years. Cesium is water soluble and can easily migrate via water. We are particularly concerned regarding the possibility of these high level materials intersecting wtih at present undetected sand lenses and migrating laterally off-site.

We feel that the state legislature should move promptly to conduct a feasibility on exhuming the high-level, hazardous material present in both the state-licensed andNRC-licensed burial ground and in placing this material in above-ground storage containers made either of steel or concrete until such a time as a permanent repository is available. We request the NYSERDA board's assistance in pressing for this important step to protect public health and safety in the region.

We know that there has already been some migration of burial ground material down stream. We believe that there will be additional migration in the future--if these materials are not dug oup and more safely stored. According to the DEC 1977 report on Environmental Radiation in New York State which was just released a sampling of sediments behind the Springville Dam, located several miles downstream from the burial area, showed the presence of both Pu-238 and Pu-239 with these isotopes in a ratio that indicates " some 238 came from the burial ground as a result of pumping water from the open trenches".

Good Condition

It has been a consistent theme of the Sierra Club that the costs for cleaning up the West Valley site should not just be borne by the U.S. federal taxpayer and the state taxpayer but should be borne by the corporate polluters whose activities resulted in a long-term toxic problem. The original waste storage agreement between Nuclear Fuel Services and the State of New York specified that the site must be left in "good condition". We feel that a significant opportunity to recover costs from the responsible corporations was jeopardized when language inserted by Congressman Dingell into the Lundine solidification bill was eliminated at the last minute (this language called for the Attorney General to do a study on the issue of corporate liability at the site). We hope that a similiar opportunity will not be lost at the burial ground.

Reimbursement of costs

According to the General Terms and Conditions Applicable to Radioactive Waste Burial Service, December 14, 1970, paragraph 9 NFS can reclaim from the Customer the costs incurred by "removing, shipping and storing" the radioactive materials in the burial ground if the removal of same is "required by law, regulation or license change". This provision should be borne in mind as we hopefully, move to an exhumation of the highly toxic materials that are currently sitting in the ground at West Valley.

Re-opening of the burial ground not acceptable

With the long history of problems at the burial ground with the problems of erosion, failure of walls of the trenches, indentation and settlement cracks on the trench covers, and the persistent accumulation of water in the trenches, plus lateral migration of isotopes and an insufficient data base on the extent and location of sand lenses, it is unacceptable to the Sierra Club and to citizens in Western New York to contemplate the re-opening of the burial ground for any purposes. We do not accept the lever of medical wastes as a method of forcing open the burial ground first for these wastes and then for all commercial low level wastes. Even if wastes could be strictly limited to medical wastes, and we do not believe that this limitation would be upheld in the courts, we would vigorously oppose the re-opening of the burial ground to these materials. It is clear that there are many management solutions to the medical waste problem, sorting of materials at source by curie and half-life, that must be thoroughly investigated before any landfill operation is considered. Given the history of migration of materials form landfill operations, we feel that hazardous materials should be placed in above-ground concrete or steel containers that can be monitored and repaired if leaks develop.

ATTACHMENT D

SIERRA CLUB

radioactive waste campaign
fact sheet

Insecure Landfills:

The West Valley Experience

A "low-level" burial ground sounds relatively harmless. The nuclear industry regularly promotes the concept of "low-level" as nothing to worry about. But is the term accurate? The Maxey Flats "low-level" burial ground, near Morehead, Kentucky contains almost 2 million curies* of radioactivity, including about 200 lbs. of Plutonium 239. And, the State-licensed portion of the West Valley dump, 35 miles south of Buffalo, New York has 12 lbs. of Plutonium, 15,000 curies of Strontium, and 40,000 curies of Cobalt 60, among other materials.

These large amounts of extremely hazardous, long-lived radioactive materials belie the term "low-level." To avoid the implication of harmlessness, we suggest the use of the term solid radioactive waste as a substitute for "low-level." It is important to note, however, that most solid radioactive waste burial grounds rapidly are liquified as water infiltrates into the dumping area.

the origin of solid radioactive waste

The popular image of solid radioactive waste material is of "slightly" contaminated booties, paper trash, animal carcasses and a few discarded work clothes. Actually, only about 1% of the curie content of waste generated by commercial reactors comes from contaminated clothing. And, slightly less than 1% comes from contaminated piping and concrete that must be periodically removed. (In understanding burial ground problems, it is important to make a distinction between waste by amount of volume, by curie content and by the half-life** of the radioactive materials involved. It is these last two factors which are most important.)

Ninety-eight percent of the curies generated by reactors come from byproducts left over after reactor coolant water has been cleaned.[1] The reactor coolant which circulates around the highly radioactive fuel rods must be regularly purified. The water is filtered through resins and dissolved contaminants are concentrated in evaporators. These contaminated resins and evaporator sludges contain significant quantities of Cobalt 60 and Cesium 137. Since Cobalt and Cesium have a half-life, respectively, of 5 years and 30 years, the materials must be carefully isolated from the environment for hundreds of years.

In one year of operation, a boiling water reactor produces a total of 4,100 curies of solid radioactive waste, and a pressurized reactor produces 1,900 curies.[2]

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* Curies are a measure of radioactivity the way miles-per-hour represent speed. One-millionth of a curie of Plutonium can cause lung cancer if it is inhaled.

** A half-life is the time during which one-half of the radioactivity of a radioactive material decays. The industry rule-of-thumb is after ten half-lives a material will be safe.

Thus, during the 30 year lifetime of one reactor, about 57,000 to 123,000 curies of so called "low-level" waste are produced.

medical treatment blackmail

The nuclear utilities have recently been using the need for dump sites for medical wastes as a cover to promote siting of radioactive waste dumps for commercial reactor waste. The medical-treatment-blackmail argument basically states if citizens do not agree to opening a burial ground, parents and loved ones will not be able to receive radiation treatment for cancer. Statistics belie this argument.

Medical wastes represent 25% of the volume of solid radioactive waste, but contain less than 1% of the total radioactivity disposed of annually. In other words, the toxicity of medical waste is minor compared to commercial nuclear power plant waste. Furthermore, according to a Nuclear Regulatory Commission survey, 97.8% of this waste has half-lives of 60 days or less.[3] This means that if this material is sorted at the source and stored temporarily for a matter of months, the waste can be disposed of as normal trash. Twenty-five percent of the solid radioactive waste problem can be solved through better planning and administrative procedures at hospitals and medical centers.

status of burial sites

There are currently three commercial burial sites that are shut-down and three operating. The three shut-down plants are Maxey Flats, Kentucky (1963-1977), West Valley, New York (1963-1975) and Sheffield, Illinois (1967-1979). These dumps are now closed because of off-site migration of radioactivity and poor burial practices. The remaining burial sites have also been plagued with problems. In 1979, both the Beatty, Nevada and Hanford, Washington sites were temporarily closed due to receipt of improperly packaged materials. The Barnwell, South Carolina dump will, by October, 1981, decrease by 50% the amount of out-of-state waste received. Since Barnwell has been receiving about 85% of the solid radioactive waste generated in the U.S., this restriction will have a major impact on other states and increase pressure for siting additional dump sites. Further, due to a referendum, the Hanford, Washington dump site will only accept medical wastes after July, 1981.

To meet the need for new dump sites, a bill passed the U.S. Congress in December, 1980, to allow states to form regional compacts to look for burial sites. Many individual states such as Massachusetts, North Carolina and New Jersey are actively developing dump site criteria and searching for locations. The assumption behind this search is that radioactive material can be safely dumped in the ground. This assumption needs to be re-examined.

does a "secure" landfill exist?

Advocates of burial grounds argue that a "secure" landfill can be "engineered" to prevent off-site migrations of radioactive materials and to adequately protect the public health and safety. The experience with toxic chemical "secure" landfills is similar to radioactive waste dumps and not re-assuring. Most "secure" landfills are, in fact, very insecure. At Love Canal, in Niagara Falls, New York

chemicals were dumped into the ground in the 1940s. Thirty years later, the chemicals had migrated underground into peoples' basements, water supply and lives. Love Canal is not an exception.

The performance record of chemical landfill sites has been extremely poor. A recent study[4] of landfills in New York run by SCA Chemical Waste Services and Cecos International, shows chronic problems of slumping, erosion and water infiltration. SCA, in 1980, was pumping 300,000 gallons per month of liquid from landfills built only 3 to 8 years earlier and Cecos was pumping, in 1980, 4,000 gallons per day from landfills closed in 1978 and 1979. The insecure landfill experience applies equally to radioactive waste dumps such as the West Valley facility.

The West Valley experience is important for citizens monitoring radioactive burial plans elsewhere in the country. The argument by industry is that West Valley was, indeed, plagued by problems, but industry has now learned from those problems and the next burial site will be correspondingly better. We see no evidence, however, that the industry has learned the lessons of West Valley. The West Valley lesson, as we shall see below, shows that radioactive materials should not be dumped into the ground where it is impossible to control or monitor the movement of these hazardous materials for the necessary number of years. The Sierra Club Radioactive Waste Campaign advocates above-ground storage in concrete or steel bunkers.

West Valley: a brief history

The West Valley State-licensed burial ground* operated between 1963 and 1975. During that time, 550,000 curies of material were dumped into dirt trenches approximately 30 feet deep and about twice as long as a football field—600 feet (see Map #1). The trenches were not lined with concrete, plastic or any other medium. Radioactive garbage was dumped directly into the ground in a "pussy-cat" approach: A little earth was scratched away, material dumped in and then, re-covered by scratching back the original earth.

There are two sets of trenches at the 7-acre West Valley facility. North trenches, #1-7, were dug and filled between 1963 and 1969, and south trenches, #8-14, between 1969 and 1975 (see Map #2). Within a few years of filling, water started to infiltrate into and accumulate in the north trenches. By March, 1975, the radioactive water broke through the cover of trench #4 and spilled radioactivity into nearby streams. Unfortunately, trench #4 contained 15,000 curies of Strontium 90, a very large quantity. During 1975, the average Sr-90 levels at a monitoring station adjacent to trench #4 were 14,102 pCi/l with a maximum reading of 270,000 pCi/l.[5]** Because of this spill, the burial ground was closed in 1975.

Ever since the 1975 spill, there have been semi-annual pumpouts at the north trenches. Over 2 million gallons of radioactive water have been pumped as of Spring 1981. The contaminated liquid is treated on site with left-over sludges being dumped into the Nuclear Regulatory Commission licensed burial ground, and the treated but still radioactively contaminated liquid released to nearby Franks Creek.

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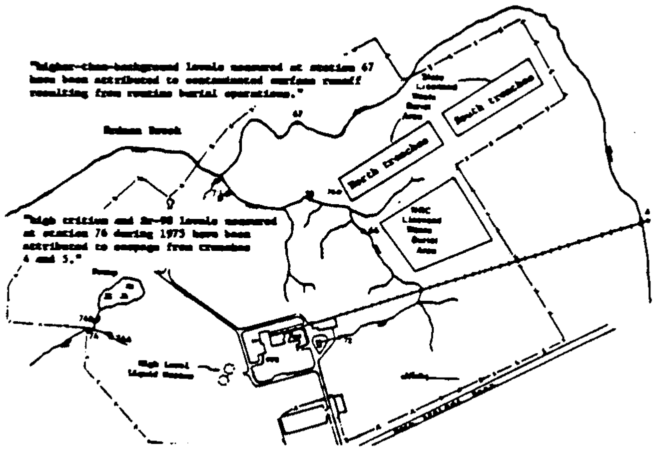
* There is also a Nuclear Regulatory Commission (NRC) licensed burial ground at West Valley. The NRC burial ground is not covered in this fact sheet.

** This is about 900 times the so-called "safe" off-site levels set by the NRC.



Map #1. Nuclear Fuel Services plant and burial grounds at West Valley. Note several streams that cut through the site. Superimposed quotations are from a 1978 U.S. Department of Energy study. Map adapted from "Annual Report of Environmental Radiation in New York State, 1975," New York State Department of Environmental Conservation.

Originally, it was thought that the water infiltration problem was due to inadequate trench cover. The original north trenches that were accumulating water had only 4 feet of cover. In 1969, the trench design was "improved" and cover at the south trenches increased to 8 feet. In 1978, the U.S. Department of Energy (DOE) was optimistic that water infiltration into the trenches would cease. But, in 1979, the New York State Department of Environmental Conservation announced that a pumpout of the "improved" south trenches was now necessary. By 1980, over 900,000 gallons of liquid needed to be pumped from these trenches. With both the north and the south trenches, the route of infiltration—through trench covers or through underground sandy strata—was not known.

In late 1980, the New York State Energy Research and Development Authority (NYSERDA), went to court to prevent the operator of the site, Nuclear Fuel Services (NFS) from abandoning the burial ground, as the company had intended to do. NFS, a subsidiary of Getty Oil, had a 17 year lease with the State which terminated on December 31, 1980. NYSERDA in asking for an injunction against NFS claimed that the burial ground was in default, and without continual maintenance would be a hazard to public health and safety. Furthermore, in an attempt to assure adequate funds for remedial action and perpetual maintenance, NYSERDA also asked that Getty Oil not be allowed to withdraw $16 million in loans it had made to NFS. A court hearing on the case is due in Spring 1981.

What are some of the lessons or warnings of the West Valley experience?

warning 1

A handful of geologic borings cannot adequately characterize a radioactive waste burial site. West Valley has been described by the nuclear industry, the U.S. DOE, and the New York State government as being located in an almost ideal, "impermeable" clay-like till. This characterization was based on four original drillings on a 22-acre burial site.[6] Obviously, this small number of drillings—one for every five acres—was insufficient evidence. Furthermore, samples were taken at 5 foot intervals, which would not detect permeable strata of significant widths. More detailed geologic studies of the site have since been made, but after large quantities of radioactive materials were already dumped into the ground. Thus, there has been a strong bias in all subsequent studies to prove the safety of the burial ground.

The inadequacy of the site characterization at West Valley is reflected in the fact that the burial ground was located in an area of swamps and sand lenses (see Warning #2). A sand lens is a sandy strata along which radioactive materials can migrate laterally, underground. A sand lens is permeable. In 1981, the dimension and depth of these sand lenses at West Valley have still not yet been accurately delineated. In 1977, the U.S. Environmental Protection Agency requested that the locationand extent of sand lenses be surveyed. Three years later, this request has not yet been acted upon.

warning 2

State agencies and commercial operators which are deriving income from a dumping operation cannot be relied upon to provide accurate information regarding radiologic hazards or geologic suitability of a site. Unfortunately, other state agencies may also not be reliable sources of information—particularly if a pro-nuclear governor is appointing agency heads. At West Valley, the State relied upon visual inspection by bulldozer operators to determine the presence or absence of sandy strata. But it took a field inspection by U.S. Environmental Protection Agency (EPA) staff to detect a large (2' by 65') sandy strata in one of the trenches, open and being filled, at the time of the EPA visit.[7] This strata had not previously been reported by the corporate operator of the site, Nuclear Fuel Services. The existence of this sandy strata was, furthermore, totally ignored in a U.S. Department of Energy report on the West Valley site in December, 1978. "Western New York Nuclear Service Center Study," TID 28905-2.

The existence of a second, even larger, sandy strata was uncovered by the Sierra Club Radioactive Waste Campaign in the Fall of 1980. Until this time, the New York Department of Health, and New York Department of Environmental Conservation had kept the existence of this strata—100' by 200'—secret. The agencies had known about the strata for six years—since 1974. It is not yet known whether there is a connection between the EPA-discovered sandy strata and this larger one. It is not known whether there is a connection between this strata and a swampy area that is close by (see Map #3). These are major uncertainties that should have been carefully investigated before a dumping operation was initiated.

warning 3

The mechanism for migration of radioactive materials off dump sites is poorly understood. At Maxey Flats, Plutonium 239 has been found a mile from the site. It is not known whether migration was via underground strata or surface runoff. At West Valley sediment in a dam on Cattaraugus Creek, 2 miles downstream of the dump site, contains Plutonium 238 and Cesium 137 from the burial ground.[8] Thus far, Tritium has migrated a distance of 32 feet from some of the West Valley trenches, and is released in each pumpout of the trenches. It is not known why this migration is occurring. In addition, a recent discovery proved that tritiated gas is being released from the trenches as methane builds up in the trenches from decomposing carcasses and rotting packaging.

warning 4

There is no known way to control slumping, compressing and shifting of material dumped in a burial ground. One reason water penetrates a dump site such as West Valley is that materials (steel drums, wooden crates and cardboard packages) inside the trenches rust, degrade, rot and settle. As this happens, the trench cover, likewise, shifts and settles. In this process, large cracks and indentations occur in the cover. One way water accumulates in the trenches is through these openings. This shifting and settling will occur indefinitely. This problem is exacerbated in a region of high rainfall such as Western New York.

As trench cover is progressively made thicker and heavier, it becomes harder to prevent the covers from slumping down into the trench cavity. Only if and when the compressive strength of the material inside the trench has been built up to equal the weight and density of the cover, will this process cease—in hundreds of years, perhaps.

warning 5

Costly pumpout at burial trenches will be needed indefinitely. Since all the solid radioactive waste burial grounds contain water-soluble radioactive materials such as Cesium and Radium, it is extremely important to prevent release of these materials to near-by streams. Pumped out liquids must be treated. Unfortunately, Tritium cannot be removed by existing treatment techniques. At West Valley, 6,700 Ci of Tritium have, thus far, been released into nearby streams. Treatment and pumping costs are high. In 1980, the annual pumpout costs at the Maxey Flats dump was $500,000 per year. With rising inflation, in a few years, pumpout costs at many shut-down burial sites will exceed $1 million per year. Nuclear Fuel Services estimated in 1980, that maintenance of the West Valley burial ground would reach a whopping $3 million per year.

warning 6

After a dump site is closed, corporate owners of burial sites try to pass perpetual care costs onto the state and federal taxpayers. It has been virtually impossible to make accurate estimates of the monies needed for these perpetual care funds. At West Valley, NFS, the corporate owner, has placed $4 million into a perpetual care fund. This was the amount of money the Atomic Energy Commission thought necessary in 1963. Seventeen years later, this estimate is a tiny percentage of expected costs. Clean up of the high level liquid wastes at West Valley have been estimated at $280 million and clean up of the burial ground may be equally high. Clearly, the $4 million fund is totally inadequate.

warning 7

As hazards of radioactive materials are better understood, regulations regarding what can and cannot be dumped in the ground are changing radically. Prior to 1972, it was considered permissible to dump liquid wastes and Plutonium 238 and 239 into the ground. This is now forbidden. We expect regulations to continue to become more rigorous. Some current 1981 burial practices will be considered unacceptable within a few short years.

The West Valley burial ground is insecure. For decades, there will be off-site migration of long-lived, hazardous isotopes unless these materials are dug up and placed in above-ground storage bunkers of steel or concrete. These bunkers could be monitored properly and maintained until a federal repository is located. The Campaign believes the New York State Legislature should fund a study of the feasibility of digging up these materials. The Campaign urges citizens in other states to investigate the integrity of existing dump sites and to promote above-ground storage for new dump sites.

For further information: Sierra Club Radioactive Waste Campaign, Box 64, Station G, Buffalo, New York 14213. Phone: (716) 832-9100. Single copies of this fact sheet $.50, 25 or more $.10 each plus postage.

Footnotes:

1. Report to the Governor's Task Force on Waste Management. Low Level Radioactive Waste Management in North Carolina. September, 1980, p. 10.

2. Final Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors, NUREG-0002, Vol 3, IV-H-16.

3. "The Problem of Disposing of Nuclear Low-level Waste: Where Do We Go From Here?" EMD-80-68, p. 8, Government Accounting Office.

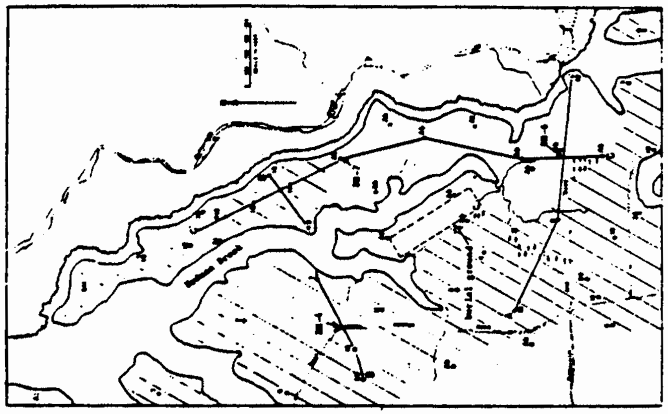
4. "Performance Difficulties of 'Secure' Landfills for Chemical Waste and Available Mitigation Measures," paper presented by Peter Skinner before American Society of Civil Engineers, 1980. Available NYS Attorney General, Albany, New York.

5. Annual Report of Environmental Radiation in New York State, New York State Department of Environmental Conservation, 1975.

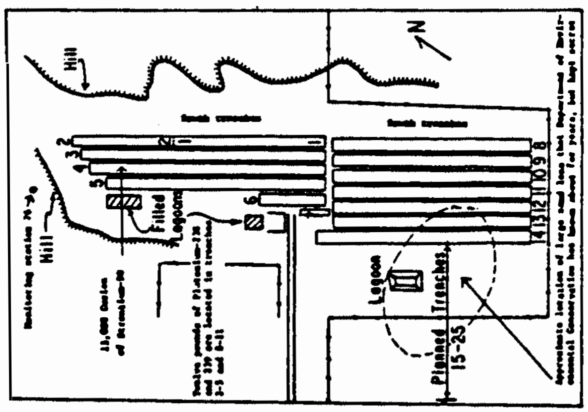
6. Safety Analysis Report, Nuclear Fuel Services, 1962, NRC Docket 50-201.

7. "Summary Report on the Low-level Radioactive Waste Burial Site, West Valley, New York, 1963-1975." U.S. Environmental Protection Agency, 1977, EPA/4-77-010

8. Annual Report of Environmental Radiation in New York State, NYS Dept. of Environmental Conservation, 1977.



Map #3. Map shows location of geologic drillings, distribution of surface deposits, and presence of swamps. Note burial ground with south end located in a swamp--see grass hatching. Ab means absence of coarse surface deposits, numbers adjacent to dots show depth of coarse deposits, where present. From Figure 2.22a, Safety Analysis Report, NFS, 1962



Map #2. Close-up of burial trenches. Trenches are built close to steep slopes leading down to Erdman Brook tributaries. Note location of Strontium 90 and Plutonium 238. Adapted from "Annual Report of Environmental Radiation in New York State," New York DEC, 1975.

ATTACHMENT E

Natural Resources Defense Council, Inc.

25 KEARNY STREET
SAN FRANCISCO, CALIFORNIA 94108
415 421-6561

Washington Office
1725 I STREET, N.W.
SUITE 600
WASHINGTON, D.C. 20006
202 223-8210

New York Office
122 EAST 42ND STREET
NEW YORK, N.Y. 10017
212 949-0049

February 20, 1980

Dr. Goetz Oertel, Director
Division of Waste Products
Mail Station B-107, GTN
U.S. Department of Energy
Washington, D.C. 20545

RE: Notice of Intent to Prepare a Draft Environmental Impact Statement (DEIS) for a Processing Facility to Immobilize High-Level Liquid Radioactive Wastes in Cattaraugus County, New York (44 Federal Register 71859; December 12, 1979).

Dear Dr. Oertel:

Thank you for the opportunity to suggest the appropriate content of the Department of Energy's (DOE) proposed draft environmental impact statement (DEIS) for a processing facility to immobilize high-level liquid radioactive wastes currently stored at the Western New York Nuclear Service Center at West Valley, New York.

The Natural Resources Defense Council, Inc. (NRDC) supports immobilization of the West Valley high-level wastes as soon as it can be accomplished safely and consistently with the ultimate disposal of such wastes. We believe, however, that the Department's outline for the DEIS on the immobilization of West Valley wastes is incomplete and would not result in a satisfactory analysis for sound decisionmaking, for the following reasons:

(1) The proposed DEIS does not appear to include an analysis of alternative techniques for immobilizing the wastes after removal from the tanks. The DEIS should include an environmental review of alternatives for immobilizing the wastes in sufficient detail to explain DOE's selection of one technique over others.

(2) The environmental review of alternative waste forms should be included in the DEIS and not treated separately in an "environmental review" as proposed in

Dr. Goetz Oertel
February 20, 1980

PAGE two

the notice of intent. 1/ It is insufficient to assert that the DEIS calculations using glass monoliths as the reference waste form will be "the worst conditions expected." 2/. The purpose of the EIS is not to provide a worst case analysis. Rather, there must be a careful assessment of the advantages and disadvantages of <u>all</u> reasonable alternatives. Any other approach will not satisfy the requirements of the National Environmental Policy Act.

(3) The selection of a waste form for West Valley waste cannot be based solely on the environmental impacts at West Valley. The behavior of the waste in the environment of an ultimate disposal facility also must be considered carefully. Therefore, the DEIS should consider a variety of waste forms which are potentially compatible with the potential geologic environments of the first high-level waste repository.

(4) The technological difficulties associated with tank cleaning at West Valley must be addressed as part of the "On-site" alternative.

In addition to these suggestions we have identified several areas that need further consideration in the West Valley immobilization plans. These suggestions are summarized below and are discussed in greater detail in our comments on the DOE study of the Western New York Nuclear Service Center, November, 1978: 3/

1. The discussion of alternative methods for cleaning the tanks at West Valley requires a detailed discussion of the difficulties encountered during similar efforts at the Savannah River Plant (SRP) and the Hanford Reservation. Before the tank cleaning techniques used at these two other sites can be transferred to the West Valley tanks, DOE must consider differences in the chemical composition of the waste and in the tank

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1/ 44 *Fed. Reg.* 71860 (footnote).

2/ *Id.*

3/ A copy of those comments is attached and incorporated thereby in this letter.

Dr. Goetz Oertel
February 20, 1980

PAGE three

at West Valley in comparison to those at SRP and Hanford.

2. A potential problem associated with in-tank solidification is the hydrologic conditions at West Valley and changes in these conditions during the hazardous lifetime of these wastes. A thorough analysis of the site geology and hydrology should be made as part of the evaluation of the option to use in-tank solidification as an ultimate disposal means.

3. There are substantial doubts regarding both the availability and acceptability of glass as a waste form for the wastes at West Valley. In addition, there has been no indepth study of the modifications required at the Center to vitrify the waste. We believe these problems and their potential solutions need to be discussed in the DEIS.

Lastly, we stress that the schedules for immobilization must be integrated with the availabilty of an ultimate disposal site. The immobilization plans, moreover, should be compatible with potential future uses of the West Valley site.

We would be happy to review and comment informally on early versions of the DEIS, or provide any other assistance we can in developing the needed full analysis of alternatives for immobilizing the West Valley wastes. In any event, please send us a copy of the DEIS as soon as it is available and keep us informed of DOE's plans regarding the future of the Western New York Nuclear Service Center. Also, we request that a copy of the transcript of the February 2, 1980, public meeting held in West Valley, New York, be available for inspection at the DOE's Energy Information Center, 111 Pine Street, San Francisco, California, 94111. 4/

4/ Please note that the address for the Center listed in the notice is out-of-date and incorrect.

Dr. Goetz Oertel
February 20, 1980

PAGE four

Thank you.

Sincerely,

Georgia Yuan
Project Geologist

Terry R. Lash, Ph.D.
Staff Scientist

GY/TRL/jt

ADDITIONAL COMMENTS OF THE SIERRA CLUB RADIOACTIVE WASTE CAMPAIGN
October 26, 1981

The Sierra Club is greatly concerned about new revelations of radiation seepage at the West Valley site. According to an aerial survey of the West Valley site done by a DOE contractor (EG&G 1183-1782, Dec., 1980), a radioactive prong now extends 1½ miles from the burial ground/reprocessing plant complex. This radioactive prong, now extending off-site, nas great ramifications regarding long-term maintenance of the burial grounds and high level waste tank farm, NFS/Getty contributions because of the "good condition" provisions in the contracts, and the health and safety of the public. This material must be factored into the West Valley EIS as it has relevance to the Solidification Demonstration Project.

A description of the radiation prong and our analysis of it is given in the attached pages. It is NFS' interpretation that the radiation pattern is due to regular releases of cesium from the reprocessing building stack. This interpretation cannot be true because the prevailing wind direction is not northwest. The cesium radiation pattern reported by EG&G can have only two possible causes. It can be due to a single puff from the stack while the wind was blowing in the Northwest direction, or it can be due to underground migration from the reprocessing building/burial ground complex. NFS has never reported a radiation puff from the stack and it has never appeared in any Inspection Report or any official agency document, either by the State or Federal government. If DOE has evidence of a release of radioactivity from the stack leading to this radiation pattern, this should be so stated in the EIS. A sampling program, measuring soil samples within and outside the plume equal distances from the stack, should quickly determine whether this radioactivity is on the surface or underground.

The Club believes that the radioactivity is migrating underground along a sand/gravel lens which underlies the entire site about 50' below the surface. If no pattern is detected in the soil samples mentioned above, then water samples from this low-lying sand strata should be taken, particularly at the homes at the intersection of Schwarz and Dutch Hill Roads. Some of these homes have deep wells.

If it is determined that radioactivity is moving along deep sand/gravel lens, this has ramifications for the West Valley EIS and the project. It implies to us that the hazard of leaving a contaminated high level waste tank at the West Valley site is greatly increased and that Options 3 and 4 must be discarded. It also implies that the burial grounds must not be used for additional low level wastes which may be generated by the project. This is because a recognized pathway exists for radioactivity to reach Cattaraugus creek in a short time period. Previous estimates by the company that water would move to the nearest waterway in 38,000 years must then be dismissed since cesium, not water, would have moved 1½ miles in 10 years.

In discussing the implications of EG&G 1183-1782, DOE must discuss why the information on the aerial survey was not factored into other DOE studies, including the EIS. DOE should also discuss why this information was not released to State agencies. Is there other information which DOE is withholding from the public regarding West Valley?

NEW OFFSITE UNDERGROUND MIGRATION OF RADIOACTIVITY AT WEST VALLEY

In 1979, EG&G conducted a radiological survey of the West Valley nuclear waste site, located 35 miles south of Buffalo. We have just obtained a copy of the report, which was published in 1980. Since the last aerial survey in 1969, a totally new area of radioactive contamination has emerged (see the enclosed maps). Cesium and other nuclides have migrated at an UNEXPECTED SPEED over 1¼ miles from the Nuclear Fuel Services reprocessing/burial ground area. Migration is in an UNEXPECTED DIRECTION.

As of this date the levels of contamination appear to be low. We are not reassured by these low levels. The aerial survey only measured gamma radiation. There may be high beta levels. Furthermore, no ground survey in this new area of contamination has been conducted, to our knowledge. Our concern is that a NEW, ENTIRELY UNEXPECTED, pathway for migration of radioactivity off of the West Valley site now exists.

A number of serious questions need to be investigated promptly.

WHERE IS THE CESIUM COMING FROM? Is the leaking from the unstable burial ground trenches? the shutdown, contaminated, reprocessing building? the high-level, liquid waste tanks? No one knows the answer to these important questions. But the Nuclear Regulatory Commission licensed burial ground is suspect. Large quantities of cesium were dumped in 50-foot deep holes in the burial ground. These deep burial holes may have intersected a permeable strata.

WHAT IS THE PATHWAY FOR MIGRATION?

AIR? This is unlikely. The reprocessing plant has been shut down since 1972. There have been no off-stack releases from the plant since then. This is a post-1973 phenomena. In addition, the wind is predominantly out of the south and southwest. If radioactivity were being blown off the site, it would be deposited on the land in a plume oriented towards the northeast and then the material would be washed by rainfall into nearby streams. But the radioactive prong is oriented towards the northwest (see Map #2) and streams in this area do not show any accumulation of radioactivity in sediment.

SURFACE DRAINAGE? This is also unlikely. The new area of radioactivity crosses the drainage basins of several creeks that drain towards Buttermilk Creek. Radioactivity has not been found to be moving down these creeks. Furthermore, the new contamination is in the location of a hill. How can surface radioactivity move UP a hill?

SUBSURFACE DRAINAGE? This is likely. If the radioactivity is moving via a HITHERTO, UNDISCOVERED, DEEP, UNDERGROUND, PERMEABLE STRATA, this would explain 1)Why the radioactivity is not affected by surface creeks and is moving in a contrary direction and 2)Why the radioactivity appears to be travelling up a hill. Actually, the radioactivity may be moving along a strata that is deep enough not to be influenced by the hill. WHERE THIS STRATA LEADS, IS UNKNOWN AT THIS TIME BUT THE CURRENT ORIENTATION MEANS CATTARAUGUS CREEK WILL BE REACHED IN 7/8TH OF A MILE.

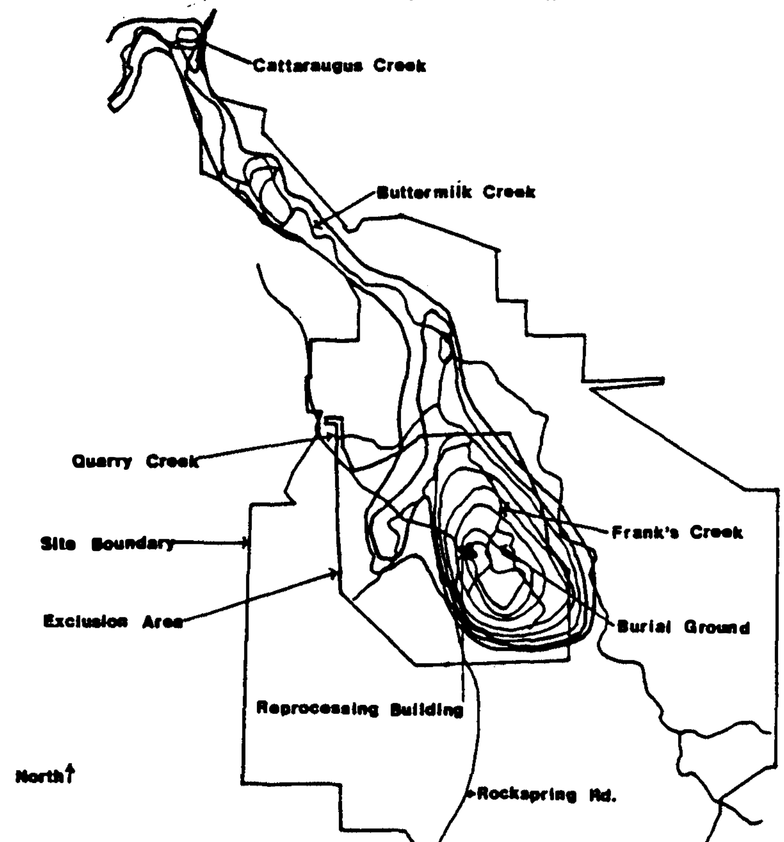
WHICH OF THESE EXPLANATIONS WILL THE U.S. DEPARTMENT OF ENERGY COME UP WITH? Or will the Department of Energy claim that its subcontractor, EG&G, has made an error and that, presto, there is no radioactivity in this area?

WHY HAS NO STATE OR FEDERAL AGENCY MADE REFERENCE TO THIS IMPORTANT FINDING BEFORE NOW? How long has this important information been kept secret? For how long have the state agencies—New York State Department of Health, New York State Department of Environmental Conservation, New York State Geological Survey, New York State Energy Research and Development Authority known about these studies? Why hasn't the public been informed? Or has the information been deliberately withheld by the U.S. DOE from the knowledge of state agencies?

THESE IMPORTANT QUESTIONS NEED TO BE ANSWERED NOW.

MAP 1

RADIOLOGICAL ISOEXPOSURE MAP OF WEST VALLEY 1969

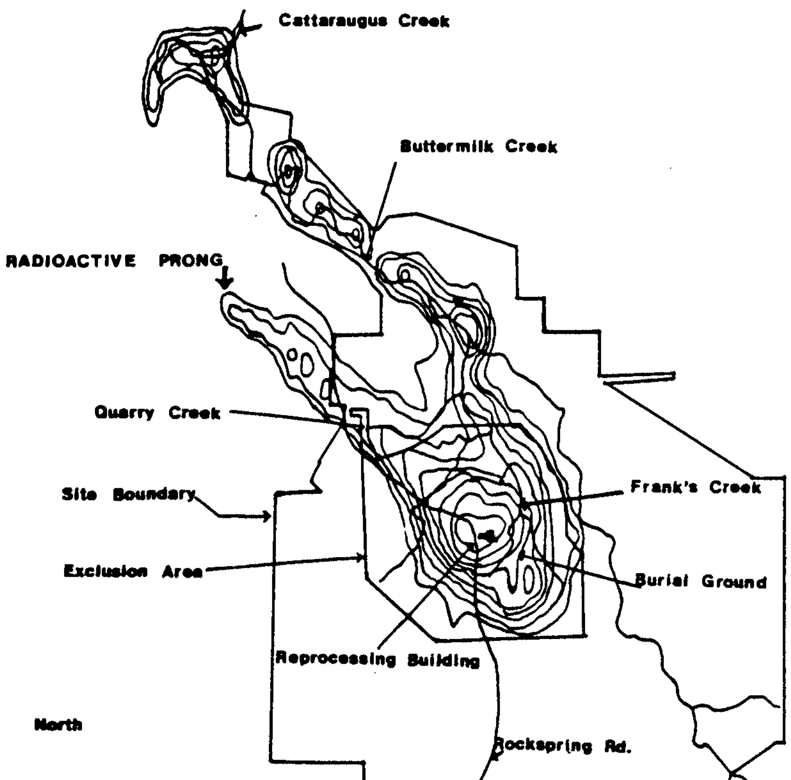


The isoexposure lines represent an equal radiation reading along its entire length (the way contour lines prepresent altitude on a contour map). The highest reading is 750 μR/h at the center over the reprocessing building and the burial ground. The lowest reading at the perimeter is 15 μR/h. This survey was done while the West Valley reprocessing facility was still in operation. Readings are considerably higher than in Map #2 which represents a survey done seven years after shutdown of the facility.

Adapted from 1969 aerial survey, "Environmental Report, Nuclear Fuel Services, Inc., Reprocessing Plant, West Valley, N.Y.", 1973.

MAP 2

CESIUM-137 ISOEXPOSURE MAP OF WEST VALLEY 1979



BLACK shows the site boundary of the West Valley facility (the 3000 acres leased by Nuclear Fuel Services from the State of New York), the exclusion area (the area directly around the reprocessing building and radioactive waste storage areas) and Rockspring Rd.

BLUE shows the streams that cut through the site and drain into Buttermilk and Cattaraugus Creek.

GREEN shows the cesium-137 isoexposure lines. Each line represents an equal radiation reading along its entire length (the way contour lines represent altitude on a contour map). The highest reading is 288 μR/h at the center over the reprocessing building. The lowest reading at the perimeter is 0.4-0.7 μR/h.

Adapted from Figure 3, page 10, "An Aerial Radiological Survey of the Nuclear Fuel Services Center (NFS) and Surrounding Area", EG&G, 1183-1782, December, 1980.

Letter 28

104 Davey Lab.
Penn State Univ.
University Park
Pa., 16802

28 October 1981

West Valley Program Office
Office of Waste Operations and Technology
NE - 320
Nuclear Waste Management and Fuel Cycle Programs
U.S. Department of Energy
Washington, D.C., 20545

Dear West Valley Program Office:

Enclosed are my comments on the Draft Environmental Impact Statement on West Valley Wastes. Please note that the opinions and calculations expressed are not necessarily those of The Pennsylvania State University. I would hope to obtain a copy of the FEIS when it becomes available.

Sincerely,

Wm. A. Lochstet, Ph.D.

Long Term Consequences of
Disposal of West Valley
Wastes

by

William A. Lochstet
The Pennsylvania State University*

October 1981

The Department of Energy has attempted to evaluate the environmental and health impacts of the radioactive wastes at West Valley in its Draft Environmental Impact Statement (Ref. 1). These impacts are evaluated for the first 10,000 years to be as high as 120,000 person -rem for the no action case (Table 4.16, P. 4-34, Ref. 1). The risk per year thereafter is estimated to be 2 person-rem per year for the same case. no indication is made for how long this risk would continue.
28-1 If this risk were to continue for only 100,000 years, the risk after the year 10,000 would exceed that before. Thus there is an arbitrary cutoff in time which is not based on reality.
28-2 Similarly, in section 4.1.7 (P. 4-30, Ref. 1) it is noted that only the population within 80 km is considered in evaluating the health consequences. This is done in direct conflict to the APS review of major reactor accidents (Ref. 2) which shows that even though the dose per person is less at larger distances, there are many more people, so that the exposure in person-rems in the outlying region is larger. The draft EIS (Ref. 1) does use the linear, non-threshold relationship between radiation doses and health effects (Ref. 1, P. 4-36), as it should.

The consequences of several specific long lived isotopes have been recommended for consideration (Ref. 3, P. 3† and 2).

* The opinions and calculations contained herein are my own, and not necessarily those of the Pennsylvania State University, which affiliation is given here for identification purposes only.

28-3 The iodine - 129 is a specific isotope suggested here. Iodine - 129 is not even mentioned in the tables of composition (Tables B.2 and B.4 , Ref. 1,). This is an improper omission. From figure 4.1 (Ref. 1, P., 4-3) it would appear that the iodine -129 inventory is about 4 curies. This material will presumably be placed in the Federal High level Waste depository,

28-4 although that is unclear. In particular, Iodine would be vaporized in a heating process such as vitrification or calcination. This situation should be addressed in the Final EIS. It is also unclear what form the iodine would be in.

28-5 The dependability of a geological disposal to provide isolation has been described by the USGS (Ref. 4) and the EPA (Ref. 5) as being inadeouite. Suppose that by pure chance, the depository remains sealed for a million years. This is much longer than the 1000 years that geologists might be able to predict. Further, suppose that it leaks just a little, so that it takes another million years for the contents to escape. This is about the time scale indicated by the cold solubility of borosilicate glass. To simplify matters, suppose that these 4 curies of iodine - 129 become uniformly diluted in the stable iodine of the biosphere. I estimate that there may be as much as 100 billion metric tons of iodine available to the biosphere. This defines a steady state concentration diminished only by the radioactive decay of the iodine - 129 (17,000,000 year half life). The iodine content of a standard thyroid is 7 milligrams (Ref. 6). From this, the activity in a standard thyroid can be found, and in turn, using the methods of ICRP publications 10 and 2, the dose is obtained (Refs. 7 and 6). If the world population is assumed to remain constant at its present number of 4 billion, the dose can be obtained. This assumption of stable population was made in the DEIS (Ref. 1, P. 4-30). If this dose is summed over the total decay of the iodine , the result is 1.7 million person-rem to the thyroid. Using the method of

EPA, (Ref. 8) which uses the linear, non-threshold relationship between radiation dose and effect, a total of 17 thyroid cancers is estimated. At current rates, three to six of these would be fatal. These health effects are unavoidable, and will occur. They are also large compared to the DOE estimates as shown in sections 4.1.7 and 4.1.8 (Ref. 1). This issue should be addressen in the final EIS.

Another isotope of importance in long term health effects is radon-222 resulting from the chain decay of uranium - 238. This problem is mentioned in page 4-2 (Ref. 1), but the real results of an actual evaluation do not appear in the results. This is because this emission of radon occurs over a very long time, being governed by the 4.5 billion year half life of uranium-238. When this time scale is addressed, as it must, the health effects are important. If only about one- onehundreth of the radon produced in this decay escapes to the atmosphere, as a result of uncovering by erosion, or water transport, there will be about 100,000 deaths which result. The lung dose corresponding is 4 billion person - rem to the bronchial epithelium.

28-6 A similar, long term evaluation should also be made for Am - 241, Pu-239, Tc-99, as were suggested (Ref. 3, P. 2).

The use of borosilicate glass as a model waste form is indeed unfortunate since it has been pointed out by McCarthy et al (Ref. 9) that under the conditions expected during the first few years of burial in a salt deposit that such glass would disintegrate. Also, considering the 30 years it took to realize that glass is not good enough, it is hard to see how some other form is to be adequately tested by 1984. Considering these uncertainties, it would seem prudent to choose some interim waste form. The agglomerated calcine would seem to have more protection from being carried around by air currents, and also leave as many as possible options available for the future.

It is hoped that DOE will meet its obligations under NEPA to consider these issues in its final EIS.

References

1 "Draft Environmental Impact Statement, Long-Term Management of Liquid High-Level Radioactive Wastes Stored At the Western New Yoek Nuclear Service Center, West Valley", DOE/EIS-0081D, DOE, July 1981

2 "Report to the American Physical Society by the study group on light-water reactor safety", H.W. Lewis, et. al., Rev. Mod. Physics, Summer 1975, Vol 47, Suppl. No. 1.

3 "Suggestions for Environmental Impact Statement on West Valley wastes", February 1980, W.A. Lochstet, Submitted to DOE.

4 "Geological Disposal of High-Level Radioactive Waste - Earth - Science Perspectives" USGS, Circular 779, 1978

5 "State of Geological Knowledge Regarding Potential Transport of High-Level Radioactive Waste from deep Continental Repositories", EPA/520/4-78-004, EPA, 1978

6 International Commission on Radiological Protection, Publication No. 2, Pergamon Press, 1959

7 International Commission on Radiological Protection, Publication No. 10, Pergamon Press, 1968

8 "Environmental Radiation Dose Committment: An Application to The Nuclear Power Industry", EPA, 1973-002

9 "Interactions Between Nuclear Waste and Surrounding Rock" G.J. McCarthy et al, Nature, 273, P. 216 - 217, 1978

Letter 29 - No response required.

RD 2 Box 415
3197 West Five Mile Rd
Allegany, New York 14706
October 28, 1981

West Vally Program Office
Office of Waste Operations and Technology
NE-320, Nuclear Waste Management and Fuel Cycle Programs
U.S. department of Energy
Washington, D.C. 20545

Gentlemen:

In August 1981 I received the Environmental Impact Statement No. DOE/EIS-0081D and a few days later, an introduction to the West Valley Demonstration Project No. DOE/NE-0016. I was surprised to find myself on your mailing list but I feel that this is a very important project, therefore, I gave it what time I could. I failed to read the entire statement but I attend the hearing which was held in the school at West Valley on September 26, 1981.

I was exposed to a great deal of information in a very short time. I am not a nuclear scientist, my hearing a little less than normal and I feel that many of the people in the hearing did not talk loud enough to be easily heard by people with normal hearing. For whatever the reason I probably missed some important parts of the program. I did come away from West Valley with the feeling that there are people in the Nuclear Service that feel that they can cope safely with the West Valley problem. If these people do indeed know how to properly handle this task I feel that they should choose the best method of cleaning up this facility at the least cost to the taxpayer. I do stress that I wish to see a top quality job done even if it is costly. I live some twenty to thirty miles distant from West Valley and in a different watershed but I still have concern for those who maybe in greater danger than I. The West Valley region drains into the Cattaraugus Creek which in turn empties into Lake Erie. I think that it is very important that no dangerous amount of radioactive material is allowed to migrate into Lake Erie. The water from Lake Erie eventually reaches the Atlantic Ocean byway of the Niagara River, Lake Ontario and the St. Lawrence River. Cities along this route use this water for their municipal water. I feel that they are entitled to a safe water supply and anything less is not good enough.

I would have you do this job in the very best way possible, not only for those now alive but for generations as yet unborn. I would not approve of any slip shod methods which could be compared to sweeping the floor's dirt underneath the rug.

Sincerely yours,

Vernon E. Field

Vernon E. Field

Letter 30

Jeanne Pudala
Box 142
Alpine, NY 14805
October 28, 1981

U.S. Department of Energy
Assistant Secretary for Nuclear Energy
Office of Nuclear Waste Management
Washington, D.C. 20545

Comments Re DRAFT DEIS LONG TERM MANAGEMENT OF LIQUID HIGH LEVEL RADIOACTIVE WASTES STORED AT...WEST VALLEY July 1981

Dear Sir:

The history and present situation of the West Valley site has demonstrated that optimistic assumptions have proven to be unwarranted in the degree of their optimism. "New" problems are constantly found to have developed with respect to local geology, groundwater, the high level waste tanks, and local contamination. Recently it has been discovered that radioactivity including Cesium-137 has migrated much further than predicted. Any DEIS and the FEIS should be based on the following:

30-1 1. A complete evaluation of site geology and hydrology.

30-2 2. The full range of uncertainties associated with various options and strategies and avoidance of over-confidence in predictions made.

30-3 3. All scenarios for a rupture of the high level waste tank, loss of coolant in the spent fuel storage pool, and transportation accidents including the most pessimistic and "theoretically" impossible ones.

30-4 4. An analysis of the effects of low-level radiation including those more severe than the generally accepted BEIR report.

30-5 Finally, a definition of technical terms such as "supernate" and centrifugation. DEIS' in general and this one in particular, when dealing with a highly technical subject are basically unreadable by the non-technical

Thank You
Jeanne Pudala
Jeanne Pudala

Letter 31

215 West Grand Blvd.
Cheektowaga, New York 1422
October 28, 1981

Dear Sir:

I have several comments on the Draft Environmental Impact Statement (DEIS) regarding the "clean-up" of the high-level liquid nuclear waste in West Valley, New York.

The first item is the misuse of the words "clean-up." Using these words makes it sound like it's a safe, and clean method of dealing with toxic nuclear waste. However, we both know that this is untrue. Use of these words may mislead people who are naive about the critical situation. It must be made perfectly clear to people that we do not have a solution for dealing with nuclear waste, but rather have devised a method of putting liquid waste into a solid form. It must be remembered and pointed out to people that the material will still be radioactive, and therefore dangerous once we are through with it. Perhaps calling it the West Valley Demonstration Project - omitting the words "clean-up."

I am also concerned about the true intention of the West Valley Project. Is it to make West Valley safe? Or is it to demonstrate the knowledge we have for dealing with nuclear waste? It must be remembered that West Valley touches the lives of many people, and should not be handled haphazardly. I also think that if the government is really concerned about West Valley, they will support a "clean-up" option that will be advantageous for the welfare of the people involved. We must think of the best option - not the option that will provide the best economic program and take longer to do. Or damage to our health the price we'll have to pay for economic progress? .. I hope not.

31-1 Of the options available, I advocate the use of calcine, rather than a borosilicate glass. Since the calcine process involves a lower temperature process than the

31-1 glass, there will be less radiation releases. 3
Additionally, calcine has been used for twenty years so we are more aware of the outcome. Vitrification is more

31-2 of an experimental project. Also, since there is no repository available yet it would seem better to leave the waste in an interim form - which could later be converted once a geologic medium is selected for storage.

31-3 Another weakness in the DEIS is the assumption that a Federal Repository will be available by 1997. Since this repository will receive the high level waste it is important that such a repository be existant. Formulating alternatives dependent on facilities that do not, and may not exist is non-sensical.

Another non-sensical thing is leaving the high-level waste tanks in the ground after the radioactive sludge and liquid has been removed. Just because the radioactive material will be removed from these tanks doesn't mean that the tanks will no longer be radioactive. It is just a matter of time before the tanks corrode and release 4
radioactivity into our environment. Since the West Valley site is known for sand lenses it is inevitable that radioactivity will seep into the swamps and small streams surrounding the West Valley Site.

31-4 The tank must be exhumed!

31-5 I also feel that because of the swampy area the West Valley Site is in, full hydrologic and geologic surveys of the area should be done before the project is begun. The soil on the sight is <u>not</u> impermeable, and a complete study would show the hazards of the site associated with leakage from the solidification process or an accident.

I would also like to take this time to express my feelings to the DOE regarding this project. I feel that you have been very helpful to the public regarding this project. Your information sessions and Public Hearing were both very informative. Although a Public Hearing in Buffalo would have been more convenient, I nevertheless thought the Hearing was a success. I find it encouraging that the government and citizens can work together to accomplish their goals. I also thought the displays demonstrating the options were very helpful. These displays really helped me to see what the process will be like.

Being a nursing student I am very concerned with health and environmental issues. I really appreciate the opportunity to make my views known. Thank you for your cooperation, and I look forward to working together once the project begins.

Sincerely,
Susan A. Melardi
Student Nurse-
Nurses for Environmental Health and Education

Letter 32

Grote Rd R.F.D. #1
Springville N.Y. 14141
10-28-81

I wish to express some of my concerns on the DEIS dealing with West Valley. It seems very comprehensive but it is still selective - i.e. all possible problems and all alternative solutions are obviously not considered. How did you choose? To ~~[illegible]~~ further clarify the question:

32-1 You list 4 alternative methods to deal with the high level wastes. Why 4? - ~~and~~ were there others at first? etc.

32-2 Another concern is that the DEIS was written by D.O.E - the project will be under D.O.E jurisdiction. Is or was that undue influence? - conflict of interest? And what happens now if the D.O.E. is abolished? There are so many questions & the subject is so complex. But as a resident of the West Valley area, the whole clean up process is so unsatisfying to date. Please, chose safety over ~~[illegible]~~ cost.

Sincerely
Kathleen Dunn
KATHLEEN DUNN

Letter 33

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

OCT 30 1981

West Valley Program Office
Office of Waste Operations
and Technology
Nuclear Waste Management
and Fuel Cycle Programs
U.S. Department of Energy
Washington, D.C. 20545

Gentlemen:

We have reviewed the Department of Energy's (the DOE) draft environmental impact statement (DEIS) for the "Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley," DOE/EIS-0081D. Our specific comments on the DEIS, which are attached, are intended to improve the accuracy and clarity of the final environmental impact statement.

As stated in the DEIS, the basic decision being considered by DOE in this impact statement is "whether to construct and operate facilities necessary to solidify the HLW stored at West Valley." (p. 1-3). In making this decision, the DOE considered the environmental effects of four alternatives which included (1) on-site processing of the liquid wastes to a terminal waste form, (2) on-site processing of the liquid wastes to an interim waste form, (3) in-tank solidification, and (4) no action. DOE will identify its preferred alternative in the Record of Decision which will be published in the Federal Register in 1982 after the public and government agencies have had an opportunity to comment on the DEIS and after a final EIS has been issued.

It is our view that the basic decision being considered by DOE in this DEIS has already been made by the West Valley Demonstration Project Act (WVDPA or Act). The Act mandates that DOE solidify the high-level radioactive wastes at West Valley and transport the solidified waste to an appropriate Federal repository for permanent disposal as soon as feasible. Thus, the primary decision being considered by the DEIS has been rendered moot by the WVDPA.

The WVDPA will have a major impact on the overall program at West Valley. Apparently, most of the DEIS was prepared prior to the enactment of the WVDPA and, therefore, does not reflect the current status of the project. Indeed, DOE acknowledges in the DEIS that several important decisions with respect to the West Valley project have not yet been made.

In our review of the DEIS, we have identified several important decisions or issues that have not yet been adequately dealt with in the EIS. These are listed below. The DOE should do an assessment of these decisions or issues and explain how it intends to resolve them. We believe that the Memorandum of Understanding (MOU)[1] recently executed by our respective agencies, and required by the WVDPA, is an appropriate mechanism by which the NRC can review, critique, and analyze these major decisions or issues. For each of the major decisions or issues identified below, it is requested that, prior to making the final decision, DOE make available an evaluation which sets forth the options considered and the environmental effects (with particular emphasis on potential radiological impacts) of proceeding with each option considered. These evaluations should be submitted to the NRC for review and comment as part of the consultation process required by the WVDPA.

The significant decisions or issues which we have identified are briefly described below.

1. New solidification facility vs. modification of existing reprocessing facility

   A decision that must be made by DOE is whether the existing reprocessing facilities, with appropriate modifications, will be used for the solidification of the liquid high-level waste or if a new solidification facility will be constructed. The DEIS addresses this subject (see pp. 2-30 and 2-31) to some degree but states that the final decision on this matter will not be made until late in 1982. The information and data set forth in the DEIS are not adequate to evaluate and compare the two options.

2. Disposal of low-level waste onsite vs. offsite

   Alternative sites for low-level waste disposal are not examined in sufficient depth. The various alternatives should be thoroughly assessed with due consideration given to the fact that a disposal site exists at West Valley and the nature of the wastes resulting from the West Valley clean-up.

3. Characterization of low-level wastes

   The West Valley project will generate a large amount of low-level wastes. Many of these wastes will be unique or special compared to low-level wastes which are routinely disposed of at commercial low-level disposal sites. Based on the information presented in the DEIS, we would be unable to determine if the low-level waste would comply with the requirements of our proposed regulations on

[1]Memorandum of Understanding between the U.S. Department of Energy and the U.S. Nuclear Regulatory Commission, West Valley Demonstration Project dated September 23, 1981.

low-level waste disposal (10 CFR 61). We believe that the DEIS has not gone far enough in describing the characteristics of low-level wastes so that special or unique wastes can be identified and the need for special processing, packaging and disposal operations can be examined.

4. Development of packages for high-level waste

The WVDPA requires that DOE, as part of this program, develop containers suitable for permanent disposal of the high-level radioactive waste solidified at West Valley [See WVDPA, Section 2(a)(2)]. The DEIS presents essentially no information on these containers. Given the importance of these containers from the standpoint of the WVDPA, as well as the proposed regulations of the NRC (10 CFR Part 60), DOE should identify, thoroughly examine, and compare alternative containers.

Finally, we recognize that the MOU will provide a mechanism for us to receive the information we need to fulfill our responsibilities as set forth in the WVDPA, and that the attached specific comments on this DEIS will not preclude the NRC staff or the Commission in any way from obtaining that information. We appreciate being afforded the opportunity to comment on the DEIS and would be willing to discuss our comments with you, if you so desire.

Sincerely,

Richard E. Cunningham, Director
Division of Fuel Cycle and
Material Safety
Office of Nuclear Material Safety
and Safeguards

Enclosure:
Specific comments

U.S. Nuclear Regulatory Commission

Specific Comments on
DEIS for West Valley High-Level Waste

Summary

1. Quantifiable Impacts and Costs, p. vii.

33-1 Except for a single column in Table S.1 (p. viii) and a single row in Table 2.4 (p. 2-28), the DEIS provides no information on the costs of the various alternatives that were considered by DOE. The only information provided on this subject is that Alternatives 1a and 1b will cost $500 million and $600 million, respectively; Alternative 2 will cost $700 million; Alternative 3 will cost $200 million; and Alternatives 4a and 4b will cost $10 million and $60 million, respectively. The basis for these cost estimates is not provided in the DEIS.

Furthermore, it is stated that these cost estimates are "very preliminary" (p. vii). Since economic costs can be the determining factor when environmental effects for the alternatives are similar, the Final EIS should provide a more detailed and definitive explanation of the cost estimates.

2. Radiological Impacts, p. 2x, third paragraph

33-2 The size of the population yielding 30 million cancer deaths in 10,000 years should be stated.

3. Nonquantifiable Factors, p. x

In the first sentence of the first paragraph after "Nuclear Regulatory Commission," add: "low-level and."

Chapter 1

1. Decisions to be Made Later, Section 1.4.3, p. 1-4.

Paragraph 2 lists four major decisions that will be made at a later date: (1) the specific waste form for the HLW and associated solidification process design; (2) the final decontamination and decommissioning procedures; (3) the location and design of the Federal repository; and (4) the location of a regional burial ground for low-level wastes (LLW) if onsite burial of the LLW is not used.

Paragraph 6 states that each of these decisions will be subject to an appropriate environmental review including supplements to the EIS as necessary.

33-3 The final EIS should state explicitly the mechanism (e.g., preparation of an environmental assessment, environmental impact statement, supplement to an EIS, etc.) that will be utilized to comply with any NEPA responsibility required to implement any of these major decisions.

Chapter 2

1. Comparison of Key Impacts, Section 2.1, p. 2-3

33-4 This section should discuss how the disposal of low-level wastes will affect disposal capacity at commercial disposal sites. The existing commercial sites have an available capacity of approximately 75 million cubic feet.

2. Comparison of Key Impacts, Footnotes, p. 2-3

The DEIS states that an "updated environmental review" of the waste form options will be prepared at the time the waste form selection is made. The
33-5 final EIS should explain in detail what is meant by an "updated environmental review." (Also see Comment No. 1, Chapter 1).

3. Comparison of Key Impacts, Section 2.1, p. 2-3

Part of the impacts associated with Alternatives 1a, 1b, and 2 involves constructing a temporary LLW storage facility and then shipping the LLW 400 miles
33-6 to a regional burial ground when one becomes available. Since there are state and federally licensed burial grounds at West Valley, the final EIS should assume that all LLW wastes generated by the implementation of Alternatives 1a, 1b, and 2 would remain at West Valley. This approach would be consistent with Alternatives 3 and 4 where it was assumed that the LLW would be disposed of onsite. DOE cannot justify transporting these low-level wastes to a regional burial ground without evaluating the impacts of onsite disposal.

Furthermore, since a regional burial site does not exist, the final EIS should consider the disposal of LLW at existing commercial and DOE sites.

4. Description and Technical Aspects, Section 2.1.1.1, p. 2-3

It is stated on page 2-3 that the solidified HLW will be contained in steel canisters and stored onsite. Eventually these canisters will be transported to a Federal repository for disposal. Other than a terse description of the canisters on pages 2-3, the DEIS contains little information on the development of containers for permanent disposal. Clearly, the West Valley Demonstration Project Act mandates that as part of this program, the DOE will develop containers suitable for the permanent disposal of the high-level radioactive waste solidified at West Valley (see WVDPA, Section 2(a)(2)). The legislative history of the Act clarifies this point to an even greater degree. The report of the House Committee on Interstate and Foreign Commerce states:

> "Under Subsection 2(a)(2), the Secretary is directed to develop containers suitable for the permanent disposal of the high level radioactive waste solidified at the Center.
>
> By including as part of the program the requirement that the Secretary design and construct containers suitable for the permanent disposal of the solidified waste, the scope of the project is expanded to include the development of containers which are suitable for the ultimate disposal of the waste which are solidified as a part of the project. As these containers will eventually be placed in a licensed repository, the Committee expects that the Secretary will develop these containers in a manner which complies with all applicable requirements of the Nuclear Regulatory Commission. The Committee further expects that the Secretary will consult the Nuclear Regulatory Commission at each stage in the design and construction of these containers to insure that such containers comply with all regulatory requirements and would be suitable for placement and (sic) a licensed repository."

33-7 The final EIS should provide a description of the containers that will be used for the HLW.

5. Description and Technical Aspects, Section 2.1.1.1, p. 2-5

For the purposes of analysis, the DEIS assumes that LLW and salt cake would be shipped 400 miles to a regional burial ground which would be available in 1990. Since a regional burial ground may not be available for West Valley wastes (see section B.4.2.2, p.B-67), we believe that existing commercial and DOE sites should be considered as well. Also, by considering the most distant of these disposal sites, the EIS would bound the possible transportation impacts.

6. Long-Term Population Risk, Section 2.1.1.2, p. 2-10

33-8 In the first paragraph, the dose (1 rem) to an intruder is compared to the current regulatory limit for occupational exposure (see 10 CFR 20). Since an intruder is not likely to be an occupationally exposed worker, a more meaningful comparison would be the non-occupational exposure limit of .5 rem/year.

7. Institutional issues, Section 2.1.1.4, p. 2-11

33-9 While the NRC has not completed its regulations with respect to high-level radioactive waste, it has promulgated final licensing procedures for the disposal of high-level radioactive wastes in geologic repositories (F.R. Vol. 46, No. 37, pp. 13971-987, February 25, 1981) and has issued proposed technical criteria for the disposal of high-level radioactive waste (F.R. Vol. 46, No. 130, pp. 35280-296, July 8, 1981). Furthermore, this section should not imply that NRC and EPA are engaged in a joint rulemaking proceeding.

8. Institutional Issues, Section 2.1.1.4, pp. 2-11 and 2-12

33-10 The availability of a "Federal waste facility" (referred to in Section 2.1.3), which would be used to process the interim waste form to a terminal waste form, should be added to the list of institutional issues.

9. Alternative 1b, Sections 2.1.2.1 & 2.1.2.3, pp. 2-12 to 2-14

The first paragraph in Section 2.1.2.1 indicates that a much greater volume of solidified HLW will have to be disposed of in a high-level waste repository for Alternative 1b than for Alternative 1a. However, Section 2.1.2.3 states

that except for salt cake, the nonradiological impacts for Alternatives 1a and
33-11 1b would be about the same. Has consideration been given to the environmental and economic impacts of disposing of the 1000 additional high-level waste canisters (i.e., 1300 canisters for Alternative 1b versus 300 canisters for Alternative 1a) in a Federal repository? These impacts should be described to provide a proper comparison with alternatives which do not require a repository.

10. Alternative 2, Section 2.1.3.1, p. 2-14 to 2-16

The DEIS states that for Alternative 2, the HLW would be converted into an interim form, which would be immediately shipped to a "Federal waste facility." This alternative assumes the existence of some "Federal waste facility" for the interim storage and final processing of the waste.

33-12 We are not aware of plans for any such "Federal waste facility." The final EIS should describe the developmental status of the "Federal waste facility" with respect to site location, scheduling, required approvals, etc.

11. Alternative 2, Section 2.1.3.1, pp. 2-14 to 2-16

33-13 For Alternatives 1a and 1b, it has been assumed that the solidified high-level waste will be temporarily stored at West Valley until a Federal repository becomes available for permanent disposal (p. 2-5 and p. 2-12). However, for Alternative 2, it has been assumed that the interim high-level waste will be immediately shipped offsite to a Federal waste facility. This additional shipment to a Federal waste facility results in higher radiological impacts for Alternative 2 (p. 2-17). In order to be consistent with the assumptions made for Alternatives 1a and 1b, the final EIS should consider temporarily storing the interim form of the waste at West Valley. The final EIS should also consider processing the interim form of the waste at West Valley.

12. Alternative 2, Section 2.1.3.1, pp. 2-14 and 2-16

33-14 It is stated in the DEIS that the interim form of the wastes would be processed into a terminal form along with other HLW. This assumes that the process devised for the "other HLW" would be compatible with the interim waste form from West Valley. This section should provide a basis for evaluating the likelihood of the terminal processing facility being compatible with both the interim form of the West Valley wastes and the other HLW.

13. Alternative 2, Section 2.1.3.1, p. 2-16

33-15 The last paragraph states: "The total time to complete the activities at West Valley would be about the same for alternative 2 as for alternative 1a." This does not consider that in Alternative 1a the waste form may not be selected until after a repository site is selected, while in Alternative 2, a waste form can be selected before that time.

14. Radiological Impacts, Section 2.1.3.2, p. 2-17

33-16 The analysis of radiological impacts for Alternative 2 (Interim waste form) assumes that the interim waste will be shipped first to a Federal waste facility

33-16 and ultimately to a Federal repository. The additional shipment to the Federal waste facility causes the radiological impacts for this alternative to be greater than Alternatives 1a and 1b. The final EIS should determine the radiological impacts of Alternative 2 by assuming that the interim waste remains onsite and is not shipped to a Federal waste facility (see Comment #13, Chapter 2).

15. Institutional Issues, Section 2.1.3.4, p. 2-17

33-17 This section of the DEIS does not address the extent to which the implementation of Alternative 2 (Interim waste form) would comply with the West Valley Demonstration Project Act (WVDPA). The final EIS should discuss the extent to which the WVDPA would have to be modified, if at all, in order to implement this alternative.

16. Institutional Issues, Section 2.1.3.4, p. 2-17

33-18 The possible negotiations with another state for temporary storage of the interim form wastes, which is listed as an issue in Section 2.1.3.4, would not be necessary if the interim form of the waste were temporarily stored at West Valley.

17. Institutional Issues, Section 2.1.4.4, p. 2-20

33-19 In Alternative 3, the liquid high-level waste would be mixed with cement and other additives, poured back into the existing tank, and left onsite. The DEIS indicates that NRC licensing would be required to implement this alternative. Although the NRC could not base a licensing decision upon the limited quantitative data supporting Alternative 3 that is provided in the DEIS, we believe that it is highly unlikely that Alternative 3 (In-Tank Solidification) would comply with our proposed regulations (e.g., containment time, release rate, groundwater travel time, etc.) (See FR Vol. 46, No. 130, pp. 35280-296, July 8, 1981).

18. Institutional Issues, Section 2.1.5.4, p. 2-22

33-20 This section of the DEIS does not address the extent to which the implementation of Alternative 4a (No action, Delay 10 years) would comply with the West Valley Demonstration Project Act (WVDPA). The final EIS should discuss the extent to which the WVDPA would have to be modified in order to implement this alternative. Particular consideration should be given to Section 2(a)(3) of the WVDPA which states that "the Secretary shall, as soon as feasible, transport, in accordance with applicable provisions of law, the waste solidified at the center to an appropriate Federal repository for permanent disposal."

19. Alternative 4b, Section 2.1.6, pp. 2-22 to 2-27

33-21 The DEIS states that Alternative 4b (No action) would not require decontamination and decommissioning or the construction of new facilities. But earlier, this section states that emptied tanks would be filled with concrete and new tanks would be constructed. This apparent inconsistency should be clarified. Also, in Table 2.3 on page 2-27, Alternative 4b indicates that no decontamination and decommissioning is required for this alternative.

20. Institutional Issues, Section 2.1.6.4, p. 2-25

This section does not mention the West Valley Demonstration Project Act which requires the Secretary to "solidify, in a form suitable for transportation and disposal, the high level radioactive waste at the Center" (Section 2(a)(1)).

21. New Facility, Section 2.2.1, p. 2-30

33-22 In discussing the advantages of constructing a new solidification facility instead of modifying the existing facility, two advantages are not mentioned. They are (1) workers would not be exposed to radiation during construction of a new solidification facility and (2) the added expense of construction in a contaminated building would be avoided.

22. New Facility, Section 2.2.1, p. 2-31

33-23 The decision on whether a new facility will be constructed at the West Valley site for waste solidification or the existing facilities will be modified is expected to be made by late 1982 (p. 2-31). Will this EIS support such a decision, or will DOE conduct a separate NEPA review? If it is the former, then the final EIS should describe the two systems and their environmental impacts in greater detail. If it is the latter, the final EIS should describe the mechanism (e.g., environmental assessment, draft EIS, supplement to EIS, etc.) that will be used to satisfy NEPA responsibilities.

Chapter 3

1. Geology and Seismicity, Section 3.1.2, and Hydrology, Section 3.1.3, pp. 3-1 to 3-8

The section on geology, seismicity, and hydrology are sufficient for the purposes of the DEIS. The NRC Staff has underway confirmatory research contracts with the U.S. Geological Survey and the New York State Geological Survey to obtain an improved understanding of these site characteristics. We expect that this information, currently being obtained, will assist in developing improved pathway models for analyzing both short-term and long-term radiological impacts for both high- and low-level waste disposal.

2. Ecology and Land Use, Section 3.1.5, p. 3-10

33-24 This section gives a general description of the entire site and refers to Figure 3.3 for specific features. Figure 3.3, however, does not identify the ten acre parcel that would be impacted by the proposed action nor does it delineate some of the natural areas discussed in this section.

3. Ecology and Land Use, Section 3.1.5, p. 3-10

33-25 Paragraph 4, sentence 3 states that "There are no floodplains associated with the onsite streams...". This statement conflicts with Section 3.1.7.2 which states that "Archaic sites are also to be expected along the floodplains of Buttermilk Creek, which crosscuts the plant property." Also, Figure 3.4 shows a floodplain associated with a creek at West Valley.

Even if there are no floodplains associated with the streams, the site could still flood as a result of overflow from the wetlands and bog lakes. The flood potential could be evaluated by comparing the construction site elevation to the 100 year and 500 year floodplain elevations.

Chapter 4

1. Figure 4.2, p. 4-6

33-26 Figure 4.2 shows various pathways by which radioactivity could reach humans. The figure should include three additional pathways:

a. irrigation could transfer radioactivity from water to soil;

b. radioactivity could be resuspended from the soil into the atmosphere. (Since most actinides are more hazardous when inhaled than when ingested, this may be a particularly significant omission);

c. vegetation could assimilate radionuclides directly from the water (e.g., sprinkler systems) rather than from the soil alone.

2. Radiological Impact Assessment, Section 4.1.3, p. 4-7

33-27 In the second paragraph, the groundwater model used to estimate doses at a regional facility should be referenced. If the parameters used are for the West Valley site, the EIS should state this and explain why these parameters are representative of a regional burial ground.

3. Radiological Impact Assessment, Section 4.1.3, p. 4-7

33-28 Lines 6-12 state that dose commitments from atmospheric and liquid effluents were derived from the radiological exposure models of Regulatory Guide 1.109. The models of Regulatory Guide 1.109 are intended to describe the relatively short-lived nuclides present in reactor effluents. For the longer-lived nuclides present in high-level wastes, a model similar to that described in NUREG/CR-1636, Vol. 1 would be more appropriate.

4. Table 4.3, pp. 4-11 to 4-15

33-29 The body of the DEIS should explain the basis for the assumptions and analyses which led to the numerical values shown in Table 4.3. For example, the text should describe:

a. liquid/gas partition coefficients;

b. the process equipment decontamination factors (DF's) used in the release models and the references for their selection;

c. the basis for the volumes and masses of spilled material assumed in the process incident computations.

5. Table 4.3, p. 4-12

33-30 The final EIS should substantiate the overall calcination facility DF of 1×10^{13}. The particulate DF claimed for the Newport News Industrial Corporation (NNI) calciner (with a HEPA filter) is 1.8×10^{4}. The NNI calciner DF claimed for iodine is 1×10^{5}. (Reference NNI "RWR-1 Radwaste Volume Reduction System" Topical Report E1/NNI-T1-7-NP.)

6. Short-Term Releases of Radionuclides, Section 4.1.4, p. 4-16

In the last paragraph, the correct date for the latest version of Regulatory Guide 1.112 is May 1977. This version does not provide specific DF's but instead references NUREG-0016 and NUREG-0017 which provide DF's for various BWR and PWR radwaste processing equipment.

33-31 These DFs are based on actual operating experience of light water reactors (LWR) and may not necessarily be applicable to use at West Valley. The EIS should explain why these DFs are appropriate for West Valley release calculations.

7. Short-Term Radiological Impacts, Section 4.1.6, p. 4-28

33-32 Beginning on line 9, the DEIS states that the cumulative risks estimated to result from sabotage and an airplane crash would be nullified when the HLW is solidified. This section should explain why solidified HLW could not be dispersed by sabotage or by an airplane crash.

8. Tables 4.12, 4.13, 4.14, 4.15 and 4.16, pp. 4-31 through 4-34

The final EIS should provide a technical basis for the values presented in these tables. For example,

33-33 a. In Table 4.12, under "Onsite Decommissioning," the number of people affected by intrusion events (5-10) seems very small. Were not long-term food pathways considered?

33-34 b. In Table 4.12, the probability of drilling into a Federal respository (5×10^{-7}/year) seems very low. The final GEIS for "Management of Commercially Generated Radioactive Waste" (DOE/EIS-0046F Vol. 1, p. 5.87) could not assign an overall probability to this event and concludes that "The probability that drilling will occur somewhere on the repository site is highly uncertain."

33-35 c. In Table 4.16, the population risk via groundwater migration under Alternative 4b (no action) would be 10 person-rem/year, but only 70 person-rem cumulative over 10,000 years. How was the cumulative figure arrived at?

9. Table 4.18, p. 4-38

33-36 The dose-risk factors of this table are reasonable. However, the way in which they were apparently used is not. It is not appropriate to calculate an "equivalent" dose from equation 4.1 and then to multiply by the factors of

33-36 Table 4.18. Instead, the genetically significant dose must be calculated separately and multiplied by the genetic risk factor. The cancer risk should be treated similarly.

10. Modifications/Construction Impacts, Section 4.2.1.1, p. 4-41

33-37 The last sentence in the last paragraph states that Alternative 4b (No Action) would have about the same construction impacts as Alternative 1a (Terminal Waste Form). This statement conflicts with information presented in Table 2.4 (pp. 2-28 and 2-29) under the headings of "Non-Radiological Impacts--General" for each of these alternatives.

11. Operations Impacts, Section 4.2.1.2, p.4-41

The third paragraph on page 4-44 states:

> "The rates and amounts of electricity, water (taken from existing wells), and natural gas are expected to be similiar to the rates and amounts used when the nuclear fuel reprocessing facility was operating. This use of natural resources is not expected to have significant impact during the solidification program."

This statement suggests that the solidification facility will not affect local utility demands because it will use the same amounts of water, gas, and electricity as the fuel reprocessing plant (FRP).

33-38 The FRP closed in 1972. Since then, local consumption of water, electricity, and gas has increased with the growing population (see Table 3.1). The final EIS should evaluate utility impacts for the years in which they will occur rather than assuming that past conditions will continue in the future.

12. Operations Impacts, Sections 4.2.1.2, p. 4-44

In paragraph 2 on pages 4-44, the DEIS states that the LLW treatment facility would have no liquid effluents and that:

> "The very small releases of water vapor to the atmosphere (no exact estimates are yet available) would not be expected to have an impact."

This statement appears to conflict with Appendix 8.3.2.1, page 8-61, last sentence in the first paragraph which states:

> "the only major releases from this (LLW treatment) facility would be gases, primarily water vapor." (emphasis added)

33-39 The final EIS should make it clear whether the LLW treatment facility will have a major or small discharge to the atmosphere.

13. <u>Alternative 1a, Section 4.2.1.5, p. 4-49 and Section 4.5.2.2, p. 4-73</u>

The fourth paragraph states on p. 4-49 states that binders and double containers would reduce the risk of water being contaminated by the salt cake. In addition, salt cake could be disposed at an arid site where leaching would be minimized by low precipitation rates.

14. <u>Waste Disposal Impacts, Section 4.2.1.5, p. 4-49</u>

On page 4-49, the following scenario is discussed in which toxic concentrations of nitrates would be released:

> "--because the soils are so impermeable, it is conceivable that in the long term water could infiltrate the trenches through the caps, dissolve the nitrate salts to toxic concentrations (up to 92,000 mg/L), and overflow the trenches. However, there are several factors that would quickly render this effluent nontoxic: (1) much of the overflow would seep into the soil, (2) once the remaining salts entered a stream they would be diluted, and (3) the nitrate would be a fertilizer that plants, soil algae, and aquatic organisms would quickly consume."

33-40 Considering the climate of West Valley and the fact that all soils including clay (as well as artificial barriers) eventually leak, it should be assumed that water will infiltrate the trenches laterally as well as through the caps. The hydrogeologic characteristics of the site, described in Sections 3.1.2 and 3.1.3 (pages 3-1 thru 3-9) suggest that the soils are not "so impermeable" and that groundwater inflow is being encountered in the trenches. The springs and seeps in the marshy areas and at the edges of steep gullies indicate lateral groundwater movement possibly along intertill sand layers or lenses, as does the existance of French drains in the area of the plant lagoons (see Figure 3.3). The potential for nitrates and radionuclides to migrate from the trenches within the groundwater flow system should be addressed.

33-41 Furthermore, none of the factors, quoted above, will "render the nitrate nontoxic." In factor (1), if the soil is so impermeable that the trenches would overflow, why would the overflow seep back into the soil once it left the trench? In factor (2), reducing the concentration of nitrate salts will not render them nontoxic. And in factor (3), green plants cannot assimilate nitrates unless phosphorous and carbon are also present. In the Lake Erie area, phosphorous, not nitrogen, triggers eutrophication (i.e., it is the element in least concentration). If toxic concentrations of nitrate entered any of the creeks at West Valley, most of it would not be "quickly consumed by plants, algae or aquatic organisms."

15. <u>Disposal of Toxic Substances, (Nitrate Salt Cake), Section 4.3.5, pp. 4-61 to 4-62</u>

The DEIS divided the non-high-level wastes into three categories: (1) TRU wastes, (2) low-level wastes, and (3) salt cake. Throughout the DEIS, it is stated that the LLW and salt cake would be disposed on-site in a shallow

landfill or at a regional burial ground. (see p. 2-5, p. 2-11, and p. 4-48). The DEIS acknowledges that "very strict criteria would have to be applied to the disposal" of the salt cake. However, the DEIS does not provide any information or analyses on the special precautions that would have to be taken to dispose of the salt cake. It appears that the DEIS assumes that the salt cake has the seme physical and chemical characteristics as the low-level wastes.

33-42 The final EIS should provide a more detailed analysis and description of the potential environmental effects of the handling, storage, and disposal of the salt cake. The impact of disposing of the slat cake in a low level waste disposal site should be specifically addressed including any adverse effect that this may have on the ability to the waste forms and surrounding soils to retain radionuclides.

16. <u>Planning Philosophy, Section 4.3.11.1, pp. 4-67 and 4-68</u>

33-43 At the bottom of page 4-67 and top of page 4-68, this section states that the FBI will assume oiperational control of all major incidents. The reference to operational control suggests that the FBI may direct the conduct of radiological operations in the event of a major incident. Unless this meaning was intended, the section should be emended to indicate a more narrow and precisely defined role for the FBI in the event of a major security breach.

17. <u>Mitigative Measures Common to All Alternatives, Section 4.5.1, pp. 4-71 and 4-73</u>.

33-44 a. This section of the DEIS describes the DOE environmental monitoring program. It states that monitoring of the site would begin at least one year prior to "any significant action." The final EIS should provide some indication of what is meant by "any significant action." In addition, the DEIS states that radioactive releases will "comply with the Department's policy and applicable standards." The final EIS should describe these policies and standards. Furthermore, the final EIS should clearly identify those monitoring programs which DOE intends to carry out after the operational period.

b. Will the mitigative transportation measures be undertaken? If not, they need not be mentioned. The regulatory limits for transportation are designed to protect the public health and safety. Under 10 CFR §20.1(c) the goal for radiation exposure should always be as low as reasonably achievable.

<u>Appendix B</u>

1. <u>High-Level Waste Removal, Section B.1.3, pp. B-11 to B-14</u>

DEIS states that the feed to the solidification process would be a homogeneous
33-45 mixture. The information contained in the DEIS does not adequately confirm this assumption. Have the environmental consequences been considered if the mixture of flow to the solidification process is not homogeneous or if residual solids are not removed from the tanks? Would the vitrification process produce an acceptable product if the feed-mixture were not homogeneous?

2. Separated Salt/Sludge Option, Section B.2.2.1, p. B-25

33-46 It is stated in paragraph 2 on page B-25 that "the acidic Thorex waste would be processed first to accommodate the waste-removal procedure (Section B.1.3)." In reviewing Section B.1.3, it is not apparent why the acidic Thorex waste will be treated first while some of the vitrification options call for blending the acidic and neutralized waste streams. The final EIS should present the reasoning for these various approaches.

3. Supernate Treatment, Section B.2.2.1, p. B-26

This section describes an ion exchange process for decontaminating the supernate
33-47 stream. Our studies indicate that organic resins experience severe radiation degradation when accumulated doses exceed 10^8 rads. The organic resins shipped for disposal should be loaded such that accumulated doses are less than 10^8 rads to assure that radiation degradation will be minimized. Radiation degradation evaluations should also consider the cumulative exposure from multiple processing runs prior to bed regeneration.

4. Nonseparated Salt/Sludge Option, Section B.2.2.2, pp. B-30 - B-31

33-48 The last paragraph on page B-31 states that a strong reducing agent could volatize the sulfates in the borosilicate glass to sulfur dioxide. The DEIS fails to address what effect, if any, such a reducing agent will have on the durability of the glass.

5. Use of a New Low-Level Waste Treatment Facility, Section B.3.2.1, p. B-61

The DEIS states that there would be no liquid effluents. It is not clear in reading the DEIS whether this statement applies to all liquid effluents that could be discharged from the entire facility or if it simply means that there will be no liquid discharges from the low-level waste treatment facility. On page F-7 (Section F.2), the DEIS mentions a sanitary sewage discharge point[1]
33-49 and Figure 4.2 (page 4-6) indicates a liquid release. The final EIS should clarify whether there will be liquid releases from the entire facility and evaluate the environmental impacts of such releases.

6. Use of a New Low-Level Waste Treatment Facility, Section B.3.2, p. B-61

33-50 Alternative decontamination methods should be identified, described and compared for the LLW treatment facility and for all other decontamination operations at the West Valley site.

33-51 The processing and disposal of decontamination solution wastes containing chelating agents should be addressed. The proposed low-level waste management regulation, 10 CFR 61, specifies that wastes containing greater than 0.1 percent chelating agents require NRC approval prior to disposal.

[1]The DEIS indicates that elevated levels of radioactivity have been a problem in the past with the sanitary sewage discharges.

For the disposal of decontamination solution wastes from the cleanup of the primary system at Dresden, the NRC position stated that these wastes should be solidified, disposed of at an arid disposal site and separated from other wastes. Disposal at an arid site and separation from other wastes is intended to minimize the migration effects from chelating agents in the wastes.

7. Use of a New Low-Level Waste Treatment Facility, Section B.3.2.1, p. B-61

33-52 The third sentence in the third paragraph states that a binder would be added to the compacted wastes. If adding a binder to compacted trash is proposed by DOE, the methods to be used should be stated. Immobilizing trash is not routinely performed and would not be required if the trash were a Class A waste in accordance with the waste classification system described in the proposed regulation 10 CFR 61.

If an incinerator for the volume reduction of trash is being considered for use at West Valley, the EIS should describe the impacts associated with its use.

8. Nonradiological Impacts, Section B.3.3.2, p. B-64

33-53 Construction site impacts are described in this section. It would be helpful if a map or drawing were presented which showed all areas affected by new construction.

9. High-Level Wastes, Section B.4.1.1, p. B-64

The DEIS states that the HLW resulting from Alternatives 1a and 1b would be stored onsite until a Federal repository becomes available. The HLW from Alternative 2 would first be transported to an offsite Federal waste facility for storage and additional processing, and then eventually to a Federal repository.
33-54 It is inconsistent to assume that the HLW from Alternatives 1a and 1b would be stored onsite while assuming that the HLW from Alternative 2 would be stored offsite. To fairly compare these alternatives, the same assumption should be used for both alternatives. (Also see Comment No. 16, Chapter 2).

10. Transuranic and Low-Level Wastes, Section B.4.2.2, p. B-66

33-55 There are now 26 NRC Agreement States not the 25 stated in the footnote.

11. Transuranic and Low-Level Wastes, Section B.4.2.2, p. B-67

33-56 To update the third paragraph, the proposed Low-Level Waste Management regulation, 10 CFR 61, was published in the Federal Register on July 24, 1981 (FR Vol. 46, No. 142, pp. 38081-38105).

12. Transuranic and Low-Level Wastes, Section B.4.2.2, p. B-67

The last sentence in the last paragraph states:

> "Impacts associated with such storage will be reduced or eliminated if the LLW are disposed on-site or a regional burial ground is available sooner."

Impacts associated with waste storage could also be reduced if the low-level wastes were disposed of at an existing commercial or DOE disposal site.

13. Table B.16, p. B-69

33-57 This table indicates that a large number of 55gallon drums containing solidified TRU and low-level waste will be generated. The drums will have a relatively high radiation level (50 rem/hr). The selection of suitable binder materials should, therefore, consider radiation stability. This is especially important for organic binders such as asphalt.

14. Occupational Dose, Section B.4.4.2, p. B-75

33-58 This section includes occupational exposure data for waste handling but fails to specify if occupational exposures from waste processing and packaging are included in the document.

33-59 The Programatic Environmental Impact Statement for the Three Mile Island Nuclear Station (TMI, PEIS), Section 8.1.5 and Appendix N provide detailed occupational exposure information for waste processing packaging and handling. The unit dose estimates in Table B.21 of the DEIS are generally lower than those calculated in the TMI PEIS. These values should be reviewed to assure that the unit dose factors are sufficiently conservative to bound occupational exposures at West Valley.

33-60 This section should also discuss pathway models and the parameters used for estimating the long-term population risks for the regional and on-site disposal options.

15. Nonradiological Impacts, Section B.4.4.2, p. B-79

33-61 Relative to dissolved nitrate salts that may overflow from the trenches, the last sentence of the second paragraph states: "This effluent would very quickly be rendered nontoxic because much of the overflow would seep into the soil,...". The site characteristics at West Valley, described in Sections 3.1.2 and 3.1.3 (pages 3-1 thru 3-9), suggest that the soils are not "so impermeable", and nitrates may be leached by percolating water and eventually reach ground-water. Nitrate is very mobile in groundwater and can migrate long distances from input areas with no transformation and little or no retardation. The final EIS should discuss the hydrochemical behavior of the nitrate salts, the potential for groundwater contamination at West Valley, and how the "effluent would very quickly be rendered nontoxic". (See Comment No. 14, Chapter 4).

16. Regulations Affecting Transport of Radioactive Materials p. B-64

a. We believe that the third paragraph describing the relationship between NRC, DOT and DOE could be improved by the following suggested paragraph.

33-62 Both the Department of Transportation and the Nuclear Regulatory Commission regulate safety in transportation of radioactive materials. Under a Memorandum of Understanding they partition their regulatory responsibilities.

33-62 The Department of Transportation regulates safety in transporting all hazardous materials including high-level, transuranic, and low-level wastes and is primarily concerned with the conditions of carriage and with Type A packages of Type A (smaller) quantities of these wastes. The Nuclear Regulatory Commission regulates receipt, possession, use, and transfer of source, byproduct, and special nuclear material, including such licensed materials as these wastes, the NRC is primarily concerned with reviewing designs of Type B packaging that would be used by licensed commercial shippers to ship Type B quantities (large quantities) of HLW and high-activity TRU and low-level wastes. The Department of Energy has the authority to certify that its own packaging for government-contractor shipper meet the requirements of the Department of Transportation.

b. Insert "(closed vehicle only)" at ends of first two bulleted items.

c. Unshielded carriers is not accepted jargon. Use packages, overpacks, or freight containers in place of carriers. These words carry regulatory meaning, however (see 1973 IAEA regulations), so caution is advised.

Letter 34

900 Main Street
West Valley, N.Y. 14171
October 30, 1981

West Valley Program Office
Office of Waste Operations & Technology, NE-320
Nuclear Waste Management and Fuel Cycle Programs
US Dept. of Energy
Washington, D.C. 20545

Dear Sirs,

It is apparent that a great deal of thought and technical knowhow went into preparing the DEIS. However, as thorough as it appears, it leaves much to be desired.

So much seems to hinge on research and development yet to be finished in various parts of the country by the DOE. And, so many decisions which the DEIS states must be made in the future. Also, the decision on a final repository selection. This all makes the layman wonder just how "on top of the situation" the experts are.

I would hope that those in charge of the project would not rush ahead to meet congressional time tables, until they know the decisions they make are the safest possible for the workers and the residents in the immediate area as well as neighboring states.

We tend to treat any dangers to our physical selves on a much more personal basis than scientists, technologists and theoreticians. You can talk of person rems per million, but we think in terms of our own family and friends as individuals.

34-1 The DEIS seems to treat the possibility of accidents lightly, using only the possibility of a plane crashing into the tank area seriously. How about human or mechanical failure. Some of these could prove to be very dangerous also, and costly. Accidents of any kind are definitely going to effect the people in the West Valley, Springville area more than people north of Buffalo and south of the Pennsylvania border. We want to know how great our risk is.

We would prefer that all waste produced by the project be removed from the West Valley Site. If some must be kept they should be contained in above ground bunkers of protective type and carefully monitored.

34-2 We don't think the geological and hydrological knowledge of the site is sufficient. Also, accidents which would discharge large quantities of radioactive liquids should be dealt with, and the impacts of such an accident on the environment. Also, the possibilities of their movement through soils and into waterways. There have recently been reports of unexplained movements of radioactive off site. This should definitely be addressed.

34-3 We believe the final DEIS should include decisions on DOE and contractor safety procedures in case of accident at the project. Also, all policies of the state in regard to emergency procedures that would go into effect for the populace in case of accident. Also, avenues of notification should an accident occur. What facilities would be used for treatment of workers and area residents.

34-4 We think there should be a statement of "possible risk to health" on all applications for employment and each should sign his or her application as to acceptance of such a risk and understanding of the risk.

We wish to thank all who made it possible to have the great amount of public involvement and consideration of our comments, possible.

Respectfully,
Henriette M. Hizwitz
Floyd F. Hizwitz

Letter 35 - No response required.

League of Women Voters
LAKE ERIE BASIN COMMITTEE

West Valley PROGRAM OFFICE
OFFICE OF WASTE OPERATIONS AND
TECHNOLOGY,NE-320
NUCLEAR WASTE MANAGEMENT AND
FUEL CYCLE PROGRAMS
U.S.DEPARTMENT OF ENERGY
WASHINGTON,D.C.20545

OCT.30,1981

Dear Sirs,

The following is a general summary of our comments on the DEIS Long-Term Management of Liquid High-LEVEL Radio active Wastes STORED at the WESTERN NEW YORK NUCLEAR SERVICE CENTER,WEST VALLEY,.

It is our intent to comment on concerns that we have addressed in the past for which we have not received answers, a discussion of impacts to air,water and soils,including a U. S. Soil Conservation report entitled " Lacustrine sediments in the Allegheny Plateau of Erie County,New York." THeir characteristics,distribution and land use problems.and a companion report entitled " Glacial Lake Sediments in West Branch CAzenovia and Eighteenmile Creek Valleys near Colden,N.Y.: A special report with reference to soil slumping hazards by the U.S. Dept. of Agriculture S.C.S. is also important. THese soil/geologic conditions extend into adjacent Cattaraugus County.

Our comments will address international implications of the project and the U.S.-Canada GREAT Lakes Water Quality Agreement of 1978,New YORK State Environmental Conservation Law WHICH EXTENDS the Law,s protection to Canadians and the rights of non-nationals to plyy a role in the administrative operations required by NEPA.

We will discuss our concerns about the low-level and transuranic waste management for the project and the NRC burial ground on the site.

Our discussion of the proposed alternatives will be limited because of the incomplete data base in the DEIS. Much more information is needed to make to make an informed recommendation as to which alternative is preferable. Whichever alternative is chosen should have a full environmental impact statement with public review.

The West Valley Program Committee is submitting comments which should be given priority consideration along with the comments by the SENIOR Technical Consulting Board to the Argonne National Laboratory dated August 1981 and additional comments on the DEIS by Richard S.Booth dated September 9,1981.

We will strongly recommend the continuation of the West Valley Program Committee and reasons for that recommendations

We feel strongly that the DOE should be aware of the very grave concern of Western N.Y. citizens that surveillance,monitoring, and enforcement regarding health and environmental protection

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LAKE ERIE BASIN COMMITTEE

of the entire demonstration-decommissioning project will be curtailed due to budget cuts.

This is a summary as requested by telephone communication with NEPA Affairs Division,U.S. Dept. of EHergy, indicating some of our areas of concern that will be enlarged upon in our comments which will be mailed at the earliest possible date.

Yours truly,
Mrs. Frances Arcara
Mrs. Frances Arcara
Lake Erie Basin Committee
League of Women Voters

MICHIGAN · INDIANA · OHIO · PENNSYLVANIA · NEW YORK

Letter 36

November 2, 1981

4327 Alconbury Lane
Suite 3
Houston, Texas 77021

West Valley Program Office
Office of Waste Operation and Technology, NE-320
Nuclear Waste Management and Fuel Cycle Programs
U. S. Department of Energy
Washington D. C. 20545

To whom it may concern:

My comments on the DEIS is as follows:

36-1 1. The use of Alternative 3, In-Tank Solidification, is superior, because the risks of leaving a solid mass where it is,following processing from a liquid in the peculiar accessability situation of tank 8D2, is less than <u>any</u> of the alternatives, including doing nothing.*

36-2 2. The EIS should have considered alternative 3A, solidification after 10 years of no action, in that no piping would be required for cooling tha in-tank solidified mass, making the process even simpler, although increasing certain risks because the liquid remains unprocessed.

36-3 3. The above comments are meant to reflect my general disagreement of taking a unique liquid waste situation and trying to make a demonstration project from it. Such trying to make good from bad, while subjecting workers and the public to unneccessary risks is unwise.

Thank you very much for the opportunity to comment, and I hope your receive this in time for its inclusion.

Sincerely,

John F. Doherty, J.D.

* This comment thus includes an assertion the EIS is incomplete for not including an analysis of such risks, or a comparison on this basis. (JFD)

Letter 37

In Regard of the West Valley Solidification project.

Gentlemen.

thank you for giving me this opportunity to express my thoughts on this most important subject. I feel many good things came out of the D.E.I.S. hearing at West Valley. there are also many shortfalls in the report. lets asess the risks as they should. there was never was a study done on the effects of the

37-1 old plant on the cattle or wild life in the area. since they shot a few deer and checked for radiation what about the cows that aborted, stillbirths, deformaties and cattle that would not breed, what about the birds rodents, crustations, and the general public. I see no mention in the D.E.I.S. concerning these concerns. why not.

37-2 What about the effects of a serious accident, major event of a large release of radioactive we materials in the atmosphere. I think you should tell the people in the immediate area what they exposure would be from this type of accident. what about migration of liquid waste into the

37-3 adjoining streams. are we to be glonee pits again. I feel the tanks which store the liquid high level wastes should be exhumed after they are emptied

37-3 of this deadly wastes and be decontaminated then cut up and removed to a federal repository. dont bury the material at West Valley.

37-4 Can we remove all of the sludge from the tanks. how leached is this waste and can it all be removed safely. I do not believe the

37-5 High level waste should be classified as safe as there is not as of yet a federal repository to store these wastes, if they are left in an intermediate form. then perhaps in a few years we will have a much safer and economical way to dispose of these wastes. I feel there should be no expense spared in maintaining the most stringent safety precautions available. another of my concerns is about monitering. I feel that there should be

37-6 public monitering the people should be well trained and not be biased to the project. who will train these people, who pays for this.

37-7 another of my concerns is should there be a major accident or release of radioactive material in the atmosphere how are we evacuated, who tells us. will they notify us in time, what about reimbursement for our ~~too~~ loss. I

37-8 hope this is not tied to the price anderson act. will there be a fund set up to let us draw from until our case is settled. we should not have to use out of pocket money to protect us from infringements on our well being.

these are all Questions that many local residents would like answered before a final E.I.S. is drawn. I feel another Public hearing on the E.I.S should be ~~heard~~ held in this area, also it should be pesented in a form that the general Public can understand. Thank you for letting me express my concerns. I do want this mess cleaned up but lets not Botch it. I am a farmer who lives about 1 mile East of the present plant. my concerns are very real.

Emil W. Zimmerman
Route 240.
West Valley N.Y. 14171

Letter 38

WEST VALLEY PROGRAM COMMITTEE

Justice Building
The Capitol
Albany, N.Y. 12224

Peter N. Skinner, P.E., Chairperson
518·474·4818
Rena H. Mayberry, Coordinator
518·237·9220

November 19, 1981

Mr. James A. Turi
US Department of Energy
Mail Stop, Box B-107, GTN
Washington, D.C. 20545

Final Committee Comments
On the West Valley Project
DEIS July, 1981

Dear Jim,

I have enclosed a copy of the final comments by the Program Committee on the DEIS for the solidification project. We appreciate the opportunity to provide input to the upcoming FEIS and the solidification option decisions. We are hopeful that the issues raised by the document are considered in the spirit of cooperation they are proffered. The DEIS is a most worthy effort to set forth the projected impacts of the project. With improvements proposed by our comments, the FEIS should go far in answering most of the outstanding questions about the job ahead.

We also appreciate the efforts on behalf of the Committee you, your staff, and the others in USDOE put forward to supply documentation, answer questions, and arrange site visits for our members. The experience of public outreach and DEIS review has been particularly fruitful; both for Committee members and the local residents. In the end, all of us expect that this project can be implemented smoothly and successfully. The Committee's functions in bettering the project through public participation is both unique and effective.

Thank you again for the opportunity to comment on the DEIS. We look forward to working with you in the future.

Sincerely yours,

Peter N. Skinner

PETER N. SKINNER P.E.

Encl.
cc: Hamric

COMMENTS BY THE

WEST VALLEY PROGRAM COMMITTEE

ON THE

DRAFT ENVIRONMENTAL IMPACT STATEMENT

July 1981 U.S. DEPARTMENT OF ENERGY

LONG-TERM MANAGEMENT OF LIQUID HIGH-LEVEL RADIOACTIVE WASTES

STORED AT THE WESTERN NEW YORK NUCLEAR SERVICE CENTER,

WEST VALLEY

SUBMITTED BY

PETER N. SKINNER, P.E., CHAIRMAN

PAMELA KIRCHNER, Consultant

November, 1981

Generated from views and information provided to the chairman.

- Report of DEIS Study Sub-committee (submitted to DOE on October 30, 1981)
- Trip reports of Committee associates.
- Written and oral comments of members.

DEIS COMMENTS

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CHAPTER I

WEST VALLEY PROGRAM COMMITTEE COMMENTS ON THE DEIS FOR HLW SOLIDIFICATION AT WEST VALLEY INTRODUCTION AND ACKNOWLEDGEMENTS

These comments are the views of Peter Skinner, who, as Chairperson of the Program Committee, is charged by the Department of Energy with the responsibility of communicating the opinions of Western New Yorkers to the Department.

In order to gather opinion end to ascertain the concerns of area residents, the Committee has held several outreach activities, including DEIS Information meetings at five locations in Western New York, attended by 270 people. The Committee made presentations on the history, current status, proposed solidification, decontamination and decommissioning alternatives. Attendees were encouraged to ask questions, were told how to get more information and how to comment on the DEIS.

Meetings of the Committee have been attended by the public when the topics under discussion were employment, transportation, emergency preparedness, health effects and the solidification alternatives. Members have brought to the Chairperson the concerns expressed to them by their acquaintances. In addition, Committee members and representatives have toured DOE installations at Idaho, Hanford and Savannah River, researching the operations there which have application to the forthcoming solidification.

All of this technical and personal input has been considered in the preparation of these comments.

The Chairman wishes to extend special thanks to the DEIS Subcommittee for their exhaustive research and review of the DEIS and their extensive commentary already submitted to the DOE. Carol Mongerson, Joanne Hameister and many others contributed to a most worthwhile effort by the Subcommittee. Special efforts by Pam Kirchner and Rana Mayberry have made the comments which follow possible and their efforts are greatly appreciated.

Special Note

Committee members indicated their concern that comments on the DEIS document not be construed by anyone as criticism of the objective of the West Valley Solidification Project or of the USDOE in writing the DEIS or in planning the project's implementation. Rather, they felt that any project involving nuclear wastes should receive careful scrutiny and review prior to choosing operational options. West Valley should receive special care because of the long history of controversy surrounding its existence, the psychological stress it has engendered locally, and the importance of demonstrating that America can indeed properly treat and dispose of high level nuclear waste.

Comments and recommendations on draft documents are an essential part of the environmental review process. Such comments have had critical impacts on the planning and implementation of numerous federal projects and continues to be an important safeguard to the health and welfare of the American people. No less important in the case of West Valley, these comments are proffered in the spirit of project improvement, not project obstruction. The Committee believes that meticulous planning and option evaluation and professional and prompt project implementation are the keys to a successful demonstration of nuclear waste solidification and facility decommissioning. The Committee and the Chairman hope that these comments further these characteristics of project implementation.

Most of the DEIS is a carefully researched and written assessment of the impacts associated with the project. Although the tenor of these comments may seem critical of the document, the Committee's overall opinion supported the approaches discussed by the DEIS authors. Every planning effort and evaluation, however, can be improved. We hope that these comments can assist in assuring that the FEIS is as well prepared as the project must be.

CHAPTER II RISK ASSESSMENT

Introduction

The Committee found itself troubled with the presentation and use of risk assessment presented in the DEIS to justify implementation of the West Valley clean-up project. Specifically, the Committee was troubled by the basic concept of risk assessment, the numbers utilized, the models relied upon and therefore the conclusions reached. The fact that the DEIS Sub-committee's report devoted 30 pages out of a total of 44 pages to discussion of these troubles exemplifies this. It reflects suspicion about the reliability of this decision making tool on a larger scale. In addition, because this tool is based on controversial data, the whole mechanism becomes suspect to some. Since, in spite of these suspicions, there is unanimous agreement on a gut level basis, without help from numbers, that the project can be undertaken in such a way that the resulting situation is much safer than the existing one and that the project can be carried out safely for both the workers and the public, the chairman recommends that DOE consider use of decision techniques other than risk assessment in the FEIS.

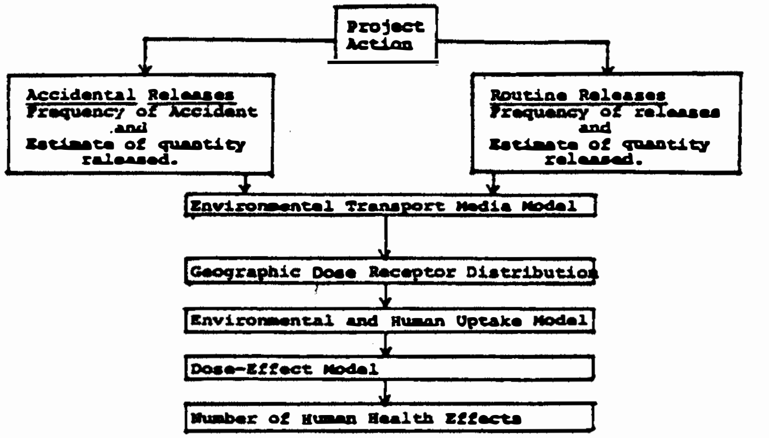
COMMENT

Organization

The DEIS organization of the risk assessment chapter was a major obstacle to the Committee in accepting the conclusions reached. The unsystematic presentation, focusing primarily on summary of results, did little to provide credibility and reliability to the risk assessment methodology employed. The Committee is aware of the complexity of assessing risk and therefore believes a coherent step by step procedure is required both for adequate discussion and public comprehension. The Committee's commentary follows the organizational framework recommended below.

RECOMMENDATION

38-1 The Committee proposes a sequential process for presenting the risk assessment materials which addresses each aspect involved and then integrates all into a comprehensive risk determination for each option.



COMMENT

Accidental Releases

The Committee had difficulty accepting at face value the summary of risks presented for the various scenarios chosen. (Pages 4-17 to 4-21 and 4-23 to 4-26) The primary emphasis of the DEIS accident analysis on page 4-10 was identifying accident potential for on-site releases while at the same time admitting that there was no attempt to exhaustively analyse all conceivable accidents.

The variety of possible accidents and incidents is enormous and hypothesizing all of them is difficult. The number and types chosen by DEIS authors, however, seem not to focus on the likely incidents at all, but rather on more far fetched, high consequence, accident scenarios.

38-2 Specifically, the attention devoted to process incidents (DEIS Pages 4-11, 12, 13 and 4-23, 24, 25, 26) appears to have underestimated the potential for releases to an unbelievable degree. Given West Valley's past operational record featuring numerous incidents each year, and operational problems which occurred often at other DOE contractor facilities, the expectation of only two on site process incidents during three years for Alternatives 1a or 1b (Table 4-6,7) is difficult, if not impossible, to accept.

Risk Assessment

38-3 The approach taken in the DEIS in devising the risks imposed by various scenarios is overly simplistic. It depicts risk as a discrete value rather than a continuum with a range of values. The risk of each scenario category (process incidents, earthquakes, etc.) should be viewed as a curve. The infinite number of events that could occur in that scenario would be depicted in that curve. Risk associated with any activity is the integrated value of such an event function.

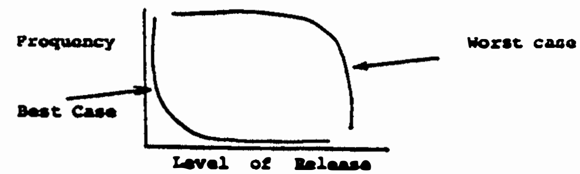
Stanley Kaplan and B. John Garrick in their article "On the Quantitative Definition of Risk", Risk Analysis, Vol. 1- No. 1, 1981, explain this concept further.

> In the case of multiple scenarios, the probability times consequence view corresponds to saying that the risk is expected value of damage, i.e., the mean of the risk curve. We say it is not the mean of the curve, but the curve itself which is the risk. A single number is not a big enough concept to communicate the idea of risk. It takes a whole curve...and in truth takes a "family of curves." (p. 14)

The idea of a family of curves incorporates the degree of uncertainty which exists around the project and the accident potential. (DEIS p. 4-22) Kaplan and Garrick, in their article, expand on this by stating

> Since the thing we are uncertain about is a curve, we express the uncertainty by embedding this in a space of curves and erecting a probability distribution over this space... The uncertainty is an intrinsic part of the risk, as it should be, and the comparison of (different) systems is readily done by viewing (a family of curves) for different systems side by side. (p. 21)

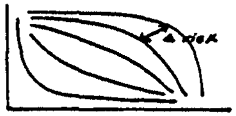
Using process incidents to exemplify this concept, the worst and best case family of process incidents might look as follows:



Risk Assessment

In between these extremes exists a family of curves representing the uncertainty in predicting the risk and the levels of risk which can be changed by giving a particular level of attention to various mitigative measures.

Frequency

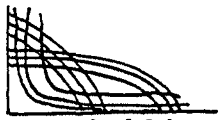


Family of Curves

Level of Release

Each release scenario category should be dealt with in the same manner, arriving at a family of curves with a worst and best case. Simultaneous utilization of these families of curves would then allow for the summation of the real risks, arriving at an overall worst and best case risk assessment for each project alternative. Presenting project risk in such a way would lend credibility to the risk values calculated and provide the bases for adoption of particular mitigation schemes.

Frequency



Overlaying Family of Curves

Level of Release

RECOMMENDATION

The Committee recommends the use of a systematic assessment of operational incidents risk, utilizing families of curves and eventual summation to arrive at a risk summary for each alternative. The steps involved in arriving at this summation should be included to support conclusions drawn.

COMMENT — Environmental Transport Media Models

In order to model the fate of radionuclides, transport media models must be developed and made site specific. The wide variety in geology, hydrology, and microclimatology which can exist from area to area can make any model a useless tool unless

Risk Assessment

it is site specific and input data has been verified.

38-4 The generic descriptions offered in the DEIS (page 4-7) offer little in providing information on both the appropriateness of the models used and whether its efficacy had been checked with data, i.e. verification.

A few examples of the general information provided are (as found in DEIS page 4-7):

Computations	Description of model cited in DEIS
Annual average relative air and ground deposition concentrations	Methodology in Regulatory guide 1-111 and computer program XOQDOQ (Program for the Meteorological Evaluations of Routine Effluents released at Nuclear Power Stations)
Radiological exposure	Computer program which implements radiological exposure models of Regulatory Guide 1-109
Groundwater migration	Model published by Nuclear Safety Associates

38-5 In addition to the concerns over site specificity, the Committee was concerned over the incompleteness of release pathways discussed. No DEIS discussion was provided on: (1) the possibility of radioactivity in the soil and water becoming airborne, (2) that atmospheric releases will inevitably re-enter the water systems through rain and snow, and (3) effects of pluming from the stacks on dispersal pattern and concentration. Although the DEIS maintains that atmospheric releases would be diluted (page 4-7) no data was provided to verify this assumption. The Lake Erie Bibliography, funded by the Army Corps of Engineers, discussed the effects of pluming and the lack of dilution of atmospheric emissions. James W. Ford, Ph.D., Physicist from Ecology and Environment, Inc., at September 26, 1981, West Valley Public Hearing, said he was "disturbed by an evident lack of concern for the way in which near surface and upper air atmospheric flows could move in such a way as to carry radioactive gases and suspend particles into near and distant portions of the region, thereat and thereby constituting a potential exposure hazard."

Risk Assessment

The Chairman wonders if a real groundwater model has been constructed for the site. If one indeed has been developed, he doubts that adequate hydrogeologic information has been developed for the site to provide the necessary input documentation. For instance, recent USGS borings in the area of the processing building and the high level waste tanks shed new light on the real extent and depth of a surficial alluvial fan of highly permeable material overlying much much of the project site to a depth of 5-25 feet. Surely these data would have a very substantial impact on the rate of migration of radionuclides spilled, leached or leaked into this stratum. If such a model has been developed, its predictive capability is certainly questionable, given the complicated local hydrogeology and geochemical attenuation factors unique to particular waste compositions and in the face of limited soil boring information and unspecified spill hypotheses.

RECOMMENDATION

The Final EIS should detail the environmental transport media models used in terms of its reference source, site specificity and verification. Expansion of the atmospheric entry points should also be reconsidered.

COMMENT — Geographic Dose-Receptor Distribution

Assessment of population risk requires identifying the geographic distribution of dose receptors. A more distant or wide spread geographic placement of dose receptors from radionuclide release sites does not necessarily reduce or preclude them from exposures. Depending on the area covered by the environmental transport media and the population distribution within that area, risk to the population will vary, potentially reaching densely populated areas at significant distances. An example of this would involve contamination of Lake Erie from ground water migration and Cattaraugus Creek outflow and subsequent health risk to the greater Buffalo area, which uses Lake Erie as its potable water supply.

RECOMMENDATION

38-6 The Committee feels that the geographic distribution of dose-receptors should be addressed in the DEIS. This should include the use of a greater radius from release points and the geographic distribution of people in the area and in relation to environmental transport media.

Dose Conversion Models

The dose-effect model discussion in the DEIS is particularly obtuse. Although specific mathematical models are referred to, their parametric bases are not well explained. What can be discerned indicates that a modified version of USNRC Regulatory Guide 1.109 is used, based primarily on ICRP recommendations of 1959. Since 1959, it is no secret that dose conversion factors and health effect impacts from various kinds of radiation exposure have been the subject of intense debate in the scientific community. The DEIS fails to highlight this controversy beyond the comparison of total body dose conversion factor ranges shown on Table 4.17 reproduced below.

Table 4.17. Comparison of Dose-Effect Conversion Factors

Report	Deaths from Latent Cancer per Total Body Dose (number/million person-rem)
BEIR III	75 - 210
BEIR I	100 - 450
UNSCEAR	125
ICRP	125

The controversy about dose-effect models certainly does not end with the reports cited here. In actuality, the debate covers numerous particular organ dose conversions. Numerous reports detail less impact per dose while others project greater impacts per dose. Reliance by the DEIS on only BEIR, UNSCEAR, and ICRP reports underestimates the range of project impacts.

The DEIS compounds the confusion between the discussion of dose response on page 4-37 and the resulting Table 4-19. Although Table 4-19 presents incremental chance of death in terms of a range of values, one cannot discern which conversion factors depicted in Table 4.17 and Table 4.18 were used in the development of the resulting numbers. The footnote #1 for Table 4.19 doesn't help explain this matter either.

More important than the validity of the numbers themselves is the way the risk of harm is presented. Instead of presenting a 3 - D graphical representation of how the risk of harm is distributed off-site geographically, Table 4-19 presents the risk in terms of incremental chance of death to the maximally exposed individual. The DEIS fails to show who that is or where he or she resides nor explains that others bear some risk as well.

RECOMMENDATION

38-7 The Committee feels that the controversy surrounding dose-effect models should be better presented in the FEIS. Instead of relying solely on BEIR III and ICRP, a wider range of non-governmental estimates of dose response factors should be
38-8 utilized and fully explained. A 3 - D depiction of geographical risk distributions should be presented for the regions impacted by the project.

COMMENT Non-Fatal Health Effects

The DEIS depicts project risks only in terms of fatal health effects with little or token consideration given to the wide variety of consequences. While the "fatal cancers" class of consequences is useful for comparisons, other categories of consequences have significant impact on the perceived quality of life. Thyroid cancer, for instance, is seldom fatal but that does not imply that it is any more acceptable than death. There are "many mechanisms of radiation injury such as damage to cell membranes, damage to body repair mechanisms, indirect damage (for example: damage to cell blood supply and formation of harmful chemicals such as hydrogen peroxide in cell cytoplasm) and impairment of efficiency to lung clearance mechanisms." (Morgan, "Cancer and Low Level Ionizing Radiation", Sept. 1978).

RECOMMENDATION

38-9 The Final EIS should include in their dose-response model non-fatal health effects. Health consequences of an activity, measured only in terms of cancer death, limits an individual's perception of the risks involved.

COMMENT Occupational Dosage

The Committee was particularly concerned to discover that the DEIS failed to discuss occupational dose to workers in a meaningful way. Rather than carefully consider all project activities and sum the resultant personnel exposures, DOE chose instead to use industry experience at SRP and Hanford to guide its estimates.

Two problems bothered the Committee. First, how do we know that the average exposure at Hanford for waste retrieval efforts of 0.65 rems per worker is comparable to West Valley? Were the activities undertaken the same, the radioactivity levels of the waste the same, the managerial control as strict, or the worker group providing the exposure base: workers, or workers and clerical/management employees or just clerical/management types? Likewise for waste processing exposure, is the 0.54 rems per person per year at the SRP comparable to the West Valley Project for similar reasons? (DEIS pages B-16, B-47)

The occupational exposure estimates presented in the DEIS may well be optimistic, compared to SRP and Hanford experience, given numerous unique features at West Valley such as these below:

1. Much hotter wastes.
2. Much more complicated, obstructed waste tanks.
3. Smaller, more cramped processing canyon.
4. Lack of remote operational capability.
5. High annual exposures at the West Valley plant in the past.
   (2.74 rems/worker/year in 1968 to 7.24 rems/worker/year in 1971)
6. Existing contamination inside and around the plant, adding to the exposure burden.

This unexplained optimism is highlighted by a comparison between the DEIS and the 1978 DOE Companion Report. The Companion Report estimates waste retrieval doses at 120 person-rems. The DEIS estimates waste retrieval doses at 35 person-rems (except for Alternative 3 for which they are 28). (DEIS Table b.5, p. B-16) Considering the controversiality to the public of the health and safety of this project, it is interesting the DEIS doesn't commit more space to a justification of the applicability of SRP and Hanford worker exposure figures.

Another troubling aspect of the DEIS' treatment of worker exposure is the cavalier assessment of worker exposures due to accidents during the project. The DEIS assumes that there will be no errors in design or operation which could result in large occupational exposures. (These assumptions are made on pp. 4-8 and 4-28.) Past experience, especially at West Valley, does not support this assumption. The probability of errors resulting in abnormal exposures will hopefully be low, but it certainly isn't zero. A realistic probability for procedural or design errors should be calculated. The occupational exposure from the worst-case accident is estimated as 100-1000 rems to the maximally exposed individual, but not used in the DEIS. More than one individual, however, would most likely be affected.

Our earlier comments about risk assessment methods for off-site doses apply to occupational exposure as well. The likelihood that accidents during the project will cause worker exposure is not represented by one number, but rather a probabilistic function for frequency/consequence events. A family of curves could be postulated on such a graph depicting different levels of exposure mitigation efforts. Such a depiction could be constructed empirically from SRP or Hanford experience over the last decade and lend credence to the hypotheses for worker exposure the EIS process requires.

RECOMMENDATION

38-10 The final EIS should examine much more carefully the estimated occupational doses, both for waste retrieval and for processing with the various alternatives. Use of SRP and Hanford data should be justified by careful explanation of the comparability to West Valley operations. It should assign a realistic probability for dose received from procedural or design errors. It should explain fully the safeguards, such as ALARA and site-specific reductions of the maximum permissible occupational dose (e.g., to 3 rem/year), that may be available to assure that exposures will not climb above the 0.54 - 0.65 rem/year level into the high but, nevertheless, legal exposure levels previously experienced at West Valley. It should acknowledge that a worker is not only a worker, but that he is also a member of the population, and evaluate the additive effect of the population, and evaluate the additive effect of the local resident population dose. The impact of a contractor incentive program to reduce occupational doses deserves discussion as well.

CHAPTER III TECHNICAL

COMMENT Quantity of Residual Radioactivity in Emptied Tank 8D2

The Committee has focused concern on the operations needed to successfully remove the HLW from 8D2. Although significant segments of the 1978 Companion Report and the Battelle report (BMI-X698) discuss the equipment and tasks required to facilitate this activity, very little discussion can be found in the DEIS on this critical subject. Only 4 pages in Appendix B discuss this issue and within these pages a great deal of unknowns are admitted. Given the paucity of discussion, the Committee remains concerned about the effectiveness of sluicing for waste removal.

The DEIS references only one study in this area . . . the informal Janicek study. The Committee is aware of significant efforts underway and experience at the SRP and Hanford which shed light on this subject. Although the Janicek study reportedly relies on some of this experience, the Hill report (DP-1093), Johnson Report (ANL), NUREG 0043, and the Battelle report are all important information bases available for discussion. We also are aware of internal engineering evaluations of this subject by Rockwell International.

The discussion of the subject on page 128 of the Battelle report is sobering indeed. The authors indicate that we can expect a residual sludge volume of 4%, retaining an incredible 20% of the original sludge activity. (This amount was after chemical flushing.) This activity could amount to as much as 3 million curies. The DEIS does not explicitly project the amount of residual waste left after cleaning.

For its part, the Janicek study sheds no light on the subject. Rather, it postulates more unanswered questions about this phase of the project and proposes a study program to answer them costing around six million 1981 dollars. The Janicek study also indicates that the SRP tanks for which sluicing experience exists have less internal structures for waste to encrust on.

The trips of committee members failed to fully answer these questions. At Savannah River, we were told that 95% of the curies originally in the tank had been removed and that after hot chemical washes, only 1% would be left. At West Valley, that could be as much as .2 million curies. In spite of the cleaning effort, the inside of the tanks still gave off 1000 r/hr. Although this radioactivity could be due to waste which had leaked from SRP tank #16 and lodged beneath the tank, such high fields indicate that the job of completely cleaning a HLW tank prior to decommissioning will be a very challenging task, especially considering that the SRP wastes are far cooler than the West Valley wastes.

The effectiveness of the sludge removal operation will depend on many different considerations. Chief among them are the rheology of the sludge, the articulateness of the sluicer nozzle system, and the capability of the tank's internal structures to shield the sludge from the stream of slurried waste. The Janicek study describes the job of closing the gaps. The differences between the SRP and Hanford tanks and the applicability of the actual SRP and Hanford experience to West Valley is not clear at this time.

RECOMMENDATION

The potential exists that the 8D2 sludge removal operation will leave between .2 and 3 million curies of HLW in 8D2 after chemical flushing. Since this quantity of waste will still represent a significant long term threat to the environment, the
38-11 DEIS should discuss the degree of uncertainty presently existing about HLW residuals the kind and quantity of research needed to resolve these uncertainties.

Comment — Will the heel be TRU wastes or HLW?

After the last chemical flush, there is a substantial likelihood that significant quantities of HLW will remain encrusted on the tank internals. As such the tank will be considered at best, transuranic waste (TRU waste) and at worst,

HLW. A definition for TRU waste has been recently proposed by the U.S. Nuclear Regulatory Commission (USNRC) in the Federal Register of July 8, 1981. When promulgated, this definition will be part of a revised Part 60 of the Code of Federal Regulations (CFR) governing the performance objectives, design, construction and operation of the federal geologic repository for high level and transuranic nuclear wastes (HLW and TRU waste).

> "Transuranic wastes" or "TRU wastes" means radioactive waste containing alpha emitting transuranic elements, with radioactive half-lives greater than five years, in excess of 10 nanocuries per gram. (10 CFR Part 60.2, proposed 7/8/81)

A similar definition in the so-called DOE Operations Manual has governed USDOE waste management efforts since the early 1970's. USNRC has proposed a definition for HLW in the same Federal Register citation as follows:

> "High-level radioactive waste" or "HLW" means (1) irradiated reactor fuel, (2) liquid wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, and (3) solids into which such liquid wastes have been converted. (10 CFR Part 60.2 proposed, 7/8/81)

COMMENT

38-12 The question the Committee has wrestled with is, if these regulations are adopted as proposed, will the waste tanks with the residual heel be considered HLW, TRU waste or low level waste?

Such a determination is critical because each waste type has its own set of management guidelines and limitations under USNRC rules and USDOE internal guidelines.

Informal discussions with USNRC representatives clarified the meaning and intent for HLW and TRU waste definitions. HLW, we understand, might be construed to cover the residual heel because, under section (2) of that definition, such heels would likely be "equivalent" isotopically to the "liquid wastes resulting from the operation of the first cycle solvent extraction system, . . ." In addition, this residual heel could reasonably be construed to be, as under section (3) of that definition, "solids into which such liquid wastes have been converted." Granted, this occurred passively. It occurred, however, just the same.

Could the heel and tankage be considered TRU waste? This question is harder to answer. First, if the heel is contrued to be HLW, it would certainly not be TRU waste since the activity level would surely exceed 10 nci/gm. However, once encased in concrete, would the resulting monolith meet the 10 nci/gm limitation?

Assume for the purpose of argument that all the free space in the vault were filled with light weight concrete at 115 pounds per cubic foot. The weight of that mass, plus the steel tanks, plus the original vault would weigh approximately 23 million pounds or 10 billion grams. In order to meet the 10 nci/gm limit, the heel could consist legally of only ~~0.1~~ curies. This residual 104 activity would require a sludge decontamination factor of 99.8 ~~99.9999~~ %, instead of a maximum 99.0% projected by studies and experience available to date.* We conclude then that the resulting vault waste mass would not be considered TRU waste.

FOOTNOTE *

Our calculations are approximate, based on dimensions informally provided by NYSERDA and estimates of volume limited by lack of structural location information. The estimate could be off by many percentage points, however, without affecting the conclusions presented herein. For the purposes of calculation, the inventory of transuranics in the sludge prior to removal was assumed to be about 60,000 curies. (See Companion Report, P. 3-24)

The direct applicability of USNRC regulations is questionable due to the recently signed Memorandum of Understanding between the USNRC and the USDOE. The Sept. 1981 MOU transfers some of the jurisdiction for operational activity review to USDOE away from USNRC and the USNRC regulations and procedures. We do, however, understand that USDOE Operational Orders and other USDOE manuals utilize similar language and concepts to those promulgated by USNRC. In addition, project activities which would substantially violate the letter or spirit of USNRC rules would likely generate public, Congressional or even USNRC response. Consequently, the concepts embodied in USNRC regulations are still reasonable bases for project decision makers.

RECOMMENDATION

DOE should assess the waste management legal ramifications of the entombment mode of decommissioning HLW tank 8D2, given the substantial residual heel, proposed USNRC TRU waste and HLW management rules and the recent MOU.

COMMENT Procedural and Engineering Ramification of TRU Waste/HLW Determination for Tank 8D2 Decommissioning

The question of the TRU waste/HLW determination for Tank 8D2 is quite important. HLW cannot be buried at West Valley because it is not a designated federal repository. If any attempt to so designate were attempted, the site would fail numerous requirements of the proposed part 60 USNRC regulations governing such facilities. For instance, § 60.122 (i) requires that the repository be emplaced no less than 300 meters below the surface.

At West Valley the vault is only 10 meters down. § 60.123 (b) (4) requires that no extreme erosion has occurred during the Quartenary period (last 2 million years). At West Valley not only has extreme erosion occurred in that time frame, but several glacial intrusions have scraped over the area, thereby indisputably violating § 60.112 in its entirety. Burying HLW at West Valley would likely violate numerous other sections of proposed Part 60 as well, including subsections of:

- § 60.111
- § 60.121
- § 60.131
- § 60.132
- § 60.135

It appears safe to say, therefore, that burial of HLW at West Valley will not be sanctioned by these regulations unless this facility is specifically exempted from USNRC Part 60 rules by future regulations or statutes. Entombment therefore, as proposed by the DEIS would not be permitted or appropriate.

If, arguendo, the entombed waste tank were determined to be TRU waste, certain other requirements may exist before burial would be allowed at West Valley at its present location. Justified in detail in NUREG - 0782, the USNRC published proposed rules for management of low level nuclear waste and TRU waste. Although the USNRC jurisdiction over waste management activities at the West Valley DOE project mav be limited by the MOU, it seems unlikely the Commission, Congress, or the public will be satisfied with a decommissioning option which will violate the spirit or letter of the law. At a minimum, entombment of the Tank 8D2, if carried out away from West Valley, if construed to be TRU waste, would require special showings under proposed rules of 10CFR Part 61. For instance, a license application and environmental report must be compiled setting forth in detail extensive geohydrolgic, tectonic, geomorphic, geochemical, and institutional information to justify the activity. The instant DEIS for the project has little of these data on which to base such an analysis. If such data were presented, the site might be found to violate several subsections of subpart D such as § 61.50(7) and (10) which discuss

ground water regime and surface geologic process limitations which West Valley has been shown to exceed in certain areas at various times.

The justification for disposal of HLW in a federal repository is founded on a wealth of documentation. In some ways, the solidification project at West Valley is an outgrowth of the same rationales. The Committee therefore wonders how the DEIS could reject the tank dismantling option entirely. In fact, we wonder why the "leave it there" or entombment options were not rejected instead.

RECOMMENDATION

38-13 If the entombed Tank 8D2 is construed to be TRU waste, proposed 10 CFR Part 61 may be applicable to the project action, at least in spirit. As such, the DEIS should assess the data requirements and the likelihood of site suitability as defined by these new regulations.

COMMENT Site Specific Considerations for Tank Decommissioning Option Choices

Site specific justification of dismantling can be seen by consideration of release scenarios for the tank entombment options. Most of the residual radioactivity would be at the bottom of the tank, underneath about a million gallons of solidified cement. While this would be a relatively effective barrier to human intrusion, it would also be very difficult or impossible to remove if it turned out not to be a satisfactory way of decommissioning the tank.

There would be no barrier below the residual radioactive waste except for the silty till and possibly the existing concrete vault. Directly below the residual radioactive material would be the steel tank bottom, which would become permeable within a couple of decades as it rusted through. Below this is a 15-inch-thick, 72-foot-diameter permeable layer of perlite blocks and gravel. Below this is the steel pan, which already has a leak in it and will become more permeable as it rusts. Below this is a 3-inch-thick layer of gravel, and then floor of the existing concrete vault. Except perhaps for the vault itself, none of these barriers represent viable HLW or TRU waste containerization.

The integrity of the vault is a question. It remains to be seen whether the vault will survive the change in stress (as the HLW is gradually removed, then replaced by at least twice as much weight of concrete) without cracking. If cracks develop in the existing vault, then groundwater is free to move througn the permeable layers underneath the residual wastes, so that the silty till would be the only barrier. This is not an encouraging prospect, especially in view of the inadequately explained water problems at other parts of the site. For example, if contamined water started percolating upward around the entombed tank (whether from a "bathtub effect" or an underground spring), it would be a very difficult problem to control, much less to remedy.

The bathtub effect would be particularly troublesome due to the recently discovered geomorphology of the area immediately surrounding the HLW tanks, the processing building and the low level liquid waste treatment facilities. Recent soil borings by USGS (80-2,3,4,5,) have documented the existence of a surficial layer of highly permeable gravel 5 to 25 feet thick in this area. Known to geologists as an "alluvial fan deposit", this structure appears to be continuous and highly permeable. Any liquid HLW or solubilized fractions thereof which escape from the vault (either before solidification or after entombment) will find subsurface transport quite easy in this portion of the site. Topographic contours in the area of the HLW tanks assure that such waste excursions would migrate either to Erdman Brook or to the swamp (which discharges to Erdman Brook). Erdman Brook then flows into Cattaraugas Creek and thereby into Lake Erie. This drainage scenario can hardly be considered far fetched as similar, albeit low level, surface discharges have already occurred from West Valley's low level burial area.

Dismantlement is certainly not an incomprehensible task. Rather, the Battelle study of 1978 devoted discussion to it on

page 129 and Rockwell International internal work was done on the subject. We understand that DOE facilities have considered the dismantlement option for their emptied tanks as well. Remote gas and plasma cutting technology and techniques have been well developed over the last few years for radioactive equipment and facilities much like tank 8D2. A great deal of information exists in the literature documenting a plethora of approaches and experience. Exactly similar work will be needed to dismantle the old reprocessing systems and eventually the solidification equipment too.

The DEIS gives dismantlement extremely short shrift. On page B-102, the authors discuss and reject the option in three sentences. Large quantities of occupational exposure (230 person-rems) are used to justify rejection of the option. Even assuming arguendo that this figure is correct, it is still a fraction of the occupational dose associated with the whole project. (1800 - 2200 person-rems for scenarios 1a and 2) Given the Committee's contention that these figures themselves are optimistic, the 230 person-rem tank dismantling figures would be an even smaller proportion of the project total.

38-14 The 230 person-rem total for tank dismantling may well be an intentionally inflated value used to discourage support for this decommissioning option. The citation for this figure is the DOE report of 1978, (the so-called Companion Report). The dismantlement option is discussed on pages 4-72 to 4-74 and is itself based on another report, ANL - UNI-1050. This report assumes that dismantlement would be carried out by workers in a shielded cage lowered into the tank wielding oxy-acetylene torches. Such a technique would likely generate high levels of personnel exposure as demonstrated by the 230 person-rem figure. If the remote cutting technique discussed by the Battelle Environmental Report of 1978 were used instead, personnel exposure would be minimized or eliminated entirely (except for the 10 - 20 person-rems likely to be generated from handling and packaging the cut-up pieces preparatory to transport).

RECOMMENDATION

Considering the wealth of experience around the world cutting up contaminated tanks and other vessels, the availability of an impermeable vault to isolate the job (i.e. the concrete

vault), the potentially large residual heel of HLW, and the likelihood that HLW will eventually escape the entombment system,
38-15 the Committee recommends that the FEIS reconsider this task in detail. The Committee believes that such a reconsideration will inevitably lead to a rejection of the emptied tank concrete entombment option.

COMMENT — Fail-safe Operational Interlocks

While on the tour of the Idaho Reprocessing facility, the Committee Chairman was made aware of a criticality incident which occurred several years ago in a pulsed column of the first extraction step. Due to a malfunctioning instrument, enriched uranium began recycling in the column, eventually reaching a critical concentration. Although damage to the facility was small, the system remained down for about two years.

Following the incident, DOE required the contractor to install a continuous system status monitor with the capability to automatically shutdown the facility when certain critical parameters exceeded setpoints. Facility operators cannot tamper with the system or defeat its capabilities without express permission from DOE representatives. In this way, inappropriate engineering judgement on the part of operators cannot cause the processing system to fail.

38-16 The DEIS does not discuss such a system's applicability to the proposed solidification systems under consideration at West Valley. As described in Idaho, such a system appears appropriate for DEIS review.

RECOMMENDATION

The FEIS should consider the installation of automatic system shutdown capability for the solidification system.

COMMENT — Pre-design Troubleshooting

While the Committee Chairman was touring the Idaho solidification facility, he was told that intensive pre-design studies and discussions were held between designers, engineers and operators familiar with the operation campaigns of the pre-existing calciner. All the old logs were consulted for recurring breakdowns, excessive maintenance requirements, awkward layouts, and other correctable difficulties and deficiencies. In this way, the new and bigger calciner would not necessarily feature the same deficiencies and cause similar difficulties in the future. The DEIS fails to discuss this kind of a review process and its applicability to the solidification systems under consideration for West Valley.

RECOMMENDATION

38-17 The FEIS should discuss the pre-design activities which will assure that the operational and design flaws of existing systems will not be repeated in equipment and designs used in the West Valley solidification system.

COMMENT — Continuous Melter

The possibility of a malfunction in the ceramic melter (Alternative 1b) is of serious concern. We question whether it will be possible to design a ceramic meltar which can be run by remote control for long periods of time under high temperatures. Some of many difficulties are mentioned on page B-31. They include difficulty in ensuring high quality waste information and corrosion of melter electrodes or the ceramic melter refractory.

RECOMMENDATION

38-18 The FEIS should assess the possibility and ramifications of repair and/or replacement of the ceramic melter with remote-maintenance systems. Occupational hazards should be estimated for such an operation.

COMMENT **Inconel Melter**

Committee member discussions at the SRP determined that the inconel ceramic melter operating at 1150° C vaporizes Iodine and Ruthenium. These gases must be captured by the off-gas system. This difficult operational undertaking was not explained in any detail, nor was the off-gas treatment system for any of the solidification options.

The success of the solidification process will be largely determined by the reliable and effective operation of the off-gas treatment system. At the Idaho calcining facility, this system comprises a very significant portion of the processing facility. Its design, engineering, operation, maintenance and components will determine its effectiveness.

The overall composition of off-gas streams for the calcining scenario cannot be found in the DEIS. Surely basic information can be generated on this important part of the operation of the facility. Tritium, one likely component, can be separated from water by a Swiss process. The DEIS fails to discuss this process.

RECOMMENDATION

38-19 The FEIS should specify likely off-gas stream composition for the calcining scenarios and present, in at least conceptual form, design and operational information for off-gas systems needed for proper control. The resulting composition of effluents from the treatment system during actual processing campaigns should likewise be discussed in the FEIS.

Technical bases for the effluent and reliability projections should include information on past experience with such systems. Also included should be a description of the remote control methods for changing filters and other equipment during the solidification campaigns. The amount of tritium released to the atmosphere should be provided, impacts estimated for it, and costs for installation and operation of the Swiss technology for tritium separation examined.

COMMENT **Low Level Waste**

The discussion of the solid waste burial grounds at West Valley (B.3.2) is deficient. The DEIS mentions that LLW burial at West Valley might be an isolation option, without mention of the fact that this burial area has been plagued by problems since the early 1970's. There is no mention of the grounds closing in 1975 due to water infiltration in the trenches and that, even now, after extensive remedial work, water must still be pumped out and treated intermittently. In DEIS section 3.1.3 it is noted that there are at least 2 aquifers in the area, but they are immediately discounted as possible migrational routes. There is no mention of the sand lenses in the burial area, as acknowledged by the NYS Department of Environmental Conservation and the Department of Health, and the role that these lenses may play in the underground movement of radionuclides. The location of the trenches near a hillside and the erosion of that hillside is also not mentioned.

The Committee also focussed on ramifications of salt cake disposal in West Valley's LLW burial area. Because of the likelihood that leachate would continue to infuse waste dumped, then leading to surface water discharges, potential eutrophication, radionuclide mobilization and other adverse impacts would be created. DEIS fails to connect the ongoing problems at West Valley's burial areas with the advisability of future salt cake burial there.

RECOMMENDATION

38-20 The Committee recommends that the FEIS fully assess the performance of the on-site low level waste burial ground and its appropriateness for disposal of project generated waste. The consensus of the Committee was that the site was inappropriate, given the continued difficulties associated with sand lenses, perpetual maintenance requirements and water infiltration. The Committee went further to question the likelihood that the Northeast could ever locate such a site, given the climatology and
38-21 hydrogeology of that region. Disposal of the salt cake in a LLW site was questioned as well.

COMMENT Technetium Removal

The 1978 DOE Companion Report raises the following question.

> "A number of uncertainties relative to the identity of radionuclides in the 8D2 supernate exists. For example, the presence or absence of technetium should be verified, and if present in sufficient quantity to require removal an appropriate ion-exchange resin should be identified and its performance and operating conditions determined."

On page 4-35 the DEIS says, "Technetium-99, which has a half-life of 2.1×10^5 years, would be transported freely by groundwater after it is leached out of the salt cake." If the salt cake were to be buried in the low level waste burial ground at West Valley, Technetium-99 could pose an additional subsurface migration hazard, given the ongoing leachate troubles with that waste area.

RECOMMENDATION

38-22 If the salt cake is disposed of in a burial ground, the technetium should be removed and placed in the HLW mix. The FEIS should include some discussion of an appropriate ion-exchange resin for separation of technetium-99. (If the supernate has been recently sampled and technetium has been found to be of insufficient quantity to require separation, this should be so
38-23 stated.) The less appropriate option of burial of technetium-99 contaminated salt cake should, however, be analyzed for migration hazards and the data presented for public evaluation.

COMMENT Uranyl Nitrate

The committee was concerned about the 3 1/2 tons of radioactive uranyl nitrate which remain in the process building. The DEIS fails to discuss the final disposition of this reprocessing left-over.

RECOMMENDATION

38-24 The FEIS must evaluate disposition options for the uranyl nitrate left at the reprocessing plant.

CHAPTER IV PSYCHOLOGICAL STRESS

COMMENT Population Psychological Stress

Committee members felt strongly that the existence of nuclear waste at the West Valley site and the controversy surrounding the facility and the project had caused and still causes psychological stress. This stress may account for a notable lack of interest in project activities by many people living in the plant environs. Perhaps a kind of resignation has set in, engendering a "what will happen, will happen" attitude.

RECOMMENDATION

38-25 The FEIS should focus on the benefits project implementation will have on reducing the psychological stress associated with the mobilizable waste on site and the public controversy surrounding its existence.

CHAPTER V PROJECT MANAGEMENT

COMMENT Managerial Adequacy

The Committee felt that the subject of mitigative measures is unsatisfactorily dealt with in the DEIS. While "sound management and quality assurance systems for all stages of a project" (DEIS Sec. 4.5.11, pp 4-71) are indeed essential in effective mitigative measures, DOE's role as overseer in this area has been weak. An August 4, 1981 report by the Comptroller General entitled "Better Oversight Needed for the Safety and Health Activities at DOE's Nuclear Facilities" states that ". . . DOE's occupational safety, emergency preparedness, facility design, safety and environmental monitoring programs warrant immediate corrective action." (Page iii)

The Committee visits to Idaho Falls disclosed that contractor incentive programs have been very effective at obtaining compliance with environmental protection, occupational exposure guidelines, and operational procedures. Idaho's Incentive Contract Funding, where DOE pays a contractor on a quarterly basis and provides additional payment over costs only if the contractor has met certain performance criteria, has proved effective encouragement for good management practices.

RECOMMENDATION

38-26 An incentive type contract between DOE and Westinghouse should be arranged and discussed in the FEIS. The Committee feels DOE should formulate performance criteria for the West Valley project and devise an incentive program that applies enough pressure to ensure contractor adherence to these criteria.

CHAPTER VI OPTION EVALUATION CRITERIA

COMMENT Criteria for Choosing Best Solidification Option

In 1978, the US DOE chartered a special citizen's committee called the West Valley Decommissioning and Decontamination Task Group to determine decommissioning criteria for the West Valley Facility. Several of these criteria are particularly appropriate now in guiding DOE's choice of the best option for implementation of the project and therefore are presented below from the summary presented in the 1978 DOE Companion Report.

The Task Group developed decommissioning criteria in terms of standards, considerations and goals. In addition, the Task Group has articulated principles upon which the decommissioning criteria are based.

Principle #1

Total risks must be minimized by the expenditure of sufficient funds to guarantee minimization of short term risk. Use of this mechanism necessitates that short and long term risks be defined with confidence. Reduction of risk to future generations should be given priority and minimized.

Principle #2

Reduction of total risk exposure should be given higher priority than financial cost reduction. The decision making process should not, however, be totally exclusive of cost-benefits. Reduction of costs to future generations should likewise be given priority.

The Task Group does not intend that these principles be applied in such a way as to create an unreasonable application of risk to either present or future generations.

1. General Selection Consideration

The Task Group agreed that in ranking various disposition options for radioactive accumulations at the site, the following considerations should be used for decision making. The best options for each of the five areas are weighted according to importance (with options from #1 given priority over those in #2, etc.)

Considerations for Selection (in descending order of importance)

1. Select options with the lowest long term population health risk levels.
2. Select options with the lowest short-term population health risk levels.
3. Select those options in which total risk is minimized, provided that the short term risk is minimized by the expenditure of sufficient funds and the long term risks can be determined with confidence and minimized.
4. Select options with lowest dollar cost to future generations.
5. Select options with the lowest short-term dollar cost.

The Task Group does not recommend that these considerations be applied in an unreasonably narrow manner.

2. Time Limits for Action Goal

The Task Group determined that a time limit of 5 years from January 1, 1979, be established to provide an adequate period of time to collect and analyze the data needed for decision making for disposition of all radioactive portions of the West Valley Site.

3. Institutional Reliability Consideration

The Task Group proposes that all wastes requiring site access control in excess of several hundred years be placed in a permanent repository as soon as feasible (See Nuclear Repository Goal). Should the decision making process determine that the site will continue to be temporarily restricted, areas with accumulations of short lived radionuclides may remain on site, constantly monitored and surveilled, with clearly articulated agreements to properly protect public health and safety, including provisions for the ultimate disposal of wastes. When natural decay has brought activity levels below our proposed standards, the site may be considered for nonrestricted use.

In addition to the Task Group criteria set forth above, the present Committee focused attention on some additional considerations to guide option selection.

1. Technology Reliability Assessment
Accident potential of each alternative should be assessed. The technology with the most substantial engineering base will have a lower potential for accident than one which is untried. Simplicity of design will also lower accident potential.

2. Back-up Technology
A technology for which back-up systems can be easily designed is preferable to one for which they cannot. The question of back-up systems has not been addressed in the DEIS. If all the alternatives could have equally effective back-up systems this should be so stated in the final EIS and some indication of what these would be should be given.

3. Flexibility
Maximum flexibility of a system is desirable. If significant difficulties are encountered at any point (during the detailed design period, testing mockups, or actual operation) adaptability to another method would be of great value. To have to continue a process which has become difficult or cumbersome simply because it cannot be reversed or abandoned should not be necessary. This characteristic has not been addressed in the DEIS for any of the alternatives.

Letter 39

League of Women Voters
LAKE ERIE BASIN COMMITTEE

THIS AUGMENTED STATEMENT IS FOR THE RECORD IN PLACE OF THE ABBREVIATED COMMENTS SUBMITTED TO THE U.S.DOE OCT.30,1981

STATEMENT

TO

UNITED STATES DEPARTMNET OF ENERGY WASHINGTON D.C.

ON

DEIS LONG_TERM MANAGEMENT OF LIQUID HIGH-LEVEL RADIO-ACTIVE WASTES STORED AT THE WESTERN NEW YORK NUCLEAR SERVICE CENTER WEST VALLEY.

The Lake Erie Basin Committee ofthe League of Women Voters represents 7800 members in 65 local Leagues in the Lake Erie watershed areas of New York, Pennsylvania, Michigan, Indiana, and Ohio. Since its inception in 1963 this ad hoc committee and its component Leagues have worked to protect and restore Lake Erie and its tributaries through pollution abatement and prevention and through improved planning and management of water and related land resources.

The LEBC has commented four times previously on various proposals for the Western New York Nuclear Service Center site at West Valley New York. Legislation has been passed and funds appropriated to begin the high-level radio-active waste demonstration project, however, we have not lost sight of the fact that the largest percentage of information published in DEPT.of ENERGY reports on the project is the result of an intensive research literature search. There does not seem to be an adequatgcamount of data on which to accurately determine how to deal with the problem.

For example in the LEBC statement dated Feb-2 1980 we directed the DOE attention to critical research needs relating to radionuclides as listed by the International Joint Commission Great Lakes Research Advisory Board as follows:

"Ecology 8 Fate of Radionuclides Released from Nuclear Facilities.

STATEMENT: The operation of nuclear facilities suchas reactors and fuel processing plants involves the regular release of small quantities of radionuclides and the finite proability that major releases of radioactivity may enter the environment as a result of a catastrophic accident. Real effects of present actions are not clear nor can the effects be predicted of major releases on drinking water supplies and those segments of aquatic food chains directly affecting man for atime equal to the lifetime of each radionuclide.

IMPORTANCE: The Great Lakes provide the drinking water for a significant portion of the population of the United States and Canada. This information will be important to develop site-by site contigency plans for water treatmnet and long-term usage of the water body.

NEED: 8-1 - Development of Improved prediction of Short-term Removal Processes for radionuclides from the Water Column.
OBJECTIVE: To determine the possible chemical form and speciation for radionuclides in water following their release. To determine the relative importance of biotic and abiotic processes such as uptake by phytoplankton and inorganic particulate matter in the water column. To predict the resulting concentration of radionuclides in drinking water.

NEED: 8-2 Determination of Bioaccumulations of Radionuclides in Aquatic Organisms.
OBJECTIVE: To determine the concentration of the transuranic elements in the commonly edible portions of aquatic organisms as a basis for the calculation of the radiation dose to man.

NEED: 8-3 - Determination of Long-Term removal and Resuspension processes for Radionuclides in the Great Lakes.
OBJECTIVE: To determine the effects of bioturbation,currents storm activity and lake morphology on sedimentation rate and the distribution of radionuclides in the sediments and their influence on the long-term availability of radionuclides to return to the water column by resuspension.

NEED: 8-4 - Determination of the Effect of Extreme Changing of Water Quality on the Availability of Radionuclides to the WATER Column.
OBJECTIVE: To determine the physical-chemical interaction of each nuclide as it may be affected by changing conditions;e.g.dissolved O2,Eh,pH,complexing capacity of the water column over lifetimes greater than several hundred years and for changes in water quality."

Have any of these critical research needs been started and/or completed to supply missing information which is essential to understanding the effects of radionuclides in water supplies?

39-1 The DEIS does not address the issues related to the Cattauragus Creek watershed and Lake Erie water quality from accidental discharges small or catastrophic from radionuclides,chemicals,heavy metals, organics etc. satisfactorily. Putting more radionuclides into the atmosphere through the stack will not eliminate the discharge. Discharges into the air do not automatically mix uniformly,but travel in plumes. These plumes as evidenced from satellite photographs travel hundreds of miles depending upon air currents,tempatures etc. An example is the acid rain problem associated with sulfur dioxide discharges into the atmosphere that have affected hundreds of lakes in Canada and the Adirondack lakes in New York State . Dilution is not certain as implied in the DEIS.

The LEBC has collected extensive reports by the U.S. Geological Survey and the New York State Geological Survey about hydrologic and erosion problems at the West Valley site. Nearly all these reports indicated need for much more extensive study of the site to make a more accurate determination of the problems. There is a

MICHIGAN · INDIANA · OHIO · PENNSYLVANIA · NEW YORK a lack of soils information which is important not only as to radionuclide adsorption capacity and erosion potential, but the land use problems associated with heavy buildings constructed on lacustrine sediments in the Allegheny Plateau. A U.S.Soil Conservation report entitled"Lacustrine Sediments in the Allegheny Plateau of Erie County, New York;Their characteristics, distribution and land use problems" and a companion report entitled" Glacial Lake sediments in West Branch Cazenovia and Eighteenmile Creek Valleys near Colden, N.Y.: A special report with reference to soil slumping hazards " by the U.S.Dept. of Agriculture S.CS. are examples of the type of information that is needed about the WNYNSC site.According to Mr.Donald Owen, Earth Dimensions, Inc. East Aurora, N.Y. these soil/geologic conditions extend into adjacent Cattaraugus County.

39-2 The Committee urges a through study of the soils/lacustrine sediments on the site. Heavy structuras such as the present reprocessing building with additional equipment loadings, proposed new structures for the solidification project, storage for high-level, transuranic, low-level waste and salt cake could present land-use problems associated with the carrying capacity of the site due not only to potential seismic action but the instability of these lacustrine sediments.

The Great Lakes Water Quality Agreement of 1978 between the U.S. and Canada treats the Great Lakes as a system, including the tributaries as well as the Lakes themselves.

The International Joint Commission has Juridiction over Great Lakes boundary waters and any pollution of them, by law, embodied in two treaties, and has special expertise in the management of the boundary waters by its investigatory functions. By the terms of Article 6 of the U.S. Constitution "the supremacy clause" treaties are the supreme law of the land.

Under Article II of the 1909 Boundary Waters Treaty, citizens of one country are entitled to remedies for injuries resulting from utilization of shared waters by citizens of the other.Article IV part 2 of the Treaty prohibits the pollution of boundary waters and water flowing across the boundary on either side to the injury of health or property on the other. The prohibition is absolute, contingent upon no additional circumstances to make it obligatory, the provision is therefore self-executing.

The New York State Environmental Conservation Law of 1970 contains provisions which extend the Law's protection to Canadians.

The Secretary of the Interior has recognized the rights of non-nationals to play a role in the administrative operations required by NEPA. That recognition stands as a precedent for the administrative extension of NEPA requirements to foreign relations.The Canadian-United States discussions over the Garrison Diversion project in North Dakota provide a more specific example of NEPA's extension to environmental effects within another nation.

In this particular case, the findings of an impact statement had a significant effect upon federal policy because they called into action Canadian rights under Article IV of the Boundary Waters Treaty. The IBWC International Boundary and Water Commission, a parallel body having authority over boundary water disputes with Mexico, has already complied with NEPA having promulgated a manuel for the preparation of impact reports.

39-3 The DOE sent a copy of the DEIS to the International Joint Commission. Was the DEIS sent to Mr. William B. Nye of the Water Quality Board requesting consideration of the document as a board and also individually as representatives of their respective agencies? Have Canadian public interest groups/citizens such as the Conservation Councils of Ontario received an opportunity to participate in the Environmental Impact process for this demonstration project? Any mistakes made at West Valley can impact Canadians as well as U.S. citizens.

Frances Arcara, Lake Erie Basin Committee, was a member of the Conservation Foundation Dialogue Group on low level radio-active waste management which just released its report to the public in July, 1981. This report covers sixteen months of deliberation about low-level waste management and recommendations for improvements in the system. Because of the proximity of the NRC burial ground to the New York state low-level burial site there must be further investigation into the water problems, sand lenses and offsite migration of radioactivity indicated in the 1979 EG & G radiological survey of the West Valley nuclear waste site. What is the source of this contamination? the NRC burialsite? the low-level burial site? the reprocessing building? the high-level

39-4 waste tanks? We question continued use of the NRC site and any proposal to reopen the state owned low-level site. In our discussions of the Dialogue group, the technical advisor indicated that when off-site migration is detected the site should be closed to determine the source and extent of that contamination.

The Nuclear Regulatory Commission report entitled"Technology, Safety and Costs of Decommissioning a Reference Low-level Waste Burial Ground"questions the validity of applying laboratory values to field situations. Measured values of distribution coefficient are strongly dependent on the physical and chemical conditions of measurements. Among other variables, mineralogy, particle size, nature of solution, and chemical natures of radioactive species are important.

Leach rates are influenced by many factors.These include the characteristics ofthe radionuclides and of the waste material, the properties of the leachant, frequency of leachant changing, leaching time and temperature.Specific field data on the leachability of radionuclides from waste buried in LLW burial grounds are not available. Published leach rate data come mainly from laboratory experiments in which small samples are leached by distilled water or by actual simulated disposal-environment water.

The LEBC is concerned about the nuclide which is the major contributor to both total body and bone doses for the food ingestion pathway, 210Pb. Lead 210 is a radioactive daughter of 226Ra. The dose conversion factor is only slightly greater for 210Pb than it is for 226Ra. However the rate of plant-root uptake is more than an order of magnitude greater for 210Pb than it is for 226Ra. Considering the inventories of radionuclides in the NRC and the state owned burial sites the problems with these sites should be resolved.

39-5 The environmental analysis of the proposed alternative waste forms in the DEIS could have been easier to understand if Appendix B had been inserted before Chapter 4. Appendix B was well written, translating difficult technical information into understandable language. If anything the DEIS reveals very well the uncertainties in choosing a particular waste form without more data on which to base a decision. Much more information is needed to make an informed recommendation as to which alternative is preferable with more accurate radiological health hazard data. When a specific waste form is proposed there must be a full environmental impact statement with public review.

The West Valley Program Committee is submitting comments which should be given priority consideration. The comments by the Senior Technical Consulting Board to the Argonne National Laboratory dated 3/81 and the additional comments by Richard S.Booth dated were excellent. It would have helped the Deis if these recommendations had been incorporated into the draft before it was released.

The LEBC strongly recommends the continuation of the West Valley Program Committee. The committee is an important linkage between the DOE and the local community. The Demonstration Project at West Valley is just barely getting started and the cooperation of the local community is essential. The majority of the local community trust their own citizens more than outsiders. Abolishment of the Program Committee could lead to a perception of "what is the cover-up now?"

The LEBC feels strongly that the DOE should be aware of the very grave concern of Western N.Y. citizens that surveillance,monitoring and enforcement regarding health and environmental protection for the entire demonstration-decommissioning project will be curtailed due to budget cuts in the regulatory programs of the Environmental Protection Agency.

The LEBC is very concerned about the rising hostility between Ottawa and Washington about the whole range of problems such as fisheries,transborder air agreements,Great Lakes pollution,and taxation policies. Any carelessness or miscalculation at West Valley causing a catastrophic release of radioactivity could cause irreversible harm to Canada and the Great Lakes ecosystem. This project must be conducted very carefully. The water supply in the Great Lakes is our most precious resource, for now and for future generations.

Thank you for the oportunity to expressour views. Enclosed is a copy of the SCS report " Lacustrine sediments in the Allegheny Plateau of Erie County,New York: Their characteristics,distribution and land use problems." for the record.

Frances Arcara Coordinator
Lake Erie Basin Committee LWV

Frances Arcara

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Appendix 6 Water Supply-Municipal,Industrial,and Rural

Erie-Niagara Counties Regional Planning Board 208 Water Quality Ground Water Study

Lacustrine sediments in the Allegheny Plateau of Erie County,N.Y. Their characteristics,distribution and land use problems. U.S.SCS D.W.OWENS, R.B.Daniels and G.B. Brauen

Glacial Lake Sediments in West Branch Cazenovia and Eighteenmile Creek Valleys Near Colden,N.Y. A report with special reference to soil slumping hazards.U.S. Dept. of Agriculture SCS May 1975

Regional Ground Water Syetems Analysis G.D. Bennett U.S.G.S. Reston,Va. for Water Spectrum Fall 1979

Geologic Disposal of High-Level Radioactive Wastes Earth Science Perspectives USGS Circular 779

Criteria For Radioactive Wastes EPA Federal Register Vol43#221 11/25/78

Recharge to Low-Level Radioactive Waste Burial Trenches 11through14 West Valley,N.Y. Prudic USGS Open-file Report 79-990

Appendix B Hydrogeologic Characteristics for six DOE and commercial land burial sites

Ground Water Hydrology and Subsurface Migration of Radioisotopes at a Solid Radioactive Waste Disposal Site,West Valley,N.Y. Prudic and Randall USGS Open file Report 77-566

Evaluation of Isotope Migration- Land burial Water Chemistry at Commercially Operated Low-Level Radioactive Waste Disposal Sites OCT.-Dec 1979 and Jan.-March 1980

Geomorphic and Erosion Studies at the WNYNSC West Valley,N.Y.12/79 USGS

Core Sampling Beneath Low-Level Radioactive Waste Burial Trenches, West Valley, Cattaraugus County, N.Y. USGS Open-file Report 79-1532

The Reconcentration Phenomenon of Radionuclide Chain Migration Batelle Pacific Northwest Lab. Revised 4/77

Cesium-137 Isoexposure Map of West Valley 1979 An Aerial Radiological Survey of the Nuclear Fuels Service Center and Surrounding Area EG&G 1183-1782, 12/80

Shallow-LAnd Burial of Low_level Radioactive Wastes in the U.S.A. Geohydrologic and nuclide migration studies Reprint from "Underground Disposal of Radioactive Wastes VolII International A E Agency Vienna, 1980

Managing the Nation's High-Level Radioactive Waste: Key Issues & Recommendations The Conservation Foundation July, 1981

IJC Great Lakes Water Quality Research Needs 1976 pg 22,23

U.S. Canada Water Quality Agreement of 1978

U.S. Canada Trans-Boundary Air Agreement 1980

sumer tastes, governmental actions, and/or the relative availability of resources, such as water and fossil fuels, can influence land use significantly. Though these and other variables will change over time, the direction of the changes and their combined impacts on land use are certainly not clear.

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Lacustrine sediments in the Allegheny Plateau of Erie County, New York: Their characteristics, distribution, and land use problems

D. W. OWENS, R. B. DANIELS, and G. B. BRAUEN

ABSTRACT—Temporary glacial lakes developed in many Allegheny Plateau river valleys 12,000 to 13,000 years ago when glacial ice dammed the north-flowing streams. The lakes were only 1 to 2 miles wide and 5 to 10 miles long, but more than 100 feet of illitic lacustrine silts and clays were deposited in some of the valleys before the lakes were drained. In most areas, 2 to 10 feet of sand and gravel were deposited over the lacustrine materials shortly after the lakes were drained. Erosion since the glacial ice melted has cut into the glacial, glaciofluvial, and lacustrine sediments in the narrow valleys, resulting in extremely complex but predictable soil patterns. A thorough knowledge of the glacial geology of the area is needed to map the areas underlain by lacustrine sediments because most soils are formed in the sand and gravel of the glaciofluvial cap. Many of the areas underlain by lacustrine sediments would be missed if only the surficial soil properties were used. The steep slopes underlain by lacustrine sediments are attractive building sites because they are close to ski resorts, visually pleasant most of the year, and located near a large city with an expanding urban population. But large areas of the most attractive building sites are on or close to steep slopes that are subject to mass movement when disturbed by normal building activities. Building on these unstable materials has resulted in considerable difficulty in maintaining the roadbed of a railroad and roads and in maintaining utility lines and foundations in a housing development.

MOST land use problems come about because planners or builders either ignore or don't have adequate knowledge of the soils and materials they are working on. The Allegheny Plateau of New York State is no exception. Ski resorts and associated urban developments dot the steep-sided glaciated valleys of the Plateau in Erie County (Figure 1). These valleys are visually attractive most of the year and close to Buffalo, so development of the wooded slopes overlooking the ski resorts is an attractive option for many builders.

Unfortunately, many of the sloping areas being developed are old glacial lake bottoms with many feet of illitic lacustrine (lake-laid) silt and clay that is unstable and subject to mass movement when disturbed. The lacustrine sediments have a thin skin of brown soil over a firm to soft, in places nearly fluid, body of dark gray silt and clay. Road cuts that expose these soft sediments are unstable, and the road ditches require periodic cleaning to remove the sediment that moves from the road cuts. The B & O Railroad has had several derailments along a short stretch of track built on these lacustrine materials in the West Branch of Cazenovia Creek.

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Glacial History

The Allegheny Plateau in Erie County is a high (1,700 feet or more) bedrock-controlled upland that north of the Lake Escarpment moraine has several narrow, nearly parallel, northwest-trending valleys (4). Stream channels in these steep-sided valleys are 400 to 700 feet below the adjacent, nearly level to sloping uplands. Shale bedrock underlies the uplands and many of the valley slopes (2),

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although exposures of shale are rare except in some stream channels. Most of the plateau has a 3- to 30-foot-thick mantle of glacial deposits dominated by shale fragments.

The continental ice responsible for these glacial deposits receded in less than 1,000 years from the Lake Escarpment moraine to the Gowanda moraine about 12,000 to 13,000 years ago (3). During the ice retreat, the ice tongues in the northwest-trending valleys dammed the normal outlets and created several short-lived glacial lakes of unknown depth. These glacial lakes were 1 to 2 miles wide and 5 to 10 miles long (Figure 2). Many of the lakes spilled over lows on the adjacent divides and cut overflow channels into the adjacent valley systems. Prior (6) believes the ice tongues in the valleys retreated rapidly and the glacial lakes were ephemeral features. But these lakes were present long enough to receive from 10 to 100 feet of silt and clay before they were drained.

Erosion has modified the surface of the old lake bottoms since the ice tongues melted and opened the normal valley outlets. As a result, few flat or level areas remain. In places, the stream channels are now 100 feet or more below the original lake bottom.

Properties of Lake Sediments

The lake sediments are silt and clay with variable amounts of material larger than 0.074 millimeter (mm). Table 1 presents a typical section located at Sprague Brook Park.

One to 10 feet of sandy, gravelly, or loamy glaciofluvial deposits commonly overlay the lacustrine sediments. Where exposed at the surface, the upper 3 to 10 feet of these lake materials are yellow to brown silty clay. Below this depth, the materials are a uniformly dark gray, sticky and/or slightly sticky, plastic to slightly plastic, calcareous soft silt loam to clay, with indistinct laminae ⅛ inch or less thick. The dark gray lacustrine sediments are so uniform that well logs from one drill hole would be essentially correct for all other drill holes except for the depth to pebbles or to the base of the deposit (Table 2). Differences in clay content are not apparent in the field under natural moisture contents. The dark gray materials probably are saturated, although water does not enter a bore hole, and much of the material is so soft that power augers can be pushed into them without rotation. Some silts and clays apparently have never been dewatered, and some lenses or beds are almost fluid. Sand or gravel lenses are rare, although pebbles 1 to 2 inches in diameter are common in the lower 5 to 20 feet. The liquid limits and plasticity index are relatively low (Table 2) and similar to the sensitive or quick marine and freshwater clays in Canada (8).

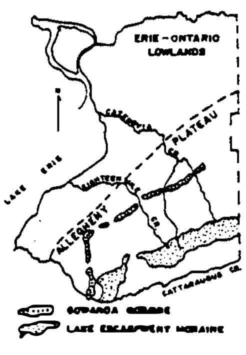

Figure 1. Location of major glacial features and Allegheny Plateau in Erie County, New York.

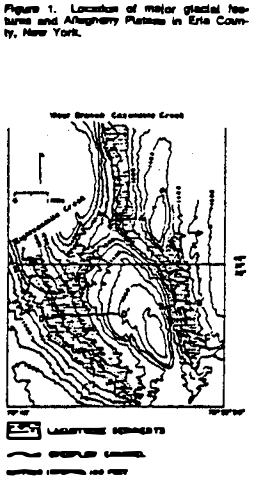

Figure 2. Distribution of lacustrine sediments in parts of the West Branch of Cazenovia Creek and Eighteen-mile Creek Valleys.

Mica or illite dominate the clay fraction, which has about 10 percent kaolinite and minor amounts of chlorite (Table 2). Mica or illite also is abundant in the silt fraction, along with large quantities of quartz. Mineralogically these sediments are similar to the sensitive Leda and Labrador clays of Canada (8).

The mica or illite in the clay and silt fraction controls the behavior of these sediments as engineering materials. Wetting and drying changes the volume of the sediments only slightly to moderately, but the sediments will not stabilize as easily as montmorillonitic clays injected with a calcium oxide slurry (oral communication with R. Handy, Ames, Iowa). The clay and silt mineralogy of the lacustrine sediments is the same as that of the shale bedrock in the area.

The lacustrine sediments are confined to the lower parts of the valleys (Figure 3). They do not interfinger with the glaciofluvial deposits and underlying tills. These materials apparently settled to the deepest parts of the glacial lakes because they do not form a thin deposit mantling the steep slopes that may have been inundated by the glacial lakes. A 2- to 10-foot-thick cap of glaciofluvial deposits covers many areas of these lacustrine sediments (Figure 3, C-C'). This apparently was emplaced shortly after the glacial lakes were drained. Sometime after the glacial lakes were drained, the lacustrine sediments were deeply dissected by the major stream in the valley and its tributaries. The thicknesses now present in the valley are a minimum because erosion has removed an unknown amount of sediment.

The lacustrine sediments we studied occupy three long narrow bodies in the creek valley (Figure 2). The maximum altitude of the sediments is

Table 1. A typical section of lake sediments, Sprague Brook Park, Erie County, New York.*

Depth in Feet	Description
0-3	Dark yellowish brown (10YR 4/4) gravelly sandy loam;† 35 percent gravel, no larger than 1 inch, base of glaciofluvial deposit;‡ abrupt boundary to
3-18	Dark gray (5Y 4/1) calcareous silty clay; slightly sticky; slightly plastic; less than 10 percent gravel smaller than ½ inch; indistinct boundary to
18-55	Dark gray (5Y 4/1) calcareous silty clay to silt loam; sticky; plastic; few pebbles less than ½ inch, below 43 feet; base of lacustrine silt plus clay; abrupt boundary to
55-76	Dark gray (5Y 4/1) calcareous loam; sticky; plastic; less than 10 percent gravel, smaller than ½ inch; base of glaciofluvial deposit; glacial till below 76 feet

*Location of section site: 290 feet south of Crane Road and 80 feet west of the Park Pond. Site is 1,650 feet east of New York Highway 240.
†Soil texture classes named after USDA textural triangle.
‡Glaciofluvial deposits are material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. These deposits consist of stratified sand, silt, and gravel layers.

at the south or upstream end of each body, and the minimum elevation is at the north or downstream end. Lacustrine materials associated with small tributary valleys may rise 300 feet or more above those in the adjacent areas of the main valley (Figure 2, overflow outlet). Within a single lake system, a contour line cannot be used to predict where these sediments will be found. But if the upstream altitude is known, most of these sediments downstream will predictably be at a lower altitude.

The maximum elevation of the lacustrine materials within any one lake roughly indicates the minimum lake level during deposition. The south lake in the West Cazenovia Branch Valley had a minimum water level somewhere between 1,400 and 1,500 feet, whereas the north lake had a minimum level of about 1,200 feet (Figure 2). This 200-foot difference in elevation between adjacent lake levels and lacustrine sediments is not marked by any noticeable change in topography or by an end moraine. The topographically indistinct borders of these glacial lakes and their associated sediments require detailed mapping of soils and sediments. When one adds the various lake levels, the altitude differences within a lake, the discontinuous glaciofluvial cap on the lacustrine sediments, and the dissection of the landscape since the lakes were drained, it is understandable why this area is difficult for surficial geologists and soil scientists to map.

Soil Patterns

Areas with complex depositional histories, such as the ice-dammed valleys, have complex soil patterns. In such areas it is impossible for the soil survey to show all the variations that may be important in land use planning. Normally, soil surveyors are concerned with the properties of the soil because this is the body they map. But in complex areas where the underlying materials may have considerable influence on the land use problems encountered, it may be necessary to develop mapping units that recognize the deeper materials even though they may not be criteria used in separating soils at the series level.

Figure 4 is a map of surficial deposits, based primarily on a soil map, of a small area in the West Branch of Cazenovia Creek. Coarse- to medium-textured glacial till, 5 to 30 feet thick, mantles the higher bedrock-controlled slopes. The lacustrine materials are most abundant on the east side of the valley (Figure 2, B-B' and C-C'), and most of the area is capped by glaciofluvial deposits 2 to 10 feet thick. Dissection after the lakes were drained has spread a reworked mantle of sand and gravel down the erosional valley slopes so only small areas of lacustrine materials are exposed at the surface.

Table 2. Physical and mineralogical characteristics of lacustrine sediments, Erie County, New York.

Traverse Location (Figure 2)	Depth (ft)	Material	Percent of Material at Various Sizes, millimeters: .1-2	1-.5	.5-.25	.25-.1	.1-.05	Percent Sand (2-0.05)	Percent Silt (0.050-0.002)	Percent Clay (<0.002)
Eighteen-mile	3-14	Lake sediment	1.8	1.5	1.3	2.9	2.9	10.4	42.4	47.2
Creek Valley	16-34.5	Lake sediment	5.0	2.1	1.4	3.8	7.2	19.5	60.8	19.7
	34.5-43.5	Basal till	4.4	2.8	2.3	6.3	12.2	28.0	57.5	14.5
West Branch	3-9	Lake sediment	0.1	0.2	0.1	0.2	0.1	0.7	40.9	58.4
Cazenovia Creek	28-30	Lake sediment	0.5	0.2	0.2	0.6	0.7	2.2	53.7	44.1
Valley	64-65	Basal lake sediment	1.3	1.3	1.3	4.5	6.2	14.6	56.5	28.9

Traverse Location (Figure 2)	Depth (ft)	Material	millimeters: 0.2-.02	2.0-0.1	0.074	Liquid Limit	Plasticity Index	ASTM Class
Eighteen-mile	3-14	Lake sediment	47.2	7.5	91.4	39	14	CL
Creek Valley	14-34.5	Lake sediment	70.8	12.3	85.4	22	2	ML-CL
	34.5-43.5	Basal till	74.2	15.8	80.3	18	3	ML-CL
West Branch	3-9	Lake sediment	41.1	0.6	99.4	43	15	ML
Cazenovia Creek	28-30	Lake sediment	54.8	1.5	98.3	36	14	CL
Valley	64-65	Basal lake sediment	66.0	8.4	89.3	28	8	CL

Traverse Location (Figure 2)	Depth (ft)	Material	Clay Mineralogy <0.002 mm: Chlorite	Kaolinite	Mica or Illite	Silt Mineralogy 0.002 - 0.050 mm: Chlorite	Kaolinite	Mica or Illite	Quartz
Eighteen-mile	3-14	Lake sediment	Minor	About 10%	Major	Present	Present	Major	Major
Creek Valley	16-34.5	Lake sediment	Minor	About 10%	Major	Present	Present	Major	Major
	34.5-43.5	Basal till	Minor	About 10%	Major	Present	Present	Major	Major

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Holocene alluvium occupies a narrow strip along Cazenovia Creek as a floodplain and low terrace. The soils in each area are distinctive, but a soil map that is concerned only with the properties of the soil profile would not recognize the areas of lacustrine sediments under a glaciofluvial mantle thicker than 4 feet. The land use interpretations based on such a soil map would be based on soil properties and could be misleading.

Figure 5 is an interpretation of the potential for mass movement of the soils when they are disturbed for housing and similar urban uses. Most of the areas of glacial till and Holocene alluvium (Figure 4) have a low potential for mass movement. The exceptions are the very steep slopes (Figure 3, B-B') that have a thin mantle of till over shale bedrock. These steep areas are subject to localized mass movement near seep spots and springs, but very little of the surrounding area is affected. The rest of the area in figure 5, the areas with lacustrine sediments exposed at the surface or underlying the glaciofluvial sand and gravel cap, has a low to high potential for mass movement, with some nearly continuous areas of lacustrine sediments that are moving or have moved in the last few years.

Mass movement of the lacustrine sediments on the lower slopes can affect large areas upslope. Figure 6 illustrates a large area of the Cazenovia Creek Valley that is actively moving or slumping because a small stream at the base of the slope started to undercut the soft lacustrine sediments. If the slumping extends upslope, it will include the loams, sands, and gravels of the glaciofluvial cap that usually are considered stable materials.

If the underlying material were ignored, most of the area in figure 5 with a low to high potential for mass movement would be rated low to moderate because soils developed in glaciofluvial deposits are usually considered stable.

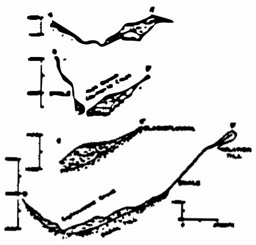

Figure 3. Relation of lacustrine sediments to other deposits in the West Branch of Cazenovia Creek and Eighteen-mile Creek Valleys. Each drill traverse is located on figure 2.

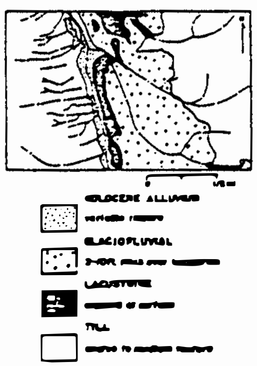

Figure 4. Sediments exposed at the ground surface in part of the West Branch Cazenovia Creek Valley. The area is included in drill traverse C-C' (Figure 2).

Land Use Implications

As we mentioned, the texture, mineralogy, liquid limits, and plasticity index of the lacustrine sediments in the Allegheny Plateau are similar to those of the sensitive or quick clays of Canada (3, 8). The sensitive clays, normally varved, were deposited in a marine environment, and some scientists feel their pore water chemistry is important in determining their sensitivity (1).

The sensitive clays flow at rates up to 2 miles per hour. Published information from 50 flows indicates a loss of over 100 lives and about 100,000 acres of upland (5). In contrast, mass movement of lacustrine sediments in the Allegheny Plateau are relatively slow and consist of backward rotating slump blocks with bulbous or irregular and contorted lower slopes. Cattails commonly grow in the depressions formed by this backward rotation of what once was a relatively steep valley slope. Trees and utility poles leaning upslope are common in the slumped areas, especially along New York Highway 240. Scars or scarps 2 to 3 feet high mark the upslope limit of the shear plane (Figure 6).

There probably is no one factor that initiates a mass movement in these sediments, and much of the steeper topography where the lake silts and clays occur probably has evolved by a combination of mass movement and water erosion. For example, the undercutting of creek banks appears to be the major reason for mass movement in otherwise relatively stable lacustrine areas of the Eighteen-mile Creek Valley and for the large slumped area in figure 6. Almost any construction in critical areas increases the chances of mass movement (7). The need for cleaning slumped material from road ditches along New York 240, the constant maintenance of and several derailments on the B & O Railroad track, plus the difficulties experienced by homeowners with cracked or broken utility lines, cracked foundations, and porches pulling away from their houses exemplify some of the problems involved in building on these lacustrine sediments. In these cases, construction was on or near steep slopes underlain by soft, dark gray lacustrine sediments.

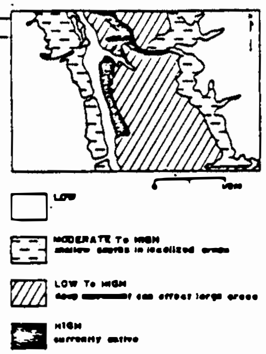

Figure 5. Interpretative map showing potential for mass movement in sediments mapped in figure 4.

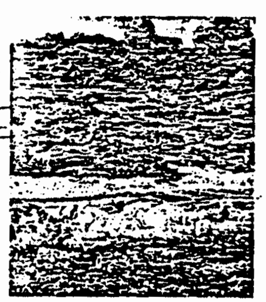

Figure 6. Mass movement and slumping of lacustrine sediments above Sprague Brook, near Sprague Brook Park, in Erie County, New York.

There are difficulties in using certain, but not all, areas of the lacustrine sediments. Steep slopes and areas near streams seem to be the most susceptible to mass movement. Many gentle slopes with or without a glaciofluvial cap are relatively stable for certain uses. The hamlets of Glenwood and Holland in Erie County are built on lacustrine sediments and apparently have experienced little difficulty with mass movement. The buildings in these hamlets are relatively light and widely spaced. They were built with a minimum of soil disturbance. Landscaping, which is believed to contribute to mass movement on similar sediments in Canada (7), has been minor or done with only slight disturbance of precultural elevations. Farm buildings have suffered little evident structural damage where they were placed on 5 to 6 feet of clayey, oxidized lacustrine sediments on gentle slopes. Farming operations apparently do not trigger mass movement of the soils so long as the operations take place on gently sloping landscapes.

The long history of using the lacustrine sediments for low-density building sites, farming, and timber production is evidence that these areas are not so fragile that they cannot be used at all. But as pressures for building sites and recreation areas increase, the unstable, steep forested slopes will become more attractive to builders. While it may not be possible legally to prevent building on these sites, land use planners have an obligation to make developers aware of the probable waste of time and resources that can result from disregarding the foundation—the soils and the sediments—they are building on.

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Assessing the recreation potential of rivers

MICHAEL CHUBB and ERIC H. BAUMAN

ABSTRACT—Although many ways of assessing river recreation potential have been suggested, no universally applicable method has been devised. The RIVERS method currently under development for the U. S. Forest Service attempts to quantitatively evaluate and compare the potential of all types of rivers for 16 recreation activities.

RIVERS can be recreation resources of great value. They are widely distributed, and they can support an extensive range of water-dependent and water-related activities. The water-land interface features a relatively high carrying capacity. Furthermore the value of rivers increases as urbanization spreads, as lake shores are developed for residential or seasonal-home purposes, and as efforts to reduce water pollution enjoy some measure of success. Unfortunately, past resource allocation processes, land ownership patterns, recreation planning and management procedures, and certain water laws in the West have tended to restrict the public's enjoyment of river recreation values.

The lack of suitable techniques for quantitatively assessing the recreation potential of rivers and comparing such evaluations when resource decisions are made has contributed to the neglect of rivers as recreation resources. Comparative, quantitative assessment of potential would make it easier to demonstrate the magnitude of the recreation values involved and demand that those values be given equal consideration with other values when allocating these resources. Such an assessment technique would also make it possible to develop comparative ratings for a series of rivers. This would be particularly useful in deciding which rivers should be included in the various categories of national, statewide, or regional recreation river classification systems.

Study Context and Objectives

Our study was commissioned by the North Central Forest Experiment Sta-

Michael Chubb is an associate professor of geography at Michigan State University, East Lansing 48824. Eric H. Bauman is a socio-cultural planner with the Minnesota Environmental Quality Council, Minneapolis 55413. *This article is a condensed version of a paper presented at the 72nd annual meeting of the Association of American Geographers. The authors acknowledge assistance by the North Central Forest Experiment Station, the Eastern Regional Office of the U. S. Forest Service, and the Huron-Manistee National Forest. Some aerial photography and interpretation were performed by the Project for the Use of Remote Sensing in Land and Resource Use Policy, Michigan State University, funded in part by the National Aeronautics and Space Administration.*

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Letter 40

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

NOV 10 1981

OFFICE OF
THE ADMINISTRATOR

Mr. James Turi
Office of Waste Operations
and Technology, NE-320
Nuclear Waste Management & Fuel
Cycle Program
U.S. Department of Energy
Washington, D.C. 20545

Dear Mr. Turi:

In accordance with Section 309 of the Clean Air Act, as amended, the U.S. Environmental Protection Agency (EPA) has reviewed the draft environmental impact statement (EIS) for Long-term Management of Liquid High-level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley. Our major concerns are described below, and our detailed comments are enclosed. We hope they assist you in perfecting this program and preparing the final EIS.

40-1 One additional option the Department of Energy may wish to consider for the West Valley solidification program is to ship the high-level liquids and sludges to another location for solidification. We recognize that there are legal and institutional issues that might preclude this option; however, this option offers the advantage of removing the high-level liquid and sludge wastes from West Valley without the financial and environmental costs of a solidification facility at West Valley.

We commend DOE for considering the decontamination and decommissioning of faciliites prior to construction, and we hope that this complete approach to facility planning is followed in other DOE projects.

40-2 The EIS presents various estimates of risks and costs, often without indicating the methodologies by which they were determined. This oversight should be corrected in the final EIS.

We have rated this EIS Category "2" (additional information requested). The EIS shows very low-impacts for the on-site solidification options (1a and 1b); for this reason we are rating these options "LO" (lack of objections). We have reservations (ER) concerning the "interim form" option (#2), because it will have impacts which will occur at another site and which are not considered in detail in this EIS. We have rated the "no action, delay for ten years" alternative (#4a) as "ER" because the final disposal method of the waste will not be determined until the end of the 10 year period of delay, so its impacts cannot now be determined.

We have very serious problems concerning the in-tank solidification option (#3) and the indefinite tank storage option (#4b). Our problems center on the severe environmental impacts likely to occur if and when institutional control of the site is lost. The EIS indicates that the long-term population risk for both alternatives are much higher than for the options that involve emplacement of the waste in a repository. We agree with the EIS's analysis that if institutional control is lost these alternatives would not meet EPA and NRC waste disposal criteria (page 2-29). For these reasons, EPA believes that these two alternatives would have unsatisfactory impacts on the human environment. Based on this analysis and the information in the draft EIS we have, therefore, rated them "EU".

Should you have any questions concerning our review, please call Dr. W. Alexander Williams (755-0790) of my staff or Mr. James Gruhlke (557-8977) of EPA's Office of Radiation Programs.

Sincerely yours,

Paul C Cahill

Paul C. Cahill
Director
Office of Federal Activities

Enclosure

Detailed Comments of the
U.S. Environmental Protection Agency
on the
Draft Environmental Impact Statement
for
Long-term Management of Liquid High-Level
Radioactive Wastes Stored
at the
New York Nuclear Service Center, West Valley

40-3 1) Section 1.2 (page 1-2) indicates that the Purex wastes in Tank 8D2 are alkaline; Section 2.1.1.1 states that these wastes are neutralized. Please clarify in the final EIS.

40-4 2) For options 1a, 1b, and 2, the decontaminated tanks would be entombed (i.e. filled with cement and left on-site permanently). Would this not require 100 years of post-closure institutional care at the site? If this is part of the cost of decontaminating and decommissioning the site, the final EIS should indicate who will bear the burden of responsibility.

40-5 3) Alternative 1a involves homogenization of the Purex waste (neutralized already) to mix sludge from the bottom of Tank 8D2 with the overlying supernatent liquid. It is not clear how this process would be accomplished. It is even further unclear as to why it is advantageous to mix the two forms rather than separating and processing liquid first and removing and treating the sludge separately. Why cannot the supernatent liquid be filtered directly through the ion-exchange resins and then evaporated to the low-level radioactive salt cake?

4) Alternative 1b would eliminate the separation of waste forms into salt cake and sludge. There would be a larger radiological dose commitment from this activity, as a result.
40-6 Since the financial cost and the volume of high-level radioactive waste would also be higher for this option it would seem difficult to justify these additional burdens.

40-7 5) After the solidification program at West Valley, will the remaining portion of the site meet reasonable criteria for use after a 100 year institutional control period?

40-8 6) EPA plans to propose standards for high-level nuclear waste disposal early in 1982. The draft document discussed on page B-65 was an internal working paper.

40-9 7) Statements on pages 2-11 and B-85 concerning local transportation restrictions seem to be contradictory. The text on page B-85 is accurate, and we suggest that the text on page 2-11 (Section 2.1.1.4) be changed accordingly in the final EIS.

40-10 8) The units used in Tables B.28 and B.29, person-rem/km, on page B-88 are not used in NUREG-0170. The sources of these units and their meaning should be further explained and referenced in the final EIS.

40-11 9) The second paragraph on page B-89 mentions "radiation levels consistent with experience." We suggest the final EIS display this data and indicate its source.

40-12 10) We ask that a breakdown of the financial costs for all alternatives be presented in the final EIS, and we recommend that the costs be expressed as capital and operating costs for the different technical steps in the program. For option 1a these might be expressed as costs for removing the waste from tanks, separating the salt and sludge fractions, solidifying the waste, and decommissioning the process equipment.

11) Our very serious concerns regarding options 3 and 4b center on the possible loss of institutional controls at this site during the next 10,000 years. As the EIS indicates, the loss of institutional control leads to the risk of large population exposures. For example, loss of institutional controls might involve intrusion in the waste by digging, undetected tank leaks, or the leaching of the waste by water. The EIS identifies massive theoretical doses to individuals digging in the waste; these are 400 rem (near fatal) for option 3 and 10,000 rem (fatal) for option 4b (see page 4-34). Also on page 4-34 the EIS indicates that the waste would certainly be released into ground water during a 10,000 year period. We do not disagree with your analysis that the waste tanks would fail and that the concrete vaults would crack after institutional control is lost; nor that this failure of the waste tank system would result in continuous releases of radioactive waste into groundwater (page 417). These potential releases would be well in excess of NRC's regulations for effluents from licensed activities into uncontrolled areas (10 CFR 20.106 and 10 CFR 20, Appendix B, Table II).

To show how these possible releases would exceed NRC's effluent regulations, Sr-90 will be used as an example. The inventory of Sr-90 in tank 8D2 is 6.7 million curies for 1987 (page B-9); the half-life is 28.1 years and the tank volume is 2.1 million liters (page B-5).

The specific activity of Sr-90 is 3.2 curies per liter; after 100 years the specific activity will be .27 curies per liter or 270 microcuries per milliliter. Table II from 10 CFR 20 lists concentrations of 3×10^{-7} microcuries per milliliter and 4×10^{-5} microcuries per milliliter for soluble and insoluble releases of Sr-90 into the environment.

Thus the potential Sr-90 releases are greatly in excess of this radiation protection standard. Similar calculations will show the potential for releases of other, longer-lived radionuclides (such as Am-241 and Pu-239) in excess of the 10 CFR 20 limits.

The EIS correctly recognizes that many radionuclides are in the insoluble sludge (option 4b) or would be bound in the cement used to solidify the waste in the tank (option 3); the EIS states (page 4-17) the fraction of waste released from the sludge (option 4b) and cement (Option 3) are .01 and .001 per year respectively. Even this reduction in the release rate will leave the leachate from the waste in excess of the 10 CFR 20 limits by a considerable margin. The isolation of these wastes into a repository would of course, substantially reduce this possible source of contamination, and the EIS indicates that all options involving repository disposal would have much lower long-term radiological risks to the popluation than the near surface disposal options.

As the EIS notes, the possibility also exists that the site might be used for farming, housing, or other uses incompatible with long-term disposal of high-level nuclear waste. We strongly urge that other alternatives, rather than options 3 and 4b, be pursued by DOE in this program.

APPENDIX H. DISCUSSION OF COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

H.1 INTRODUCTION

The Draft Environmental Impact Statement (DOE/EIS-0081D) was issued in July 1981, and comments were solicited from interested groups and individuals. In addition, the opportunity to comment on the draft statement was provided at public hearings held at West Valley on September 26, 1981. The viewpoints expressed in each comment (oral and written) were considered in preparation of this Final Environmental Impact Statement (EIS).

The comment letters are reproduced in Appendix G. Some of the respondents offered opinions on the EIS that did not require a specific response. These opinions were, however, noted and factored into the Final EIS to the extent that they were appropriate. Many of the respondents had questions or suggestions that dealt with similar issues. The primary areas of interest were: (1) waste processing and technology, (2) accident analyses, (3) radiological analysis, (4) site-specific considerations, (5) solid waste disposal, (6) institutional and regulatory concerns, and (7) public information and attitudes. These comments were addressed in one of two manners: (a) appropriate changes were made in the text of the EIS in response to the comment, or (b) a response to the comment was prepared and is given in this appendix. The first method was used for those comments concerned with text changes, usually dealing with clarifications or revisions of data that were deemed appropriate. In these cases, the changes were made in the text without further discussion in this appendix. The second method was used to provide additional clarification of information in the EIS that could not be covered adequately in the text. These responses are given in Section H.2 of this appendix and are organized into the seven groups noted above.

A key to the responses follows. In this key, the disposition of each comment designated in Appendix G is given. This key is structured in the same format that was used to identify comments in Appendix G. In addition, the page numbers for the responses in Section H.2 are provided. The following example illustrates use of this key. Comment letter No. 18 (Food and Drug Administration), comment 18-1, requested more information on radiological monitoring during the solidification operations; this comment is addressed in Section H.2, Response H.2.3.3p (p. H-31).

KEY TO RESPONSES

Letter Number	Comment Number	Disposition	Page Number(s)
1	1	Comment noted; no response required	
2	1	Comment noted; no response required	
3	1	See Section 4.3.12.2	
4	1	See Responses H.2.3.1b, H.2.3.3m, and H.2.3.3n	H-22, H-30, H-31
	2	See Responses H.2.3.2b and H.2.3.2e, and revisions in Sections 4.1.3 and 4.1.4; EIS modified to incorporate liquid releases	H-25
	3	See Response H.2.3.1b	H-22
	4	See Response H.2.3.3k	H-30
	5	See Response H.2.3.3k	H-30
	6	Text in Section 4.1.3 revised	
	7	See Response H.2.2.1c	H-17
	8	See Response H.2.3.2a	H-24
	9	See Response H.2.3.3m	H-30
	10	See Response H.2.3.3l	H-30
	11	See Response H.2.3.3j	H-30
	12	See Response H.2.7.2b	H-40
5	1	See Response H.2.3.3i	H-29
	2	See Response H.2.2.2i	H-20
	3	See Response H.2.6.2d	H-38
	4	See Response H.2.1.4c	H-13
	5	See Response H.2.2.2b	H-18
	6	See Response H.2.3.3i	H-29
	7	See Response H.2.3.3e	H-28
6	1	See Response H.2.7.1b	H-39
	2	See Response H.2.5.1a	H-33
	3	See Response H.2.1.5d	H-14
	4	See Response H.2.1.5a	H-13
	5	See Responses H.2.2.2i, H.2.2.2k, H.2.2.2l	H-20, H-21
	6	See Response H.2.1.5i	H-15
	7	See Responses H.2.4.1a, H.2.4.1b; text in Section 3.1 revised	H-31, H-32
7	1	See Response H.2.2.2a; text in Section B.4.4.1 revised	H-18
	2	See Response H.2.2.2l	H-21
	3	Text in Section 4.2.1.5 revised	
	4	See Response H.2.5.1c	H-35
	5	See Responses H.2.5.1d, H.2.6.2b	H-35, H-37

KEY TO RESPONSES

Letter Number	Comment Number	Disposition	Page Number(s)
8	1	See Response H.2.3.3p	H-31
	2	See Section 4.1	
	3	See Section 2	
9		Letter noted; no response required	
10		Letter noted; no response required	
11	1	See Response H.2.4.1a; text in Section 3.1 revised	H-31
	2	See Response H.2.4.2e; text in Section 4.2.1.3 revised	H-33
12	1	See Response H.2.5.1a	H-33
	2	See Response H.2.1.5a	H-13
12a		See Letter No. 12	
13	1	See Response H.2.7.1a and Section 4.3.12.2	H-39
14	1	See Response H.2.2.2h	H-20
15	1	See Response H.2.1.2a	H-11
	2	Text in Section B.2.1.1 revised	
	3	See Response H.2.1.5c	H-14
	4	See Response H.2.1.5f	H-15
	5	See Section B.2.2.1; no revision required	
	6	See Section B.2.2.1; no revision required	
	7	Text in Section B.2.2.2 revised	
	8	See Section B.2.2.2; no revision required	
	9	Text in Section B.2.2.2 revised	
	10	See Section B.2.2.2; no revision required	
	11	See Section B.2.2.2; no revision required	
	12	See Response H.2.1.5c; text in Section B.2.2.2 revised	H-14
	13	See Section B.2.2.2; no revision required	
	14	See Response H.2.5.1e	H-35
	15	Table B.10 in Section B.2.2.3 revised	
	16	Comment noted; no response required	
16	1	See Response H.2.5.1a	H-33
	2	See Response H.2.1.5a	H-13
	3	See Responses H.2.1.5d, H.2.3.2b; text in Section 4.1.3 revised	H-14, H-25
	4	See Response H.2.1.5i	H-15
	5	See Responses H.2.4.1a, H.2.4.1b; text in Section 3.1 revised	H-31, H-32
	6	See Response H.2.2.2l	H-21
	7	See Response H.2.7.2d	H-41

KEY TO RESPONSES

Letter Number	Comment Number	Disposition	Page Number(s)
17	1	See Response H.2.7.2d	H-41
	2	See Response H.2.1.5i	H-15
	3	See Response H.2.3.3o	H-31
	4	See Responses H.2.3.3p, H.2.4.1b	H-31, H-32
18	1	See Response H.2.3.3p	H-31
	2	See Responses H.2.5.1a, H.2.5.1c	H-33, H-35
	3	See Response H.2.5.1a	H-33
	4	See Response H.2.5.1a	H-33
	5	See Responses H.2.5.1a, H.2.5.1b	H-33, H-34
	6	See Section B.2	
	7	See Section B.2	
	8	See Sections B.3 and B.6	
19	1	See Section 4.3.12.2	
	2	See Responses H.2.3.3b, H.2.7.1b	H-26, H-39
	3	See Responses H.2.2.2k, H.2.2.21	H-20, H-21
	4	See Response H.2.2.2c	H-18
	5	See Responses H.2.4.1a and H.2.4.1b; text in Section 3.1 revised	H-31, H-32
	6	See Response H.2.1.5d	H-14
	7	See Response H.2.1.5a	H-13
	8	See Response H.2.3.2b; text in Section 4.1.3 revised	H-25
	9	See Response H.2.1.5a	H-13
	10	See Response H.2.5.1a	H-33
	11	See Response H.2.1.5i	H-15
20	1	See Response H.2.2.2c	H-18
	2	See Response H.2.1.5a	H-13
	3	See Response H.2.2.2c	H-18
	4	See Response H.2.1.3a	H-12
	5	See Response H.2.2.2e	H-19
	6	See Response H.2.2.2d	H-19
	7	See Response H.2.2.1d	H-18
21	1	See Response H.2.3.1f	H-24
	2	See Response H.2.1.1a	H-10
22	1	See Response H.2.3.1f	H-24
23	1	See Response H.2.3.3j	H-30
	2	See Response H.2.3.1d	H-23
	3	See Responses H.2.1.5d, H.2.3.1a	H-14, H-21
	4	Comparison provided in Summary, Table S.1	
	5	See Response H.2.7.2c	H-41
24		Letter noted; no response required	

KEY TO RESPONSES

Letter Number	Comment Number	Disposition	Page Number(s)
25	1	See Response H.2.6.1d	H-37
	2	See Response H.2.7.1b	H-39
26	1	See Response H.2.4.1b	H-32
	2	See Responses H.2.3.1a, H.2.4.1b	H-21, H-32
	3	See Response H.2.2.2g	H-19
	4	Text in Sections 3.1.2 and B.3.1.1 revised	
	5	See Response H.2.2.1b	H-17
	6	See Response H.2.1.4c	H-13
	7	See Response H.2.2.2f	H-19
	8	See Response H.2.3.3f; text in Section B.6.3.2 revised	H-28
27	1	Comment noted; no response required	
	2	See Response H.2.5.1a	H-33
	3	See Response H.2.1.5a	H-13
	4	See Responses H.2.1.5d, H.2.3.1d, and H.2.3.2a	H-14, H-23, H-24
	5	See Response H.2.7.1c	H-39
	6	See Responses H.2.1.5d, H.2.3.1a	H-14, H-21
	7	See Response H.2.3.3b	H-26
	8	See Response H.2.1.5l	H-16
	9	See Response H.2.3.3c	H-26
	10	See Response H.2.6.1c	H-37
	11	See Responses H.2.3.2b and H.2.3.2e, and revisions in Sections 4.1.3 and 4.1.4; EIS modified to incorporate liquid releases	H-25
	12	See Response H.2.3.3i	H-29
	13	See Response H.2.3.3l	H-30
	14	See Responses H.2.4.1a and H.2.4.1b; text in Section 3.1 revised	H-31, H-32
	15	See Response H.2.2.1a	H-17
	16	See Response H.2.1.4c	H-13
	17	See Responses H.2.1.5i, H.2.6.2e, H.2.6.2g	H-15, H-38
	18	See Response H.2.6.2f	H-38
	19	See Response H.2.1.5g	H-15
	20	See Response H.2.7.1d	H-39
	21	See Table B.2 in Section B.1.2.1	
	22	See Response H.2.3.3n	H-31
	23	See Response H.2.3.2f	H-26
	24	See Response H.2.2.2k	H-20
	25	See Response H.2.1.4c	H-13
	26	See Response H.2.4.2f	H-33
	27	See Response H.2.1.1c	H-10

KEY TO RESPONSES

Letter Number	Comment Number	Disposition	Page Number(s)
28	1	See Response H.2.3.3n	H-31
	2	See Response H.2.3.3m	H-30
	3	See Response H.2.1.3b; Table B.2 in Section B.1.2.1 revised	H-12
	4	See Response H.2.1.5b	H-14
	5	See Responses H.2.5.1a, H.2.5.1d	H-33, H-35
	6	See Section 4.1	
29		Letter noted; no response required	
30	1	See Response H.2.4.1a; text in Section 3.1 revised	H-31
	2	See Response H.2.3.1a	H-21
	3	See Responses H.2.2.1a, H.2.2.21	H-17, H-21
	4	See Response H.2.3.3i	H-29
	5	See Appendix I (Glossary)	
31	1	See Response H.2.1.5a	H-13
	2	See Response H.2.5.1a	H-33
	3	See Response H.2.5.1c	H-35
	4	See Response H.2.1.5i	H-15
	5	See Responses H.2.4.1a and H.2.4.1b; text in Section 3.1 revised	H-31, H-32
32	1	See Response H.2.1.1b	H-10
	2	See Response H.2.6.2a	H-37
33	1	See Response H.2.6.1c	H-37
	2	Text in Summary revised	
	3	See Response H.2.6.2c	H-37
	4	See Response H.2.5.2a	H-35
	5	See Response H.2.6.2c	H-37
	6	See Response H.2.5.2b	H-36
	7	See Response H.2.5.1b; text in Section B.2.2 revised	H-34
	8	Text in Section 2.1.1.2 revised	
	9	Comment noted; no response required	
	10	Text in Section 2.1.3.4 revised	
	11	See Responses H.2.5.1d, H.2.6.1c	H-35, H-37
	12	See new Section 4.3.15	
	13	See Response H.2.1.1d	H-10
	14	See Response H.2.1.2b	H-11
	15	See Response H.2.1.2c	H-11
	16	See Response H.2.1.1d	H-10
	17	See new Section 4.3.16	
	18	Comment noted; no response required	
	19	Text in Section 2.1.4.4 revised	
	20	See new Section 4.3.16	

KEY TO RESPONSES

Letter Number	Comment Number	Disposition	Page Number(s)
33	21	Text in Section 2.1.6 and Table 2.3 revised	
	22	See Response H.2.6.1c; text in Section 2.2.1 revised	H-37
	23	See Response H.2.6.2c; text in Section 2.2.1 revised	H-37
	24	See Response H.2.4.2a	H-32
	25	Text in Section 3.1.5 revised	
	26	See Response H.2.3.2b; text in Section 4.1.3 revised	H-25
	27	See Response H.2.3.1d	H-23
	28	See Response H.2.3.1c	H-23
	29	See Response H.2.1.5d	H-14
	30	See Response H.2.1.5e	H-15
	31	See Response H.2.1.5d	H-14
	32	See Response H.2.2.2j	H-20
	33	See Response H.2.3.2d	H-25
	34	Tables 4.12 through 4.14 in Section 4.1.7 revised	
	35	See Response H.2.3.2c	H-25
	36	See Response H.2.3.1e	H-24
	37	See Response H.2.4.2b	H-32
	38	See Response H.2.4.2c	H-32
	39	See Response H.2.3.2e and revisions in Sections 4.1.3 and 4.1.4; EIS modified to incorporate liquid releases	H-25
	40	See Response H.2.4.2f	H-33
	41	Text in Section 4.2.1.5 revised	
	42	See Response H.2.4.2f	H-33
	43	Comment noted; no response required	
	44	See Response H.2.3.3p	H-31
	45	See Response H.2.1.2d	H-12
	46	See Response H.2.1.4a; text in Section B.2.2 revised	H-13
	47	See Response H.2.1.5j	H-15
	48	See Response H.2.1.5n	H-16
	49	See Response H.2.3.2e and revisions in Sections 4.1.3 and 4.1.4; EIS modified to incorporate liquid releases	H-25
	50	See Response H.2.1.5m	H-16
	51	Text in Section B.4.3.2 revised	
	52	Comment noted; no response required. Note that text in Section B.3.2.1 reads "could be added" not "would be added"	
	53	See Response H.2.4.2d	H-32
	54	See Response H.2.1.1d	H-10
	55	Text in Section B.4.2.2 revised	
	56	Text in Section B.4.2.2 revised	
	57	Text in Section B.4.3.2 revised	

KEY TO RESPONSES

Letter Number	Comment Number	Disposition	Page Number(s)
33	58	See Response H.2.3.3g	H-28
	59	See Response H.2.3.3h	H-29
	60	See Response H.2.3.1d	H-23
	61	Text in Section B.4.4.2 revised	
	62	Text in Section B.5.2 revised	
34	1	See Response H.2.2.21	H-21
	2	See Response H.2.4.1a and H.2.4.1b; text in Section 3.1 revised	H-31, H-32
	3	See Response H.2.2.2i	H-20
	4	See Response H.2.7.1b	H-39
35		Letter noted; no response required	
36	1	Comment noted; no response required	
	2	See Response H.2.1.1a	H-10
	3	Comment noted; no response required	
37	1	See Response H.2.7.1d	H-39
	2	See Responses H.2.2.21, H.2.4.1b	H-21, H-32
	3	See Response H.2.1.5i	H-15
	4	See Response H.2.1.4c	H-13
	5	See Response H.2.5.1a	H-33
	6	See Response H.2.7.1b	H-39
	7	See Response H.2.2.2i	H-20
	8	See Response H.2.7.1d	H-39
38	1	See Response H.2.3.1a	H-21
	2	See Responses H.2.2.1c, H.2.3.1a	H-17, H-21
	3	See Response H.2.3.1a	H-21
	4	See Response H.2.3.1b	H-22
	5	See Responses H.2.3.1b, H.2.3.2b; text in Section 4.1.3 revised	H-22, H-25
	6	See Responses H.2.3.3i, H.2.3.3m	H-29, H-30
	7	See Response H.2.3.3i	H-29
	8	See Response H.2.3.3i	H-29
	9	See Response H.2.3.3j	H-30
	10	See Response H.2.3.3d	H-27
	11	See Response H.2.1.4c	H-13
	12	See Response H.2.6.2e	H-38
	13	See Response H.2.6.2e	H-38
	14	See Response H.2.3.3f	H-28
	15	See Response H.2.1.5i	H-15
	16	See Response H.2.1.5h	H-15
	17	Comment noted; no response required	
	18	See Section B.2.2.2; no revision required	
	19	See Section B.2.2.1; no revision required	
	20	See Response H.2.5.2c	H-36

KEY TO RESPONSES

Letter Number	Comment Number	Disposition	Page Number(s)
38	21	See Response H.2.4.2f	H-33
	22	Text in Section 4.1.7 revised; no technetium-99 removal from salt cake considered	
	23	See Response H.2.4.2f	H-33
	24	See Response H.2.1.5k	H-16
	25	See Response H.2.7.2a	H-40
	26	Comment noted; no response required	
39	1	See Response H.2.4.1b	H-32
	2	See Response H.2.4.1a; text in Section 3.1 revised	H-31
	3	See Response H.2.7.1e	H-40
	4	See Response H.2.5.2c	H-36
	5	Comment noted; no response required	
40	1	See Response H.2.1.1c	H-10
	2	See Responses H.2.3.1a, H.2.6.1c	H-21, H-37
	3	See Response H.2.1.3c	H-12
	4	See Response H.2.6.1a	H-36
	5	See Response H.2.1.4b	H-13
	6	See Response H.2.6.1c	H-37
	7	See Response H.2.6.1b	H-37
	8	Text in Section B.4.2.1 revised	
	9	Text in Section 2.1.1.4 revised	
	10	See Response H.2.3.3a	H-26
	11	Text in Section B.5.5.1 revised	
	12	See Response H.2.6.1c	H-37

H.2 RESPONSES TO COMMENTS

H.2.1 Waste Processing and Technology

H.2.1.1 Alternatives for High-Level Wastes

a. Comment: The following alternatives for high-level wastes (HLW) not considered in the Draft EIS were proposed: allow decay heat to evaporate liquids and precipitate the solids (Comment 21-2); process the HLW by in-tank solidification after 10 years of no action (Comment 36-2).

Response: There are many possible alternatives not explicitly discussed in the EIS. The alternatives suggested above, however, are variations of alternatives described in the text: the alternative suggested in Document No. 21 is intermediate between removal of the HLW from the existing tanks and solidifying it (alternatives 1 and 2) and addition of cement to immobilize the HLW in the tank (alternative 3); the alternative suggested in Document No. 36 is a variation of alternative 3 in the EIS. The impacts of the suggested alternatives are covered by the range of options discussed in the text. It must be borne in mind that not all variations or combinations of process alternatives can reasonably be covered in the EIS. However, the range of reasonable alternatives is encompassed in the EIS. (See also next response.)

b. Comment: How were alternatives identified for analysis in the EIS? (Comment 32-1)

Response: The public was invited in December 1979 to participate in a scoping process that included identification of alternatives. The scoping process included a public meeting at West Valley on February 2, 1980. The written and oral comments received were used, in part, to identify the alternatives. See Appendix D of the EIS for a more detailed discussion of the scoping process and results.

c. Comment: The EIS should consider shipping the West Valley liquid HLW to another location for processing. (Comments 27-27, 40-1)

Response: The liquid HLW at West Valley currently are exempt from the requirements of 10 CFR 50, Appendix F, which states that "wastes in liquid form offer a much more serious potential for dispersal in the environment in the event of an accident." However, the spirit of these requirements plus legal and institutional issues that would arise make the transfer of the liquid HLW to another location for solidification an alternative unsuitable for consideration. Hence, this option was not considered in the range of alternatives covered in the EIS. Sandia Laboratory is designing a shipping cask for shipping small (liter) quantities of liquid HLW.

d. Comment: Alternative 2 is not consistent with alternatives 1a and 1b because in alternative 2 the interim-form HLW are shipped immediately offsite to a Federal waste facility for interim storage and eventual processing to a terminal form. For consistency, the EIS should consider interim storage and processing of the interim-form HLW to a terminal form at West Valley. (Comments 33-13, 33-16, 33-54)

Response: One of the major advantages of converting the West Valley HLW to an interim form would be to allow its shipment away from West Valley to another site at an earlier date for interim storage and eventual processing to a terminal form along with other HLW. This alternative is not meant to be consistent with alternatives 1a and 1b.

H.2.1.2 Processed Waste Forms

a. Comment: Alumina-silicate glass should have been listed as a terminal waste form. (Comment 15-1)

Response: It is not required that the EIS evaluate all possible waste-processing alternatives or terminal forms. Those chosen for discussion were meant to present a range of options that span the reasonable choices currently available. The use of borosilicate glass was selected for analysis because it was determined to be representative of final waste forms that include alumina-silicate glass. The use of borosilicate glass for analysis purposes does not imply that this glass form has been selected for the terminal waste form.

b. Comment: The EIS should provide a basis for evaluating the likelihood of a terminal processing facility being compatible with both the interim form of the West Valley wastes and other HLW. (Comment 33-14)

Response: If a decision is made to select the interim-form alternative, the decision on the specific interim form would be made by 1984. Thus, at this time there is no engineering basis for determining the compatibility of the West Valley HLW and HLW from other sources with a terminal processing facility (the interim waste form would be shipped to a Federal waste facility for final processing). Therefore, although it is not possible to evaluate compatibility between such waste forms and a yet-to-be-designed facility, any future facility would be designed to ensure compatibility with the West Valley interim-form wastes.

c. Comment: The statement that the length of time to complete activities at West Valley for alternative 2 is about the same as for alternative 1a is not correct because the terminal waste form (for alternative 1a) cannot be chosen until a repository site is selected whereas the interim form can be selected without detailed knowledge of the characteristics of the repository. (Comment 33-15).

Response: It has been assumed in this EIS that the terminal waste form can be selected prior to the selection of the waste repository. The containment of radioactivity in the HLW is dependent upon the waste form, canister, overpack, and backfill (see responses in Section H.2.5.1). If a repository is selected after the West Valley HLW have been solidified, it may be necessary to provide an additional overpack to ensure the containment of the HLW for the length of time they remain hazardous. If an overpack should be required, the material selected would be compatible with both the waste canister and the repository medium. Thus, the length of time to complete activities at West Valley for alternative 2 is predicted to be similar to that for alternative 1a.

d. Comment: Have the environmental consequences been considered with regard to the waste feed for the solidification process being nonhomogeneous or with regard to residual solids remaining in the tanks following waste removal? (Comment 33-45)

Response: It was assumed in this EIS that the waste feed for the solidification process would be essentially homogeneous. However, if the feed became heterogeneous, it would not be expected to greatly alter the environmental impacts because the solidification equipment would be properly designed for this. It should be noted that other processes are being considered that could utilize a nonhomogeneous feed. Prior to execution of the program, a safety analysis of the specific solidification process would be made that would address the specific waste feed in detail.

It was assumed in this EIS that 99.9% of the HLW in Tank 8D2 would be removed for alternatives 1a, 1b, and 2. Any residual solids would be entombed with the emptied tanks following HLW removal. In alternative 3, all of the HLW would remain in Tank 8D2 in a solidified form. Thus, the environmental impacts associated with leaving all or a portion of the HLW in Tank 8D2 prior to tank entombment would be bounded by these two analyses as presented in the EIS.

H.2.1.3 Contents of High-Level-Waste Tanks

a. Comment: Actinides are listed as 10,000 Ci in the Draft EIS whereas an earlier report (U.S. Dep. Energy 1978) gave 67,000 Ci. (Comment 20-4)

Response: The text of the Draft EIS actually lists 100,000 Ci (1×10^5), not 10,000 Ci, as the actinide content (Table B.2 in Section B.1.2.1). The difference between the actinide radioactivity presented in the Draft EIS and the value given earlier (U.S. Dep. Energy 1978) is due chiefly to a revised estimate of the plutonium-241 content of Tank 8D2.

b. Comment: Why is iodine-129 not listed in the HLW composition tables? (Comment 28-3)

Response: The Purex reprocessing process used at West Valley involved dissolution of fuel in nitric acid; iodine-129 is released as a gas in that step, and the volatilized iodine is processed by the dissolver off-gas system. Thus, the iodine would not appear in the HLW. However, for conservatism, the radiological impacts were analyzed assuming that all the iodine-129 remained in the wastes. Table B.2 in Section B.1.2.1 has been revised in the Final EIS to reflect this assumption.

c. Comment: Use of the terms "alkaline" and "neutralized" to describe the Purex wastes in Tank 8D2 should be clarified. (Comment 40-3)

Response: In relation to the HLW in Tank 8D2, the terms "alkaline" and "neutralized" are synonymous as used in this EIS. In Section B.1.2.1 of the EIS, it is indicated that the HLW in Tank 8D2 resulted from Purex processing of fuel that produced acid waste solutions. The acid was subsequently neutralized with NaOH; excess hydroxyl ions (OH^-) exist in the HLW, rendering them alkaline.

H.2.1.4 Removal of High-Level Wastes from Tanks

a. Comment: Reasons for processing Thorex wastes before alkaline wastes for alternative 1a should be clarified in the text of the EIS. (Comment 33-46)

Response: Processing the Thorex wastes first allows use of Tank 8D4 as a surge tank for transfer of the alkaline wastes from Tank 8D2; it also provides a demonstration of vitrification of wastes from the thorium fuel cycle. The text of Section B.2.2 of the Final EIS has been revised to incorporate these points. It should be noted that it is possible that the Thorex wastes might be combined with the Purex wastes for alternative 1a; it is not necessary that the Thorex wastes be processed separately for this alternative.

b. Comment: How will the homogenization of the wastes in Tank 8D2 be achieved and what is the reason for doing it? (Comment 40-5)

Response: The removal of sludge from Tank 8D2 is a necessary part of alternative 1a, and homogenization of the sludge with the supernatant liquid is one appropriate means for removing the sludge from Tank 8D2 without unduly increasing waste volumes. The details of the homogenization process are discussed in Section B.1.3.2 of the EIS. It should be noted that other processes, such as decantation of the supernate with subsequent removal of sludge by addition of water and/or acids, are being considered.

c. Comment: Concerns about the ability to remove the sludge in Tank 8D2 were expressed (Comments 26-6, 27-16, 27-25, 37-4, 38-11); in particular, it was stated that there is no proven technology for coping with the intractable sludge in Tank 8D2 (Comment 5-4).

Response: It is premature, at this time, to classify the sludge in Tank 8D2 as intractable as stated in Comment 5-4 because no information exists to support such a contention. Efficiency of sludge removal from Tank 8D2 is estimated in the EIS to be in excess of 99%, based upon technology for sludge removal from underground tanks that has been developed and proven at the Hanford and Savannah River facilities (see Janicek 1980). Development needs are identified in Section B.1.4 and a program will be carried out to optimize waste removal.

H.2.1.5 Processing Technology for High-Level Wastes

a. Comment: Vitrification involves higher risks than other processing options due to the high temperature and process steps involved (Comment 20-2); since the volatilization temperature of cesium is about 670°C, more cesium and other radioactive materials will be volatilized in the production of borosilicate glass than in the production of agglomerated calcine (Comments 6-4, 12-2, 16-2, 19-7, 19-9, 27-3, 31-1).

Response: Both the agglomerated calcine and borosilicate glass processes, as described in the EIS, require off-gas systems of similar complexity. Since the borosilicate glass process is a higher-temperature process, the off-gas system would probably be exposed to more radioactive materials due to volatilization of radioactive substances such as from cesium compounds. If the borosilicate glass process is chosen, the off-gas system would be designed to keep effluents from the site within prescribed guidelines and in accordance with the as low as reasonably achievable (ALARA) principle. This may require use of additional air-cleaning equipment (e.g., multiple filtration) that would not be required for the agglomerated calcine process.

b. Comment: The fate of iodine in the calcination step should be treated in the EIS. (Comment 28-4)

Response: Iodine has been considered in the Final EIS in assessing the impacts of the processing alternatives (see Table B.2 in Section B.1.2.1). (See also Response H.2.1.3b.)

c. Comment: Calcium sulfate formed in the off-gas system will amount to 180 drums, not 890 as stated in Draft EIS. (Comments 15-3, 15-12)

Response: The sulfate content of Tank 8D2 (Table B.1 in Section B.1.2.1) is estimated as 6.3×10^5 gram moles. This corresponds to 800-900 drums of wastes containing scrubber sludge, assuming ~50 wt% calcium sulfate solids in the wastes.

d. Comment: The EIS does not provide sufficient information regarding radioactive releases associated with implementing the alternatives (Comments 6-3, 16-3, 19-6, 23-3, 27-6, 33-29); in particular, the EIS should explain why the decontamination factors (DFs) used to estimate the radioactive releases from the site are appropriate for West Valley release calculations (Comments 27-4, 33-31).

Response: The radioactive releases were estimated using decontamination factors (DFs) that represent the fractional amounts of material released for a given process. Conservative DF values were employed in the impact analyses performed for the EIS. These DFs are acceptable to the U.S. Nuclear Regulatory Commission (NRC) for their usual licensing evaluations (U.S. Nucl. Reg. Comm. 1979). The DFs used in estimating releases were:

Operation	Decontamination Factor
Filtration (HEPA)	10^2 (1 for tritium)
Evaporation*	10^4 (1 for tritium and 10^2 for iodine-129)
Ion Exchange	10^2

*For processes involving evaporation into a ventilating air stream, the DF used was 5×10^4; the exit humidity assumed was 0.1 lb water/1 lb air.

Additional details of the assumptions and methodologies used to estimate the radioactive releases associated with this project are given in Section 4.1 and in the references cited in that section.

e. Comment: What is the basis for the overall calcination DF of 10^{13}? (Comment 33-30)

Response: The overall calcination DF of 10^{13} was based on the conceptual design of a calcination facility presented in a report of the U.S. Department of Energy (1979). To be consistent with the conceptual design for this project, this value has been reduced to 10^{11} in the Final EIS.

f. Comment: Spray calcination should be noted as a troublesome process because of the dust produced and the oxidation of ruthenium and molybdenum. (Comment 15-4)

Response: Research with regard to spray calcination has been going on at Pacific Northwest Laboratories (PNL) since the 1950s, and this work has been extensively documented (e.g., Larson 1980). Spray calcination has not proven to be a "troublesome process," although careful design is necessary to obtain satisfactory operation.

g. Comment: What is the basis for 6500 Ci in the salt cake? (Comment 27-19)

Response: The salt cake will occupy about 5100 drums containing about 0.65 Ci each; this corresponds to a total of about 3300 Ci. These values are based on process flow sheets developed by Holton (1981).

h. Comment: The Draft EIS does not discuss fail-safe operational interlock applicability to the proposed solidification systems at West Valley. (Comment 38-16)

Response: Consideration of the details of the operational systems involved in implementing the alternatives is beyond the scope of the EIS, which deals with conceptual designs only. After the choice of a specific alternative is made, the engineering and design of plant safety details--including applicable fail-safe operational interlocks--will be covered in a Safety Analysis Report (SAR).

i. Comment: Dismantlement of the HLW tanks should be considered in detail in the EIS. (Comments 6-6, 16-4, 17-2, 19-11, 27-17, 31-4, 37-3, 38-15)

Response: Tank dismantlement has been considered in detail in earlier documents dealing with the West Valley HLW (U.S. Dep. Energy 1978; United Nucl. Indus. 1978), which are referenced in the EIS. Dismantlement of the HLW tanks is addressed in Section B.6.3.2. The final decontamination and decommissioning of the HLW tanks, hardware, facilities, and materials used in the project will be addressed by the end of the solidification campaign in a separate decision-making process (see Section 1.4).

j. Comment: Organic resins shipped for disposal should be loaded to accumulated doses of less than 10^8 rads to minimize degradation of the resins due to the high radiation. (Comment 33-47)

Response: Consistent with current state-of-the-art, the organic resins will not be loaded to levels that would impair the stability of the waste form.

k. Comment: The ElS must evaluate disposition options for the uranyl nitrate left at the reprocessing plant. (Comment 38-24)

Response: The uranyl nitrate containing depleted uranium will continue to be stored safely in the process building in accordance with regulations applicable to special nuclear material handling. Its disposal options will be evaluated in detail at the time of final decontamination and decommissioning of the reprocessing facility. The issues addressed in this EIS pertain to the disposal options of HLW stored in underground Tanks 8D2 and 8D4.

l. Comment: Decontamination of the cells in the reprocessing plant to a level of 10 mrem/h was questioned. (Comment 27-8)

Response: The 10-mrem/h radiation level in the cells would be achieved by a combination of dry vacuuming, use of high-pressure sprays of water and various caustic and acidic solutions, scrubbing with a power brush, removing localized hot spots by concrete spalling, and painting. These techniques, as applicable to this project, are described in the 1981 report of Burns and Roe Industrial Services Corporation (Task 1A). Other more rigorous techniques would be utilized if these techniques did not reduce the radiation levels to 10 mrem/h or less. If the decontamination of concrete to a 10-mrem/h level could not be achieved, use of the current reprocessing building would have to be reevaluated.

m. Comment: Additional information on alternative decontamination methods was requested. (Comment 33-50)

Response: The decontamination analysis included in the EIS was performed to show feasibility and not to select a particular approach. Although there are many approaches, the analysis showed that decontamination was feasible. There are various methods that are commercially available today for decontaminating radioactively contaminated facilities. This is a rapidly developing technology with new techniques constantly being developed and marketed. Since the purpose of the document is to analyze the environmental impacts associated with the various waste solidification alternatives, it does not seem prudent at this time to analyze the full range of available methods for implementing different phases of this project. Rather, use is made of reasonable and currently available techniques in estimating environmental impacts. When the facility is to be decontaminated, an appropriate environmental review consistent with the requirements of the National Environmental Policy Act (NEPA) will be performed, and the best methods available at that time will be utilized.

n. Comment: A strong reducing agent to volatilize the sulfates in the borosilicate glass to sulfur dioxide is suggested in the EIS; the impact of such a reducing agent on the durability of the glass should be addressed. (Comment 33-48)

Response: Control of the glass formulations is a very important component in designing the process for waste solidification. Development of the best formulations for the product glasses is mentioned in Section B.2.2.2 as a development need. The impact on glass formulation of using such a reducing agent will be considered in the design of the solidification process.

H.2.2 Accident Analyses

H.2.2.1 Accident Frequency

a. Comment: The EIS should provide additional information on the probability of a leak in the HLW tanks. (Comment 27-15, 30-3)

Response: The design lifetime of the tanks is 40 years; however, corrosion coupons in the tanks indicate that the lifetime may actually be longer (U.S. Nucl. Reg. Comm. 1977b). For the purposes of the EIS, tank lifetime was assumed to be 40 years. Reprocessing started at West Valley in 1966. Based upon the above, the Department of Energy believes that the probability of leakage over the next several years is small. The tanks will be inspected in the summer of 1982, and if deficiencies are discovered, the possibility of HLW tank leakage will be reevaluated.

The design of the HLW tanks and the environmental surveillance measures that have been and will be adopted (see Response H.2.3.3p) would ensure the prompt detection of a liquid leak from the HLW tanks. The HLW tanks are contained within a monitored concrete vault as described in Section B.1.1 of the EIS. Should a leak from the tank into the concrete vault occur, the HLW would be pumped to the spare tank. The vaults are surrounded by clayey till that is maintained in a saturated condition, thus suppressing migration from the vault should a leak in the concrete vault occur. The permeabilities of the clayey till are extremely low, and this would permit necessary mitigative measures to be implemented in a timely manner. Analysis of the migration of radionuclides through the clayey till (Nucl. Fuel Serv. 1973) indicates that the maximum credible release to the nearest surface stream would be less than 10^{-5} of the concentrations given in DOE Order 5480.1, Chapter XI (U.S. Dep. Energy 1981c). That is, the annual dose to an individual from the release would be about 0.005 mrem.

b. Comment: Was the Nuclear Safety Associates earthquake recurrence estimate of 6250 yr for a 0.2 g occurrence at West Valley used in the EIS calculations? If so, is this recurrence interval valid? (Comment 26-5)

Response: The value used in the EIS calculations corresponds to the Nuclear Regulatory Commission earthquake recurrence interval of about 16,000 yr for a 0.2 g occurrence at West Valley (U.S. Nucl. Reg. Comm. 1977b).

c. Comment: The Department of Energy should provide detailed information on the nature and number of accidents per year at its contractor facilities--specifically, the Savannah River Plant (SRP), the Idaho National Engineering Laboratory (INEL), and the Hanford Reservation--to verify the accident probabilities used in the EIS. (Comments 4-7, 38-2)

Response: No accidents have occurred at SRP, INEL, or Hanford that have resulted in a significant impact to the public health and safety to nearby residents. The frequencies for accidents described in the EIS represent realistic yet conservative estimates. The basis for these estimates is provided in the 1980 report of the Nuclear Safety Associates, which is referenced in the EIS.

d. Comment: Construction of a containment structure around the HLW tanks is suggested. (Comment 20-7)

Response: The HLW are currently being safely stored in belowgrade tanks that provide multiple barriers to potential releases (see Response H.2.2.1a). The Department does not believe that it is necessary to provide additional containment of these tanks at present. The necessity for providing additional containment during removal of the HLW will be addressed in the Safety Analysis Report (SAR) to be prepared by the Department prior to solidification.

H.2.2.2 Accident Scenarios

a. Comment: There is no analysis of potential accidents that might lead to release of radionuclides during interim storage of processed HLW at West Valley. (Comment 7-1)

Response: Scenarios leading to the release of radionuclides from potential accidents during the interim storage of processed HLW at West Valley were considered. However, the contributions from such accidents to the total radiological risk for this project were so small (less than 0.1% of the total short-term risk) that a specific discussion of such events was not warranted. The text of Section B.4.4.1 has been modified accordingly. (See also Response H.2.2.2j.)

b. Comment: The EIS does not consider or mention the possibility of a loss-of-containment accident. (Comment 5-5)

Response: A "loss-of-containment" accident is usually considered in the context of a nuclear reactor. Such an accident refers to a break in the containment structure of the nuclear reactor, with subsequent release of radionuclides to the environment. In the context of this project, a "loss-of-containment" accident could refer to any processing accident (such as a break in Tank 8D2) that could release a very large quantity of radionuclides into the environment. Two such accidents were considered in this EIS--i.e., an airplane crashing into the HLW tanks and a sabotage event; the radiological risks associated with these two accidents are given in Section 4.1.6. In addition, accidents that could result in a breach of the HLW canisters and casks during transport were also addressed in the EIS.

c. Comment: The alternatives proposed are subject to risk of a criticality accident, which is not discussed in the EIS. (Comments 19-4, 20-1, 20-3)

Response: The major fissile species in Tank 8D2 is plutonium-239 (estimated to be about 29 kg). Since design of process equipment would be in accordance with established standards for prevention of criticality, it was assumed that criticality would not occur during the solidification process.

The potential that recriticality can occur in Tank 8D2 was also examined. The concentrations of plutonium-239 existing in the sludge are too low for recriticality. No reasonable mechanisms for selective concentration of the plutonium into critical masses during waste removal could be envisioned. Thus, such criticality problems do not require discussion in the EIS.

d. Comment: Temperature history of Tank 8D2 implies recriticality has or is occurring. (Comment 20-6)

Response: During reprocessing operations at West Valley, heat was added to the HLW in Tank 8D2 via a steam coil because there was not a sufficient volume of HLW to induce boiling. This additional heat allowed the evaporation of about one gallon of water per minute to concentrate the wastes and increase the usable volume of Tank 8D2. Since cessation of reprocessing operations, the wastes in Tank 8D2 have come to a steady-state condition in which the heat produced by radioactive decay is transferred to the surrounding soil by radiant heat loss and in the production of vapors from the liquid phase. These vapors are condensed by air-cooled condensers and the resultant condensate is returned to the tanks; the remaining gases are vented according to technical specifications. Recriticality need not be invoked to explain the temperature history of Tank 8D2. (See also previous response.)

e. Comment: The storage of liquid HLW in small aboveground tanks (~1000 to 10,000 tanks) is suggested to reduce the potential for criticality. (Comment 20-5)

Response: The suggestion is untenable from a safety standpoint because the chance of accidental release from thousands of small tanks is markedly greater than from one tank; furthermore, aboveground storage makes the chance of subsequent environmental impact even greater. For this reason, this alternative was not considered to be reasonable and was not addressed in the EIS. The potential for criticality has been examined and is not believed to be a problem. (See previous two responses.)

f. Comment: Since the bulk of the residual activity in Tank 8D2 would be at the bottom following waste removal, a concern was expressed that the barriers below the tank are not adequate to ensure that the radioactivity would not migrate from the entombed tank. (Comment 26-7)

Response: After the sluicing operations and chemical treatment with hot oxalic acid (see Janicek [1980] for details), the activity remaining in Tank 8D2 would be virtually fixed to the interior surfaces--i.e., the remaining activity would essentially be a part of the tank since it could not be removed by aggressive treatment. Having survived the oxalic acid treatment, the residual activity would not be picked up in significant quantities as a result of contact with groundwater even if vault failure and penetration of the silty till occurred. Furthermore, the assumed entombment process would provide additional barriers to release by coating much of the residual activity with cement-like grout. If the entombment alternative is chosen, additional engineered barriers would be designed if required.

g. Comment: A steam explosion would result if the feed nozzle of the spray calciner failed, allowing a stream of HLW to flow through the calciner to the molten glass below. (Comment 26-3)

Response: The problem of nozzle failure was considered in the accident analysis of Larson (1980). That analysis did not indicate that steam explosions would result from nozzle failure. Even during intentional melter-flooding experiments, no explosions or even eructations were observed (Wicks 1981).

h. Comment: A more definitive indication of the transportation routes that would be utilized should be given in the EIS. (Comment 14-1)

Response: Since the destinations of the radioactive wastes resulting from the solidification of the West Valley HLW have not yet been identified, it is not possible to detail the exact routes that would be used. When the destinations of the various waste packages are determined, the exact routes to be utilized will be identified in accordance with applicable local, state, and Federal regulations, and coordinated with the appropriate agencies and officials. The environmental impacts of transportation have been included in the EIS. A discussion of the transportation routes that could be utilized is given in Section B.5.3 and illustrated in Figures B.17 and B.18 of the Final EIS; Figure B.17 gives the potential routes from West Valley to interstate highways, and Figure B.18 gives potential rail routes from West Valley to major rail systems.

i. Comment: There is no specific contingency planning to deal with actual radiological hazards associated with solidification of the West Valley HLW, especially in the event of a major accident. (Comment 5-2, 6-5, 34-3, 37-7)

Response: Sections 4.3.10 and 4.3.11 of the EIS deal with general planning for contingencies that might arise during the solidification project. As pointed out in Section 4.3.10, specific detailed contingency planning will be developed after a decision has been made among the alternatives for the proposed waste solidification. An environmental safety and health plan has been approved for this project. In addition, a Safety Analysis Report (SAR) will be prepared prior to solidification.

j. Comment: The EIS should explain why solidified HLW could not be dispersed by sabotage or by an airplane crash during interim onsite storage at West Valley. (Comment 33-32)

Response: Scenarios leading to the dispersal of solidified HLW during interim storage at West Valley are considered to be highly unlikely. After being solidified, the HLW are assumed to be stored in an onsite, belowgrade structure until a repository becomes available. The design and construction of this temporary storage facility would be such as to minimize any potential for release by projectiles. In the unlikely event that the individual HLW containers were breached, the monolithic form of the HLW would make dispersal of the material very difficult. (See also Response H.2.2.2a.)

k. Comment: The EIS has not evaluated the possibility of an explosion at West Valley such as occurred in Russia in 1957 which devastated an area of almost 2600 km^2 (1000 mi^2). (Comments 6-5, 19-3, 27-24)

Response: There is no detailed information concerning the incident referred to in these comments; only speculation by people outside the Soviet Union is available. There is debate among the scientific community as to whether the environmental impacts in this area of Russia are due to a single event (such as the explosion mentioned by these commenters) or caused by chronic environmental contamination with poorly designed and operated facilities. It is not reasonable to consider this topic in the EIS since no suitable information is available from the Soviet Union.

1. Comment: The EIS has not considered the effects of normal operations and major accidents or severe natural phenomena. (Comments 6-5, 7-2, 16-6, 19-3, 30-3, 34-1, 37-2)

Response: The EIS evaluated short- and long-term releases from normal or routine operations as well as releases from process incidents, accidents, or natural disasters. Sections 4.1.3 through 4.1.8 provide the details of the analysis. These events and release scenarios are considered to bound the radiological impacts associated with HLW solidification.

H.2.3 Radiological Analysis

H.2.3.1 Methodology and Modeling

a. Comment: The risk assessment given in the EIS is inadequate. Specific concerns include: (1) the risk assessment methodology should present sequentially the various aspects involved and integrate them into a comprehensive evaluation (Comment 38-1), (2) the potential for radionuclide releases associated with process incidents appears to be much too low (Comment 38-2), (3) the risk assessment methodology is overly simplistic (Comment 38-3), and (4) the information given in the EIS describing the risk assessment calculations is inadequate (Comments 23-3, 26-2, 27-6, 30-2, 40-2).

Response: The main emphasis of the accident analyses in this EIS is to identify accidents with potential for offsite releases. A wide range of postulated accidents that might occur during the operating phases of the waste-processing facilities were analyzed. Of these, several possible events could lead to the discharge of a significant quantity of radionuclides, but it is expected that they would be largely confined within the processing facility. In each case studied, the ultimate release of radionuclides to the environment is estimated to be small.

In preparing the EIS, the umbrella source terms discussed by the U.S. Department of Energy (1979) were examined and analyzed. The umbrella source-term concept was used to limit the number of accidents requiring detailed impact analysis. Viewed independently of accident initiation sequences and frequencies, the accident source terms can be grouped by release severity for analyses of environmental consequences. More than 40 different release groups were defined for this project, based on similar release pathways, chemical form, accident severity category, and isotope types released. The largest release from any of the accidents in a group of accidents was then selected as the umbrella source term for that group. The presentation of the radiological impacts from accidental events were based on a consequence viewpoint. The frequency of occurrence of the particular event is identified so that it is possible to determine the expected impact from such an event, if desired. It is believed that the accidents given in this EIS are representative for solidification of the West Valley HLW and that they bound the radiological impacts from this project.

The step-by-step process by which the dose estimates were developed is given in a supporting document by Nuclear Safety Associates (1980). The contribution of various pathways to total dose is dependent on the radionuclides released, and it varies markedly among the many release situations considered. Inclusion of all this information in the EIS is not practical.

b. Comment: The methodology and transport models used to evaluate the radiation doses to the general population as a result of airborne radionuclide releases is inadequate. Specific concerns include: (1) a more thorough description should be provided of the computer models and parameters used in the analysis (Comments 38-4, 38-5), (2) the doses associated with radionuclide releases should be integrated globally (Comment 4-1), and (3) the locations of highest population exposure should be given (Comment 4-3).

Response: The adequacy of the atmospheric transport models used in the EIS have been recently reviewed (Hoffman et al. 1978). In general, the accuracy of the models is a function of sampling, terrain, and vegetation, or a unique meteorological environment such as a valley wind or sea breeze. In generally uniform terrain with steady winds, the uncertainty is about ± 20% for the maximum concentration of radioactivity in a plume at short downwind distances (within 10 km) for ground-level releases. In complex wooded terrain conditions such as those around West Valley, the Gaussian model for short-term releases overestimates the concentration under poor diffusion conditions of stable atmosphere and low wind speeds when compared to actual measurements. Evaluations of annual average releases have shown them to be generally within a factor of two to four for distances out to about 100 km, depending on the terrain conditions. A detailed description of the computer models used in this EIS is given in documents referenced in Section 4.

The atmospheric dispersion parameters used were selected to ensure that calculated doses were conservative. The values used for dose calculations of the maximum exposed individual from atmospheric releases were not selected on the basis of the actual nearest residence but were selected on the basis of the actual location (1.6 km [1 mile] NNW) where the annual concentration and relative deposition rate are highest. The meteorological parameters used for normal releases represent annual, average, long-term conditions whereas the meteorological parameters used for accidental releases represent short-term conditions. The short-term conditions are assumed to occur under unfavorable meteorological conditions, which are exceeded only 5% of the time. The joint frequency distribution for West Valley was based on site meteorological measurements made in 1974-1975 (Bechtel Corp. 1979).

For calculating population doses, the geographic distribution of the population within 80 km (50 miles) of the West Valley site projected for the year 1990 was used (Bechtel Corp. 1979). This projection was calculated based on 1975 site-specific population data and the anticipated population growth in the region. The choice of 80 km for calculating population doses has been standard for some time. It is used conventionally, and often, because at this distance, the airborne concentration of a particulate radionuclide from routine release will have decreased to a value that is indistinguishable from the background concentration. Extrapolating population doses from routine particulate releases beyond 80 km is meaningless because the doses are so small that they are not only greatly exceeded by natural background doses but also are exceeded by fluctuations in natural background doses. Population doses for the continental United States from gaseous releases, such as tritium and iodine-129, have been included in the Final EIS. Global estimates of population doses from airborne releases have not been included but would increase the total population dose by less than 5%.

For accident events, unfavorable meteorological conditions were used to estimate the doses. Under these conditions, all of the released radionuclides were assumed to be deposited within an 80-km radius of the release point. This results in overestimating the possible population doses rather than underestimating them.

c. Comment: The environmental transport models used in the EIS are not appropriate for the long-lived nuclides present in the HLW. A model similar to that described in NUREG/CR-1636 (Helton and Kaestner 1981) would be more appropriate. (Comment 33-28)

Response: There are many possible models that may be used to predict the radiological impacts. These range from simple hand calculations to sophisticated computer codes. The accuracy of an analysis is dependent upon the site-specific data that are available. Complex calculations are used only when the necessary, rather-extensive quantity of site-specific information is available.

The Department considers the evaluation models used in this EIS to be adequate for the purpose of providing a basis for impact evaluations. The models of Regulatory Guide 1.109 (U.S. Nucl. Reg. Comm. 1977a) were extended to include the long-lived radionuclides similar to that given in NUREG/CR-1636 (Helton and Kaestner 1981). Use of the models of Regulatory Guide 1.109, as modified, is appropriate for analyzing the radiological impacts associated with the alternatives analyzed in the EIS. The detailed description of the radiological impact evaluation model is given in a supporting document by Nuclear Safety Associates (1980).

The information required to use a model similar to that described in NUREG/CR-1636 (Helton and Kaestner 1981) is not available. The use of such a model is therefore not possible at the present time. Use of this model would be desirable if the specific HLW repository site for disposal of the West Valley HLW were known.

d. Comment: The detailed assumptions of environmental release calculations should be included in the EIS. Specific requests include: (1) more specific information on the quantification development (Comment 23-2), (2) a description of the process by which each important radionuclide is released to the environment (Comment 27-4), and (3) a more complete description of the groundwater model and parameters used for calculating the population doses associated with disposal of radioactive low-level wastes (LLW) (Comments 33-27, 33-60).

Response: Although the detailed assumptions for release calculations are not discussed within the text of the EIS itself, the relevant information has been incorporated as appropriate. For a full discussion of the assumptions used in the analyses of releases and effluents, readers are referred to Section 4.1 and to the references cited in that section. Inclusion of the level of detail suggested in some of these comments is not feasible in a document of this length and has been incorporated by reference.

e. Comment: A question was raised about the manner in which the effective dose equivalent (calculated by Equation 4.1, Section 4.1.3) was used with the dose-risk factors (given in Table 4.18, Section 4.1.8) to calculate the genetic and cancer risks. (Comment 33-36)

Response: In the EIS, the genetically significant doses were calculated separately and multiplied by the genetic risk factor to obtain the genetic risk. Each type of cancer risk was also calculated separately. The use of Equation 4.1 in Section 4.1.3 of the EIS follows the above calculation procedure implicitly. The total health risk in the EIS includes both the cancer risk and the genetic risk.

f. Comment: The radiological risks given in the EIS are overconservative. (Comment 22-1); in particular, the radiological risks for the no-action alternative (4b) are inflated relative to those for the action alternatives (1a, 1b, 2, and 3), which may be underestimated (Comment 21-1).

Response: An EIS is intended to provide a realistic evaluation of the impacts of the proposed action and alternative actions. The evaluation models and assumptions used in the EIS are considered to be appropriate for the purpose of providing a basis for performing compliance and impact evaluations. The Department does not know of any instance where conservatism is of significant importance with respect to the final results and conclusions of the EIS or to the choice among the alternatives.

H.2.3.2 Radionuclide Pathways to the Environment

a. Comment: The EIS should show how each important radionuclide is vaporized, describe fully the equipment that would be used to contain these releases, and give the associated decontamination factor for each radionuclide (Comment 27-4); in particular, a description of the amount of cesium-137 released to the environment should be given (Comment 4-8).

Response: Although sufficient information is available to estimate the radiological impacts from airborne radioactive releases, it is not possible at present to provide detailed information on the airborne radioactive effluents because details of the solidification process have not been defined. As currently envisioned, a very small quantity of radioactive particulates (less than 0.05 Ci/yr) would be released from the facility off-gas system during normal operation. The air effluent stream would be provided with double high-efficiency particulate filter systems and would be discharged from a stack. The discharge would be routinely monitored. The radionuclide release fractions used to calculate the radiological risks to the surrounding population are given in Table 4.3 (Section 4.1.4) of the EIS. These releases include those associated with process incidents or accidents, natural disasters, and normal or routine operations. The total health impacts of these gaseous radionuclide releases are considered in the radiological impacts presented in the EIS. A more detailed evaluation of gaseous releases associated with solificiation of the West Valley HLW will be addressed in the Safety Analysis Report (SAR) to be prepared by the Department of Energy prior to waste solidification.

b. Comment: Pathways involving irrigation, rain wash, runoff, and resuspension of deposited radionuclides should be included in the EIS. (Comments 4-2, 16-3, 19-8, 27-11, 33-26, 38-5)

Response: In preparing the EIS, the pathways mentioned above were included in the radiological impact analysis and were found to have contributed less than 5% of the calculated doses. The text in Section 4.1.3 has been modified accordingly.

c. Comment: In Table 4.16, Section 4.1.7, why is the population risk via groundwater migration for alternative 4b estimated to be 10 person-rem per year but only 70 person-rem cumulative over 10,000 years? (Comment 33-35)

Response: In the EIS, the leach rate assumed for the liquid HLW in the tanks was 0.2 (20%) per year. Based on this assumption, all of the liquid HLW would be leached from the tanks over a five-year period. Technetium-99 and iodine-129, due to their small retardation coefficients and long half-lives, would become the dominant sources of radiation exposure to the population through the ingestion pathway. Because of these assumptions, the overall population risk via groundwater migration under alternative 4b would be 10 person-rem in the first year, but would be only 70 person-rem accumulated over the long-term period. The model used for this analysis is discussed in Section 4.1.3 and in the references given in that section.

d. Comment: Were long-term food pathways considered for human intrusional events for decommissioned facilities remaining at West Valley? (Comment 33-33)

Response: Long-term food pathways were considered for human intrusional events in Sections 4.1.5 and 4.1.7 for decommissioned facilities remaining at West Valley as well as for LLW disposal sites. The likelihood of future human activities that could adversely affect the integrity of any decommissioned facility can be reduced to a very low probability through the use of appropriate protective measures (e.g., barriers, markers).

e. Comment: The EIS should provide further discussion of liquid releases and indicate whether the LLW treatment facility will have a major or minor discharge to the environment. (Comments 4-2, 27-11, 33-39, 33-49)

Response: The Final EIS has been revised to incorporate liquid releases. All the tritium (2.4×10^3 Ci) has been assumed to be released to the environment as a liquid. In addition to the tritium, the radioactivity released through the LLW treatment facility via liquid effluents is estimated to range from 3×10^{-4} to 3 Ci. The concentrations and volumes of release will depend on the alternative chosen (see Table 4.3, Section 4.1.4, of the Final EIS). These releases are considered to be minor releases to the environment.

Liquid releases do not significantly change the estimated total radiological impacts to the general population for this project because the major component of the radiological risk results from sources other than routine releases during HLW processing (e.g., transportation).

f. Comment: Discussion of plutonium hazards has not included the fact that plutonium mixed with chlorine, as occurs in city water supplies, increases the toxicity of that material because it becomes more soluble. (Comment 27-23)

Response: At this time, one cannot reasonably conclude that chlorination would increase plutonium hazards from drinking water. The toxicity of plutonium (i.e., the body's response to radiological insult by plutonium) is not affected by its chemical form. The absorption and degree of retention of plutonium by biota is, however, dependent on its chemical form. A recent study has shown that chlorination, such as occurs in municipal water supplies, does not affect the degree of absorption of plutonium in the gastrointestinal tract (Larsen et al. 1981).

H.2.3.3 Dose Calculations

a. Comment: Additional explanation of the unit "person-rem/km" was requested. (Comment 40-10)

Response: Unit-dose factors (person-rem/km) give the amount of radiation dose received by the general population and the work force for each kilometer of travel. These unit-dose factors were obtained using the computer code RADTRAN-II (Taylor and Daniel 1980) as specifically applied to the West Valley HLW solidification project. The doses to the general population and work force were obtained by multiplying the unit dose factors by the number of shipment-kilometers required for the various waste forms. The use of unit-dose factors also illustrates the effect of waste volume and transportation distance on this radiological impact.

b. Comment: The use of Hanford experience in estimating occupational doses at West Valley was questioned. (Comment 19-2, 27-7)

Response: The calculation of occupational doses was based on various sources of data, not just the Hanford experience referred to in these comments. The sources used to calculate occupational doses are summarized in Table H.1 along with the section of Appendix B where they are discussed in greater detail.

c. Comment: The historical record associated with fuel-reprocessing activities at West Valley could be used to estimate occupational doses from waste solidification. (Comment 27-9)

Response: According to this commenter, use of the West Valley historical record to estimate the occupational doses from waste solidification results in an estimate of 5000 person-rem as opposed to the 1800 person-rem estimate given in this EIS for alternative 1a. The 1800 person-rem estimate was arrived at through the estimating procedures discussed in Appendix B of the EIS and is summarized in the response to the preceding comment. In recent years, the radiation doses to workers has steadily decreased as the Federal government and the commercial nuclear industry have made extensive efforts to implement the ALARA philosophy. The Department of Energy has been able to maintain the average radiation dose to workers at less than 1 rem (U.S. Dep. Energy 1982b). The 5000 person-rem estimate is somewhat inflated because it is based on data that are not representative of current Department practices. (See also Response H.2.3.3e.)

Table H.1. Sources Used to Calculate Occupational Doses

Operation	Dose Rate	Data Source	Section in EIS Where Discussed
Waste retrieval	0.65 rem/worker/year	Hanford experience at HLW tank farm	B.1.5.1
Waste processing	0.54 rem/worker/year	Savannah River Plant experience on nuclear fuel reprocessing	B.2.5.1
Decontamination of cells and equipment installation	Variable	Detailed analysis of proposed activities (see Burns and Roe Indus. Serv. Corp. 1981, Task 1A)	B.3.3.1
Handling, storage, and disposal of solidified HLW	250 person-mrem/canister for alternative 1a; 120 person-mrem/canister for alternatives 1b and 2	Irradiated nuclear fuel handling experience	B.4.4.1
Handling, storage, and disposal of transuranic and low-level wastes	Variable	LLW handling experience	B.4.4.2
Transportation	Variable	Use of RADTRAN-II computer code along with the properties of the various waste forms	B.5.5.1
Decontamination and decommissioning of cells used	Variable	Detailed analysis of proposed activities (see Burns and Roe Indus. Serv. Corp. 1981, Task 1B)	B.6.3.1
Decontamination and decommissioning of emptied HLW tanks	0.65 rem/worker/year for entombment	Hanford experience at HLW tank farm	B.6.3.2
	Variable for dismantlement	Analysis of proposed procedures (see U.S. Dep. Energy 1978)	B.6.3.2
No action (HLW storage)	8 person-rem/year	Current level of occupational doses	B.7.3.1

d. Comment: Justification for use of Savannah River Plant (SRP) and Hanford data for estimating occupational doses at West Valley was requested. (Comment 38-10)

Response: The SRP and Hanford data are appropriate because many of the operations performed at these two government facilities would be similar to those required to solidify the West Valley HLW. In this EIS, it has been assumed that equipment and facilities would be designed and operated so that the average occupational dose would be limited to about 0.5 rem/worker/year. Janicek (1980) addresses the use of Hanford data for estimating the occupational doses for waste retrieval and concludes that it is indeed appropriate. The SRP data was assumed to be similarly appropriate for use in calculating the occupational doses for waste processing. Since the waste-processing facility has not yet been designed, it is not possible to present a detailed analysis of the various activities to estimate occupational doses at this time. The HLW solificiation project will be undertaken in a manner consistent with the ALARA philosophy for minimizing radiation doses to workers and the general population.

e. Comment: The ability to limit average occupational doses during waste solidification activities to about 0.5 rem/worker/yr was questioned. (Comment 5-7)

Response: In the general context of radiation exposure control, the Department of Energy's policy is to maintain exposures as low as reasonably achievable below occupational exposure limits. The Department's radiation exposure records clearly demonstrate positive initiative and success in exposure reduction. An occupational exposure rate of 0.5 rem/worker/yr is an administrative guideline that is 10% of the maximum allowable occupational dose limit (U.S. Dep. Energy 1980c). During 1980, 96% of Department and Department-contractor employees received less than 0.5 rem, about 2% received between 0.5 and 1 rem, and less than 2% (about 1500 of 85,500 employees) received more than 1 rem but less than 4 rem (U.S. Dep. Energy 1982b). No employee received a dose in excess of 4 rem. The average exposure for workers who received more than 0.5 rem was approximately 1 rem. The Department expects each person on the project to receive less than 0.5 rem/yr. Although it is possible that a few individuals might receive higher doses, their doses will be substantially below the 5 rem/yr limit.

f. Comment: The occupational dose estimate for dismantlement of the HLW tanks may be too high (Comment 38-14); the EIS should indicate whether additional engineering work could provide remotely operated equipment that could reduce the doses associated with tank dismantlement (Comment 26-8).

Response: Dismantlement of the emptied HLW tanks would, at best, be a very difficult task. The appropriateness and feasibility for such an undertaking is highly dependent upon the amount of residual contamination that remained following removal of the liquid HLW. As stated in Comment 38-14, the references cited for this occupational dose estimate are U.S. Department of Energy (1978) and United Nuclear Industries (1978). Use of other techniques, such as remote underwater cutting, might result in a lower occupational dose commitment. However, such techniques would not totally eliminate doses to workers during tank dismantlement as it would be necessary for the workers to spend time in or near the tanks to set up the equipment and monitor progress. The specific procedure that would be utilized, should tank dismantlement be undertaken, would employ state-of-the-art techniques for such activities. Decontamination and decommissioning of the tanks will be addressed in more detail in the late 1980s when an environmental review of the decommissioning of the facilities used in this project, including the tanks, will be performed.

The text of Section B.6.3.2 has been revised in the Final EIS to reflect Comment 26-8.

g. Comment: Are occupational doses from waste processing and packaging of TRU and low-level wastes included in Section B.4.4.2 of the EIS? (Comment 33-58)

Response: The occupational doses given in Section B.4.4.2 are only for handling the wastes after they have been processed and packaged. The occupational doses for waste processing and packaging are included in the occupational doses given in Sections B.2.5.1 (for TRU and low-level wastes resulting from HLW processing), B.3.3.1 (for TRU and low-level wastes resulting from presolidification decontamination), and B.6.3 (for TRU and low-level wastes resulting from final decontamination and decommissioning).

h. Comment: The unit-dose estimates given in Table B.21 for handling TRU and low-level wastes were questioned; reference was made to NRC dose estimates prepared for the Three Mile Island (TMI) Programmatic Environmental Impact Statement (PEIS) (U.S. Nucl. Reg. Comm. 1981c). (Comment 33-59)

Response: The reference given in this comment was utilized, along with other references, in derivation of the unit-dose factors given in Table B.21. The unit-dose factors given in Table B.21 are generally lower than those in the TMI PEIS for two main reasons:

1. The unit-dose factors given in Appendix N of the TMI PEIS involve activities other than just waste handling, and
2. It was assumed that the design of the West Valley solidification facility will include provisions for handling these TRU and low-level wastes in lower radiation fields than at TMI.

Even though the unit-dose factors utilized in this EIS are somewhat lower than those for the TMI PEIS, the difference is small considering the uncertainties involved.

i. Comment: The health risk estimators used are not representative, resulting in a low estimate of the health hazards associated with radioactive releases from this project (Comments 5-6, 27-12, 30-4, 38-7); specifically, there is no consideration of the actual health hazards associated with this project, only fictitious calculations (Comment 5-1). In addition, a geographic distribution of the population at risk should be included (Comments 38-6, 38-8).

Response: An EIS is intended to provide a realistic evaluation of the impacts of the proposed action and alternative actions. In order to quantify the potential risks of various actions, it was necessary to estimate the potential individual and collective exposures to radiation and to calculate the potential number of serious health effects that might be postulated to result from such estimated exposures. Substantial uncertainties are inherent in relating the low levels of exposure to the risks of realizing health effects.

A range of health effects (300-800 per million person-rem) was used in this EIS to estimate the health risks of radiation doses. These risk factors were developed in an attempt to obtain results that are realistic, yet conservative. This range is conservative compared with recent data (e.g., Comm. Biol. Effects Ionizing Radiat. 1980; Int. Comm. Radiol. Prot. 1977).

Recent work (Loewe and Mendelsohn 1981; Straume and Dobson 1981), based on revised dose estimates for Hiroshima and Nagasaki, has concluded that risk coefficients for radiation-induced leukemia and breast cancer obtained from the new dose-response curves are consistent, at low doses, with those of the International Commission on Radiological Protection (ICRP). The low linear-energy-transfer (LET) risk coefficients for fatal malignancies appear to be lower than the ICRP values.

The calculated risks are so small (they are exceeded by the fluctuations in natural background doses) that a geographic distribution of the population at risk would not provide any additional information that would affect the choice among the alternatives.

j. Comment: The effect on the EIS risk estimates of the inclusion of nonfatal health effects was raised. (Comments 4-11, 23-1, 38-9)

Response: The risk for nonfatal cancers is generally considered to be about two times that of fatal cancers. The EIS concludes that no significant health effects and risks are expected as a result of this project. This conclusion would have been the same if nonfatal cancer risks were included.

k. Comment: The validity of the dose conversion factors and environmental transfer factors used in the EIS was questioned. (Comments 4-4, 4-5)

Response: The dose conversion factors used in the EIS are considered appropriate by the Department. Dose conversion factors currently used by NRC and the U.S. Environmental Protection Agency (EPA) are based primarily on reports of the ICRP. Recommendations of this Commission serve as the basis of the dose conversion factors used in this EIS. The environmental transfer factors used in the EIS represent the average of values tabulated in the open literature and are consistent with NRC and EPA usage.

l. Comment: Comparison of radiological risks associated with this project to natural background radiation levels is misleading and objectionable. (Comments 4-10, 27-13)

Response: The use of natural background radiation is considered to be a valid measure for providing perspective for the estimated doses. The potential offsite radiation doses resulting from this project and the naturally occurring background radiation in the West Valley area were compared only to illustrate the relative level of radiation doses resulting from each alternative.

m. Comment: The validity of using an 80-km radius for calculation of population doses was questioned. (Comments 4-1, 4-9, 28-2, 38-6)

Response: The choice of 80 km has been standard for some time. It is used conventionally, and often, because at this distance, the airborne concentration of particulate radionuclides from routine releases will have decreased to a value that is indistinguishable from the background concentration. Extrapolating population doses from routine particulate releases beyond 80 km is meaningless because the doses are so small that they are not only greatly exceeded by natural background doses but also are exceeded by fluctuations in natural background doses. Population doses for the continental United States from gaseous releases, such as tritium and iodine-129, have been included in the Final EIS.

For accident events, unfavorable meteorological conditions were used to estimate the doses. Under these conditions, all of the released radionuclides were assumed to be deposited within an 80-km radius of the release point. This results in overestimating the possible population doses rather than underestimating them. (See also Response H.2.3.1b.)

n. Comment: The cutoff time for the dose calculations (10,000 years) is arbitrary and too short (Comments 27-22, 28-1); it should be extended into infinite future time (Comment 4-1).

Response: Calculation of doses to infinite time due to this project serves no useful purpose because the all-time background dose to the population is infinite. Based on the 2 person-rem/yr dose (alternative 4b) received by the 1.5×10^6 people at West Valley after 10,000 years, each person would receive an average dose of 1.3×10^{-3} mrem/yr (a negligibly small dose compared to that from natural radiation sources).

o. Comment: Worker health records should be kept before the project starts and after it is completed. (Comment 17-3)

Response: During the project, radiation dosimetry will be performed and worker health records will be kept in accordance with established Department procedures as outlined in DOE Order 5480.1 (U.S. Dep. Energy 1981a). These procedures are also being followed at other Department-contractor sites.

p. Comment: The environmental surveillance program that would be implemented before, during, and after solidification of the West Valley HLW should be clarified. (Comments 8-1, 17-4, 18-1, 33-44)

Response: The environmental surveillance program before and during the project will be designed in accordance with accepted guidelines from the U.S. Environmental Protection Agency (1972--"Environmental Surveillance Guide"), the U.S. Nuclear Regulatory Commission (1975a, 1975b--Regulatory Guides 4.8 and 4.1), the Department of Energy (U.S. Energy Res. Dev. Admin. 1977--"A Guide for Environmental Radiological Surveillance at ERDA Installations"), and the National Council on Radiation Protection and Measurements (1976--"Environmental Radiation Measurements"). Considerations for unusual events (such as a radioactive liquid release from the HLW tanks) will be incorporated into the surveillance program.

The postoperational surveillance program cannot be addressed at this time. In accordance with the West Valley Demonstration Project Act, facilities used in the project shall be decontaminated and decommissioned in accordance with such requirements as NRC may specify. A portion of the postoperational surveillance program would have to be designed to demonstrate compliance with NRC specifications.

H.2.4 Site-Related Comments

H.2.4.1 Geohydrology

a. Comment: Discussion of geology and hydrology in the vicinity of the HLW tanks and surficial soils at West Valley should be expanded. (Comments 6-7, 11-1, 16-5, 19-5, 27-14, 30-1, 31-5, 34-2, 39-2)

Response: The text of Section 3.1 has been expanded to further address the site geology and hydrology.

b. Comment: Analysis of the potential implications of events leading to radioactive contamination of the Cattaraugus Creek watershed and Lake Erie should be included in the EIS. (Comment 6-7, 16-5, 17-4, 19-5, 26-1, 26-2, 27-14, 31-5, 34-2, 37-2, 39-1)

Response: Several catastrophic events leading to the release of large quantities of radioactive materials to Cattaraugus Creek were analyzed; the analysis can be found in Sections 4.1.3 through 4.1.8 of the EIS. Additional details on dose calculations can be found in the 1980 report of Nuclear Safety Associates. The concerns expressed in these comments will be one of the primary bounding conditions in the development of the safety envelope to be established in the Safety Analysis Report (SAR) to be prepared by the Department for this project in accordance with the DOE Order 5481.1A (U.S. Dep. Energy 1981b) prior to operation. Additional information on West Valley and Lake Erie hydrology has been added to Section 3.1.3 of the Final EIS.

H.2.4.2 Nonradiological Impacts

a. Comment: Figure 3.3 in the EIS does not identify the 4-ha (10-acre) site that would be impacted by the proposed action nor does it delineate some of the natural areas discussed in that section. (Comment 33-24)

Response: Figure 3.3 illustrates the location of the lagoons and nearby marsh. It was not intended that this figure be used to locate other natural features discussed in that section. With respect to the 4-ha (10-acre) parcel of land that would be impacted by the proposed action, it is noted in Section 4.2 (Nonradiological Impacts) that the exact location and design details are not yet known, and therefore cannot be shown on the figure. However, it is anticipated that any major facilities constructed for this project would be within the security fence.

b. Comment: Apparent inconsistency was noted between Section 4.2.1.1 and Section 2.1.7 (Table 2.4) regarding construction impacts. (Comment 33-37)

Response: Both statements in the EIS text are correct. The statement in Section 4.2.1.1 refers only to the construction aspects of the two alternatives, whereas the statement in Table 2.4 refers to comparison of the total nonradiological impacts between the two alternatives.

c. Comment: The EIS should evaluate utility impacts for the years in which they will occur rather than assuming past conditions will continue in the future. (Comment 33-38)

Response: Since no detailed design or schedule is available for any of the alternatives, such a detailed analysis is not possible at this stage in the decision-making process. However, utility requirements are expected to be similar to those during operation of the now-defunct fuel-reprocessing facility.

d. Comment: A map of all areas affected by new construction would be helpful. (Comment 33-53)

Response: See Response H.2.4.2a.

e. Comment: Approximate capacities of the existing wells providing water for decontamination should be indicated. (Comment 11-2)

Response: Water used at the West Valley facility comes from two artificial lakes, not from wells as incorrectly stated in the Draft EIS; Section 4.2.1.3 of the Final EIS text has been corrected. These lakes impound about 570 million liters (150 million gal) of water (Nucl. Fuel Serv. 1973).

f. Comment: Questions were raised concerning the potential for migrational releases from land disposal of salt cake. (Comments 27-26, 33-40, 33-42, 38-21, 38-23)

Response: Groundwater migrational releases from the regional disposal facility are considered in Section 4.1.2.5. The estimated characteristics of the salt cake to be generated by this project (if alternative 1a is implemented) would permit land disposal of these wastes in accordance with the provisions of the criteria now being developed by the Department for land disposal of radioactive wastes. The major concern, that of the solubility of nitrates in water, can be compensated for by waste-form improvements and/or engineered land disposal of these wastes as discussed in Section 4.1.2.5 and in the "Final Environmental Impact Statement, Defense Waste Processing Facility" (U.S. Dep. Energy 1982a).

H.2.5 Solid Waste Disposal

H.2.5.1 High-Level-Waste Repositories

a. Comment: The terminal-form alternative (borosilicate glass) should not be implemented since the geologic medium for a repository is not known (Comments 31-2, 37-5); additionally, salt is not a compatible medium with borosilicate glass (Comments 6-2, 12-1, 16-1, 19-10, 27-2). Institutional issues associated with a HLW repository were identified, including: (1) a federal repository does not currently exist (Comment 18-2), (2) finalized HLW regulations from EPA and NRC are pending (Comment 18-3), (3) transportation regulations are subject to future change (Comment 18-4), (4) waste form/package criteria do not exist (Comment 18-5), and (5) the dependability of geologic disposal to provide isolation is not adequate (Comment 28-5).

Response: The decision on waste form and geologic medium for a repository has not yet been made by the Department. However, because of its advanced stage of development, borosilicate glass has been used as a reference waste form in the analysis. The decision on waste form will be made at a later time and will be subject to an appropriate NEPA review. With respect to geologic disposal of HLW, it should be stressed that--as used in this EIS--geologic disposal employs the concept of multiple barriers. Thus, a mined geologic repository will employ three self-supporting and interrelated components to form a complete system for long-term isolation of radioactive wastes: a qualified site, a suitable repository design, and an engineered waste-package system.

The waste-package system assumed in this EIS includes the waste form, canister, overpack, and backfill. The waste-package system is expected to provide a long-term barrier to radionuclide release and transport into the surrounding rock strata. The package system will be evaluated to ensure that, if individual components fail, the package will maintain its ability to act as an effective barrier to radionuclide transport. The Department will prepare a description and analysis of the extent to which the final waste form and container complies with any NRC technical regulations (or proposed regulations) regarding disposal of high-level radioactive wastes in geologic repositories.

Extensive testing and development studies on various individual barrier components of the waste-package system, under expected conditions of geologic isolation, have been in progress for several years. These studies have been conducted in industrial and national laboratories, as well as universities, both in this country and abroad. Most of these studies are not complete, but the data and results generated during the past few years indicate that components of the waste-package system can prevent or minimize releases of radionuclides to the natural system by functioning as effective chemical and physical barriers. Problems specific to a salt repository material (thermal effects, lack of sorption, corrosive brines) have been addressed in general terms by Jenks and Claiborne (1981).

The Department position paper to the NRC rulemaking proceedings on nuclear waste storage and disposal (U.S. Dep. Energy 1980c) also contains an extensive discussion of environmental evaluation of a salt repository. In general, the Department recognizes that some uncertainties exist relative to the performance of salt as a repository medium, and programs are in progress to address these uncertainties. The extensive data obtained to date have not revealed any information about domed or bedded salt that would render it unsuitable as a medium for mined geologic disposal. It should be emphasized that the Department has not selected a repository medium or site and is investigating various geologic media in addition to salt--e.g., basalt, granite, tuff.

This EIS deals primarily with the solidification of the HLW at West Valley; the impacts at a repository are addressed in the EIS but are tiered to the Final EIS for "Management of Commercially Generated Radioactive Waste" (U.S. Dep. Energy 1980b). The environmental impacts at a specific repository are not part of this project but will be considered in a separate NEPA review.

b. Comment: The EIS should provide a description of the containers that will be used for the HLW. (Comments 18-5, 33-7)

Response: Development of HLW canisters is being conducted in conjunction with specific design details of the waste solidification program. As currently envisioned, the HLW canisters will be cylindrical, 0.6 m (2 ft) in diameter by 3 m (10 ft) tall. The canisters will be constructed of a material that is compatible with the host rock formation of the Federal repository that is selected; if the canister material should prove to be incompatible with the repository, the canisters would be provided with an overpack constructed of a compatible material.

A brief description of the currently envisioned canister is given in Section B.2.2 of the EIS.

c. Comment: The availability of a repository to receive the HLW in 1997 was questioned. (Comments 7-4, 18-2, 31-3)

Response: The assumption of the availability of the repository in 1997 was made on the best information available at the time the Draft EIS was prepared and was used in the analysis of environmental impacts (U.S. Dep. Energy 1980c). Currently, the earliest planned availability of the first repository is 1998; availability could be as late as 2001 depending upon the repository medium selected. This 1- to 4-year change in date of availability would not have any significant effect on the impacts discussed in the EIS. There is program planning and proposed legislation to have a repository in place at an earlier date.

d. Comment: The environmental impacts of waste disposal in the repository received limited analysis. (Comment 7-5, 28-5, 33-11)

Response: The environmental impacts of HLW disposal in a geologic repository are addressed in Section 4.1.7 of the EIS. These impacts are based on an analysis prepared for the Final EIS for "Management of Commercially Generated Radioactive Waste" (U.S. Dep. Energy 1980b) but modified for the differences between West Valley wastes and other commercially generated wastes. This tiering approach was used in keeping with the Council on Environmental Quality (CEQ) regulations, 40 CFR Parts 1500-1508 (1508.28), because it "helps the lead agency to focus on the issues which are ripe for decision and exclude from consideration issues already decided or not yet ripe." Detailed analysis of these HLW disposal impacts is beyond the scope of this EIS. Decisions on the location and design of a Federal repository where the HLW would be emplaced will be made at a later date and will be subject to a separate NEPA review.

e. Comment: The spacing requirements for HLW glass canisters from alternatives 1a and 1b were questioned. (Comment 15-14)

Response: Although repository criteria would be less stringent (in terms of quantity of waste per unit area) for alternative 1b than for alternative 1a, it is not clear that the space requirements would differ significantly. Factors such as minimum space requirement, backfill area, etc., could offset the space savings as a result of lower heat loading. More detailed engineering design is required before a definite space requirement can be stated.

H.2.5.2 Low-Level Wastes

a. Comment: How would the disposal of the LLW affect disposal capacity at commercial disposal sites? (Comment 33-4)

Response: The maximum volume of LLW (including salt cake) that would be generated is estimated to be approximately 6,700 m^3 (236,000 ft^3) (see Table B.22 in Section B.4.4.2). This volume represents less than 1% of the commercial disposal capacity currently available. Moreover, most of these wastes would be generated towards the end of the project; it is anticipated that, in the interim, several additional disposal sites--each with a reference capacity of 990,000 m^3 (35 million ft^3) (U.S. Nucl. Reg. Comm. 1981d)--would be established. The effect of the West Valley LLW on commercial disposal capacity is likely to be minor if it is decided to dispose of these wastes at commercial disposal sites.

b. Comment: The disposal of LLW offsite for alternatives 1 and 2 and onsite for alternatives 3 and 4 is inconsistent; further, the alternative of LLW disposal at existing commercial and Department of Energy sites should be considered. (Comment 33-6)

Response: It is consistent to consider the disposal of LLW offsite for alternatives 1 and 2 because the HLW are also disposed offsite. For alternatives 3 and 4, the HLW are disposed onsite and it is therefore reasonable to consider onsite disposal of LLW. However, a final decision on the LLW (onsite or offsite disposal) has not yet been made (see Section 2.2.6).

The existing and future commercial sites are expected to comply with the requirements of the finalized form of the proposed rule, 10 CFR 61. The characteristics of the estimated LLW to be generated by this project would permit land disposal of these wastes in accordance with the requirements of the proposed rule. It can be estimated that the impacts resulting from such disposal would be consistent with the generic impacts estimated in the "Draft Environmental Impact Statement on 10 CFR Part 61, Licensing Requirements for Land Disposal of Radioactive Waste" (U.S. Nucl. Reg. Comm. 1981a).

The environmental impacts associated with LLW disposal at Department of Energy sites would be comparable to those for disposal at commercial sites.

c. Comment: The existing burial grounds at West Valley are not suitable for disposal of LLW, specifically those resulting from this project. (Comments 38-20, 39-4)

Response: The suitability of the NRC-licensed burial ground, the availability of an offsite disposal site, the potential environmental impacts and risks associated with transporting the wastes offsite, as well as costs will be taken into consideration when making any decision about using the NRC-licensed burial ground. The State-licensed burial ground is not being considered for disposal of the LLW generated during the solidification project.

H.2.6 Institutional and Regulatory Concerns

H.2.6.1 Institutional Concerns

a. Comment: Who would bear the burden of responsibility for 100 years of institutional control? (Comment 40-4)

Response: The 100 years of institutional control was assumed for all radioactive facilities, including the entombed tanks. Based on the West Valley Demonstration Project Act and on the Cooperative Agreement between the Department and the New York State Energy Research and Development Authority (October 1, 1980; amended September 18, 1981), "the Department shall surrender the Project Premises and Project Facilities to the Authority on the Project Termination Date, decontaminated and decommissioned in accordance with such requirements as the Commission (NRC) may prescribe; provided, however, that the Authority may (but shall be under no obligation to) agree that certain facilities may be surrendered to it without having been decontaminated and decommissioned." Thus, New York State would have institutional responsibility, and because the project would have been terminated, the State would also have responsibility for costs.

b. Comment: After completion of the solidification project, will the remaining portion of the site meet reasonable criteria for use after a 100-year institutional control period? (Comment 40-7)

Response: The Department has no authority with respect to the remaining portion of the site. This question is a matter between NRC and New York State.

c. Comment: Additional details on the costs for the various alternatives were requested. (Comments 27-10, 33-1, 33-11, 33-22, 40-2, 40-6, 40-12)

Response: According to the CEQ regulations and Department of Energy implementation of these regulations, costs are only required to be included in an environmental statement if cost is relevant to the choice among alternatives. It was determined that cost was not likely to be a major factor in this decision, so no cost information is included in the Final EIS.

d. Comment: There is a need for evacuation plans and cleanup preparedness along the transportation routes. (Comment 25-1)

Response: As discussed in Section 4.1.10, emergency plans will be developed for all transportation of radioactive wastes associated with this project, in cooperation with other Federal agencies and state and local governments.

H.2.6.2 Regulatory Concerns

a. Comment: Is there a conflict of interest for the Department of Energy to prepare the EIS when the project is under Department jurisdiction? (Comment 32-2)

Response: The National Environmental Policy Act requires the lead agency, in this case the Department of Energy, to prepare an environmental impact statement for any major Federal action that may significantly affect the quality of the human environment. The Department has determined that solidification of the West Valley HLW is a major Federal action requiring an EIS.

b. Comment: The failure to thoroughly assess the environmental impacts of the proposed repository undermines the intent of NEPA. (Comment 7-5)

Response: The West Valley EIS is not an appropriate place to go into detailed assessment of the environmental impacts of the repository. These impacts are assessed in the generic EIS on commercial waste management (U.S. Dep. Energy 1980b) and are being further assessed in forthcoming NEPA documents supporting decision-making on the repository program. As recommended by the CEQ regulations for implementing NEPA, the West Valley EIS focuses on the West Valley decision, with reference to NEPA-support documents for the repository.

c. Comment: The EIS should explicitly state what mechanisms the Department will use to comply with NEPA for later decisions. (Comments 33-3, 33-5, 33-23)

Response: The Department has not yet determined the precise type of NEPA documents that will be prepared to provide environmental input to later decisions. Compliance with NEPA will be in accordance with the Department's published guidelines (U.S. Dep. Energy 1980a) and the Council on Environmental Quality regulations (40 CFR Parts 1500-1508).

d. Comment: There is a need for judicial and evidentiary hearings regarding this project. (Comment 5-3)

Response: Neither the West Valley Demonstration Project Act nor the National Environmental Policy Act mention the requirement for judicial and evidentiary hearings. The assessment of radiological health hazards in the EIS, the numerous oral and written comments, the required Safety Analysis Report (SAR), and NRC's review of the project (provided by the Memorandum of Understanding) will be considered by the Department in making informed decisions regarding the protection of public health and safety.

e. Comment: Are NRC regulations 10 CFR 60 or 10 CFR 61 applicable to the waste tanks? (Comments 27-17, 38-12, 38-13)

Response: It is not clear whether the proposed 10 CFR 60 regulations on HLW and the proposed 10 CFR 61 regulations on licensing requirements for land disposal of radioactive wastes will be applicable to the tanks. Furthermore, as noted throughout the EIS, there is uncertainty regarding the level of contamination that might be left in the tanks, and this uncertainty cannot be resolved until the project is actually carried out. The analysis to determine the applicability has not been performed and is beyond the scope of this EIS. Decontamination and decommissioning of the tanks will be addressed in more detail in the late 1980s when an environmental review of the decommissioning of the facilities used in this project, including the tanks, will be performed.

f. Comment: What is the Department response to the U.S. General Accounting Office (GAO) report (1981), "Better Oversight Needed for Safety and Health Activities at DOE's Nuclear Facilities" (August 4, 1981), and its implications for this project? (Comment 27-18)

Response: The Department submitted its formal response to the GAO report to Congress on October 7, 1981. As noted in the GAO report, the Department's record of safety performance has been good and compares favorably with non-Department industries. The report emphasized GAO's preferred process and not the results (e.g., the Department's good health and safety record). The GAO report also did not address recent changes in the Department of Energy's safety and health program that might have affected the report's recommendations. Thus, although the report has no direct implication for this project, the recommendations given in it will be taken into consideration in the West Valley solidification project.

g. Comment: It is probably inconsistent with Federal policy to leave the entombed HLW tanks onsite, making the site a defacto repository, and entombment of buildings is inconsistent with developing NRC decommissioning policy. (Comment 27-17)

Response: The Department shall decontaminate and decommission the HLW tanks and other facilities used for the West Valley Demonstration Project in accordance with such requirements that the NRC may specify, as required by the West Valley Demonstration Project Act. The NRC's "Draft Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities" (U.S. Nucl. Reg. Comm. 1981b) indicates that an important and technically difficult issue is the problem of determining acceptable residual radioactivity levels required for release of property for unrestricted use. A case-by-case analysis of costs (including occupational doses) and benefits will be required to establish appropriate limits. For the West Valley project, this will include consideration of the final disposition of the rest of the site that may remain under restricted use and over which the Department has no control. It is consistent with developing NRC policy that it may be acceptable to leave the entombed tanks and buildings and have restricted use of that part of the site.

H.2.7 Public Information and Attitudes

H.2.7.1 Informing the Public

a. Comment: The Department should provide information to the Cattaraugus County Legislature throughout the project and should also provide a means for the county to give input to the project. (Comment 13-1)

Response: The Department is establishing a public information plan, as noted in Section 4.3.12.2 of the EIS.

b. Comment: Workers, including transportation workers, should be informed of the implications of working in a radiation environment and trained accordingly. (Comments 6-1, 19-2, 25-2, 34-4, 37-6)

Response: The Department is committed to informing and properly training all workers, as noted in the discussion of a worker training/monitoring program in Section 4.5.1.2.

c. Comment: Pertinent references to each chapter of the EIS should be sent to one library in the western New York area. (Comment 27-5)

Response: Copies of all the major references and contractor reports have been placed in the Springville library. The Department has not been directed nor does it believe that the intent of either the West Valley Demonstration Project Act or of the National Environmental Policy Act is to place copies of all references in local libraries. The Department will try to honor reasonable requests to provide library copies of difficult-to-find references.

d. Comment: There is insufficient description of the local economy in Section 3 and a lack of discussion of effects on the local dairy industry. (Comments 27-20, 37-1, 37-8)

Response: As required by the regulations for implementing NEPA, the EIS should be succinct and avoid unnecessary descriptions. In Section 3, the description was limited to what is believed to be necessary to understand the effects of the alternatives discussed in Section 4. As noted in Section 4.2.2.1, the impact on the local economy is expected to be insignificant for any of the alternatives. As noted in Section 4.3.7 (Insurance/Liability), it has been determined by the Department that the project would be covered by the Price-Anderson Act, which allows for automatic coverage of public liability up to $500 million and requires Congressional approval for amounts in excess of $500 million. This would include indemnification for loss of cattle as a result of damage from an accident involving radiation.

e. Comment: Additional Canadian participation should have been performed. (Comment 39-3)

Response: The Department provided a copy of the Draft EIS to the International Joint Commission. The Commission has jurisdiction over Great Lakes boundary waters and any pollution of them. No comments were received from this Commission. Although the publicity West Valley has received over the past several years has made this project publicly known, no interest has been expressed by any Canadian government or public interest group. Also, the EIS analysis shows that the impacts on Canada would be small.

H.2.7.2 Public Attitudes

a. Comment: The EIS should address the presumed impact on population psychological stress associated with immobilization of the wastes. (Comment 38-25)

Response: The EIS focuses on psychological impacts in Section 4.2.2.2 (Indirect Impacts) and Section 4.2.2.3 (Equity). As stated therein, it is not clear which of the alternatives would significantly alter public perceptions of risks with consequent fear. Radioactive wastes would remain at the site, subject to separate government decision-making, under any of the alternatives (e.g., the two burial grounds). Also, there would be risks associated with any of the alternatives; they would simply be unequally distributed with respect to geographic location and time, and between workers and the general population.

b. Comment: The EIS methodology of reducing dose estimates and limiting health effects to those labeled "of concern" causes erosion of public confidence regarding either the technical competence or honesty of the Department of Energy. (Comment 4-12)

Response: The Department notes the comment, but feels that the technical evidence supports its analysis in the EIS. Furthermore, the Department believes that in keeping with the regulations and the intent of NEPA, a reasonable state-of-the-art methodology was applied in estimating impacts of all the alternatives so that input of environmental considerations occurred early in the decision-making process. A more-detailed technical analysis of health effects, using the debatable effects mentioned in the comment, is also unwarranted considering the lack of refinement of the engineering specifications at this early stage in the decision-making process. The uncertainty in the overall comparison of alternatives would not be reduced.

c. Comment: Use of the term "dose receptors" in the EIS shows insensitivity. (Comment 23-5)

Response: The Department regrets the use of this term and does not intend to convey the impression that people are mere numbers. Indeed, a section of the EIS is devoted to a discussion of public perceptions and the question of individual equity (Section 4.2.2). The term "dose receptor" is not included in the Final EIS.

d. Comment: Many citizens asked for hearings in Buffalo and the Department just ignored them. (Comment 16-7, 17-1)

Response: The Department considered a number of locations for public hearings, including Buffalo. After taking into account those persons affected most by this project, it was determined that a meeting at West Valley would be most convenient for the people most directly affected. Oral and written comments received equal consideration; consequently those who were unable to present oral comments were still able to make their views known in writing.

H.3 MAJOR TOPICS DISCUSSED IN PUBLIC HEARINGS AT WEST VALLEY, NEW YORK, SEPTEMBER 26, 1981

Public hearings were held at the West Valley Central School on September 26, 1981, to receive comments on the Draft EIS. The following presents the major topics discussed at these hearings; the topics were extracted from the transcripts of the hearings. Most topics are similar to those contained in the written comments that have been addressed in Section H.2 and, therefore, are referenced by number to the appropriate response in Section H.2. Any topics discussed at the public hearings but not previously considered or accommodated are responded to in this section. The following topics were presented by one or more persons at the public hearings:

- It is not prudent to process the wastes to a terminal form without specific designation of the final repository (see Response H.2.5.1a).

- The technology is sufficiently developed to make a decision on the waste form now (comment noted; no response required).

- The EIS should emphasize the uncertainties about the existing burial grounds at West Valley for disposing the LLW produced by this project, and additional analysis should be provided to support the use of the burial grounds (see Response H.2.5.2c).

- The suitability of entombing the emptied tanks with cement was questioned. Serious discussion should be provided in the Final EIS on how the tanks might be dismantled and removed (see Responses H.2.1.5i and H.2.3.3f).

- Criticality of the HLW as currently stored should be considered (see Response H.2.2.2c).

- The radiological analyses and conversions to health risk were questioned and opinions varied from believing that the risks were essentially zero to believing that the EIS underplayed the risks (see responses in Section H.2.3, Radiological Analysis).

- The method of informing the citizens of Cattaraugus County about the progress of the project was requested (see Response H.2.7.1a).

- The existence of community preparedness plans was questioned, e.g., how people would be informed if there was an emergency (see Response H.2.2.2i).

- Concern was expressed about a radiation study by EG&G showing cesium-137 migration from the burial site. (Response: Technical experts within the Department of Energy and the New York State Department of Health interpret the existing data to indicate that the elevated surface radiation readings to the northwest are probably the result of earlier gaseous releases from the NFS stack. However, since this matter is of such great concern, the Department of Energy will analyze soil samples to precisely determine whether or not there is underground migration of radioactive contaminants.)

- The EIS should address the monetary loss to the farmers and other people in case of an accident (see Response H.2.7.1d).

- There was support for each of the alternatives discussed in the Draft EIS (comment noted; no response required).

- Information pertaining to meteorology, especially air flow and atmospheric dispersion at the West Valley site, are inadequate and should be developed in a site-specific manner. (Response: Meteorological monitoring criteria for the West Valley project are currently being developed. Criteria approved by the Department of Energy will be used to evaluate the existing data base for the West Valley site. New data will subsequently be collected where needed. Safety Analysis Reports required for the project will present meteorological data appropriate to the West Valley site.)

- The appropriateness of using 80 km as a radius for calculating population doses was questioned (see Responses H.2.3.1b and H.2.3.3m).

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APPENDIX I. GLOSSARY

ACTINIDES - Chemical elements with atomic numbers of 89 (actinium) and above.

ALLUVIAL FAN - Fanlike deposit of a tributary stream near or at its junction with its main stream.

ALPHA PARTICLE - A particle emitted from the nucleus in the radioactive decay of certain nuclides. It consists of two protons and two neutrons bound together; identical to the nucleus of a helium-4 atom.

AQUIFER - An underground water-bearing layer of permeable material that can yield significant quantities of groundwater to wells and springs.

BEDDED SALT - Underground layers of mineral rock salt (principally sodium chloride) deposited in horizontal formations of generally uniform vertical thickness.

BETA PARTICLE - A particle emitted from the nucleus during radioactive decay. It is negatively charged and identical to an electron. Beta particles are easily stopped by a thin sheet of metal or plastic. Large amounts of beta radiation may cause skin burns, and beta emitters are harmful if they enter the body.

BIOSPHERE - Life-sustaining portions of the earth, bodies of water, and the atmosphere.

BIOTA - The animal and plant life of a region.

BOROSILICATE GLASS - Glass made primarily of sand and borax. As a waste form, high-level wastes are incorporated into the glass to form a leach-resistant nondispersible (immobilized) material.

BURIAL GROUND - Tract of land where radioactive wastes are buried in shallow trenches or holes.

CALCINE - Material heated to a temperature below its melting point but high enough to dry and oxidize it to a chemically stable form.

CANISTER - An engineered metal container into which immobilized radioactive wastes are sealed.

CASK - A heavily shielded container used to store and/or ship radioactive materials. Lead and steel are common materials used in the manufacture of casks.

CELL - A heavily shielded room designed to house radioactive processing systems.

CENTRIFUGE - A mechanical device using centrifugal force, through rotation, for the separation of materials of different densities.

CERMET - A dense, alloy-like material of ceramic and metal powders, formed under heat and pressure.

COMMERCIAL - Applied in this EIS to wastes and fuels resulting from the production of electric power for public consumption, using nuclear reactors, as distinguished from materials produced from the nuclear national defense program.

CONDENSATE - A liquid, usually water, from an evaporative process, which has been converted from a vapor (steam) to a liquid in a cooling heat exchanger (condenser).

CONTACT, HANDS-ON - Maintenance or operational procedures performed by direct contact (manipulation) by personnel of the equipment.

CRETACEOUS AGE - Last period of the Mesozoic era, about 100 million years ago.

DECAY, RADIOACTIVE - The spontaneous radioactive transformation of a radionuclide into a different nuclide (inert or radioactive) or into the same nuclide with a different energy level. The process results in the emission of nuclear radiation (alpha, beta, or gamma) and in the steady reduction of radiation and heat generation.

DECOMMISSIONING - To remove a facility from service and reduce or stabilize radioactive contamination.

DECONTAMINATION - The selective removal of radioactive material from a surface, area, object, or person. May be accomplished by: (1) treating the surface with liquids or abrasive materials to remove or decrease the contamination; (2) letting the material stand so that the radioactivity is decreased as a result of radioactive decay; and (3) covering the contamination to shield or attenuate the radiation emitted. Also applies to removal of high-level radioactive nuclides from within a material (e.g., decontaminated, low-activity salt cake).

DEFENSE WASTES - Those wastes generated from government defense programs as distinguished from wastes generated by commercial and medical facilities.

DEMOGRAPHY - Study of human population--size, density, distribution, and vital statistics (e.g., age, sex, and ethnicity).

DISPERSION - Release of particulate or gaseous radioactivity into the atmosphere, followed by mixing and transport.

DOMED SALT - Underground structures of mineral rock salt (principally sodium chloride) deposited in vertical formations of generally uniform horizontal width or diameter.

DOSE - Total radiation delivered to a specific part of the body, or to the body as a whole.

DOSE COMMITMENT - The dose that an organ or tissue would receive during a specified period of time (e.g., 50 or 100 years) as a result of intake (as by ingestion or inhalation) of one or more radionuclides from one-year's release.

DOSE EQUIVALENT - A term used to express the amount of effective radiation when modifying factors have been considered. It is the product of absorbed dose (rads) multiplied by a quality factor and any other modifying factors. It is measured in rems (Roentgen equivalent man).

DOSE RATE - Radiation per unit time (i.e., dose per minute, dose per hour) as it is being delivered to the body.

EFFLUENT - Liquid, gaseous, or solid discharges into the environment generated by a process or procedure.

ELUATE - Liquid resulting from removing trapped material from ion-exchange resin.

ENTOMBMENT - As applied to structures, the filling of void spaces with solid, stable material. Complete immobilization of a facility's contamination and subsequent isolation of the facility by burial.

EPICENTER - Area of earth's surface directly above the focus of an earthquake.

ETIOLOGY - All of the causes of an abnormal condition.

EVAPORATOR - An apparatus for the volume reduction of liquid solutions containing dissolved and/or suspended solids. The evaporator utilizes heat to drive off the liquid while leaving behind a much smaller volume with a high solids concentration.

FLUVIAL MATERIAL - Material produced by the action of a water stream.

FRACTIONATE - To separate into different portions, as a liquid mixture stratifying into layers of different densities.

FRIT - A granular, partly fused mixture of sands and fluxes of which glass is made.

FUSED SALT - A monolithic, resolidified salt. It is the interim form assumed for purposes of analysis in this EIS. This form is different from the salt cake, which was assumed to be low-level waste in this EIS.

GAMMA RADIATION - Penetrating high-energy, short-wavelength, electromagnetic radiation (similar to X-rays) emitted during radioactive decay. Gamma rays are very penetrating and require dense materials (such as lead or uranium) for shielding or to be stopped.

GENERIC - Relating to a general group or class.

GENETIC EFFECTS - Radiation effects that can be transferred from parent to offspring. Radiation-induced changes in the genetic material of sex cells.

GEOLOGIC DISPOSAL - Indicates final, permanent isolation of hazardous waste within cavities prepared by mining stable underground formations at depths greater than 300 m (1000 ft).

GROUNDWATER - Water in a zone of saturated aquifer under the land surface.

HALF-LIFE, RADIOLOGICAL - The time in which half the atoms of a radionuclide disintegrate into another nuclear form. Half-lives vary from millionths of a second to billions of years. Also called physical half-life.

HEAD REQUIREMENT - For liquid pumps, the minimum height of liquid above the pump's intake below which the pump will be unable to maintain discharge pressure.

HEEL - In the high-level waste storage tanks, the heel is that amount of waste remaining after a procedure has been performed to remove the sludge from the bottom of the tank.

HIGH-LEVEL WASTES (HLW) - The highly radioactive wastes that resulted from the reprocessing operations at West Valley. Generally it is wastes that come from the operation of the first-cycle solvent extraction system used for the recovery of uranium and plutonium from spent reactor fuels. These wastes contain greater than 99.9% of the nonvolatile fission products and the major portion of transuranium actinides from the spent fuel. The term includes the wastes as originally produced in liquid form and the solid products subsequently formed from the liquid waste.

HORIZONTAL ACCELERATION - A measure of earthquake severity, expressed as surface movement in terms of acceleration due to gravity (g).

HYDRATED - Chemically combined with water.

HYDROLOGIC - Pertaining to the properties, distribution, and circulation of water.

IMMOBILIZATION - Treatment and/or emplacement of radioactive materials so as to impede their movement.

INSTITUTIONAL CONTROL - Management by any governmental body.

INTERIM WASTE FORM - A solid, radioactive waste form suitable for shipment, but not necessarily suitable for final disposal.

INTRUSION - Any action by a person that brings that person in contact with all or part of radioactive wastes so as to produce a radiation dose to that person or to others.

ION EXCHANGE - A chemical process involving the interchange of ions between a solution and a granular solid, usually a synthetic resin or a natural zeolite.

ISOTOPE - Nuclides having the same atomic number (i.e., protons) but different mass numbers (i.e., neutrons).

JOULE-HEATED - A melter in which electric energy is dissipated in molten glass between two immersed electrodes.

LEACH - To remove or separate soluble components from a solid by contact with water or other liquids.

LICENSE - Legal document issued by a government body (e.g., Nuclear Regulatory Commission) indicating compliance, by an applicant, with specified regulations covering the actions proposed by the applicant.

MANIPULATORS - Mechanisms to transmit manual movement from operators outside shielded cells to within the cells.

MONOLITH - A massively solid, uniform casting of material (i.e., glass or fused salt).

NATURAL BACKGROUND RADIATION - Ionizing radiation that is present as a result of natural conditions. It is comprised of cosmic radiation and radiation from naturally occurring, terrestrial radioactive material. In the continental United States, this radiation varies from 60 to 130 mrem/year. In this EIS, a value of 100 mrem/year is used for illustration.

NEUTRALIZED - Indicates a chemically neutral solution; in the case of West Valley "neutralized" high-level waste, however, the solution is highly alkaline, or basic, through addition of an excess of the strong base, sodium hydroxide.

NRC-LICENSED BURIAL GROUND - Formerly used by Nuclear Fuel Services under an NRC license. It is now under the control of the Department of Energy for the duration of the solidification project under an NRC license amendment.

NUCLIDE - A species of atom characterized by a mass number, atomic number, and nuclear energy state.

OCCUPATIONAL DOSE - Amount of radiation received by those occupied with the operation of an activity involving the handling of radioactive material.

OFF-GAS - Gas released from any industrial process.

OVERPACK - Secondary external containment and shielding for packaged radioactive waste.

PARTICULATES - Fine, solid or liquid particles dispersed in air, stack emissions, or water.

PELLETIZE - To produce ceramic-like pellets by mixing calcine with a liquid binder, shaping, and heating.

PERSON-REM - The total radiation dose commitment to a given population; the sum of individual doses received by a population segment.

POPULATION DOSE - Summation of the doses received by all individuals in a specified population in the vicinity of an activity involving the handling of radioactive material.

PUREX PROCESS - A chemical separations process for uranium-based spent reactor fuels.

RADIOLYSIS (RADIOLYTIC) - Chemical decomposition by the action of ionizing radiation.

RADIONUCLIDE - A radioactive nuclide.

REFERENCE PROCESS - The process against which other processes are compared or measured.

REM (ROENTGEN-EQUIVALENT MAN) - A quantity used in radiation protection to express the effective dose equivalent for all forms of ionizing radiation. It is the product of the absorbed dose in rads and factors related to relative biological effectiveness.

REMOTE OPERATION - Carrying out procedures by remote means, i.e., the personnel are separated from the procedures and equipment by a shielding wall.

REPOSITORY - The site and all facilities where radioactive waste disposal takes place.

REPROCESSING, FUEL - The chemical-separations procedure for recovering and purifying the reusable uranium and plutonium in spent nuclear fuel.

RERACKING - Changing the geometry and/or arrangement of spent fuel or containers of radioactive waste in a fuel storage pool so as to maximize the number of containers of waste the pool can hold.

RESIN - A solid organic polymer used in ion-exchange processes.

RETRIEVABLE - Radioactive material in a safe storage mode, packaged and secured in such a way that subsequent removal can be done with ease and minimum environmental impact and personnel exposure.

RISK - Assuming the factors can be quantified, risk equals the consequences of an event multiplied by the probability of the event's occurrence.

SALT CAKE - Crystallized salt(s) just wet enough to adhere in a mass. Primarily nitrates and nitrites resulting from evaporation of decontaminated, liquid high-level wastes.

SCRUBBING SYSTEM (SCRUBBER) - A device for the removal or washing out of suspended particulates or an undesired gas component from process off-gas streams.

SEISMIC - Having to do with the geology of earthquakes and extending to prediction of earthquake frequency and severity.

SINTER - Heating of solid chemical compounds to form a fused conglomerate.

SLUDGE - Insoluble salts and complex colloidal material in alkaline ("neutralized") aqueous solutions that settle out on standing in storage tanks. At West Valley, it refers to the precipitated solids that settled to the bottom of the storage tanks containing the liquid high-level wastes.

SLUICING - The use of high-velocity liquid jets to both agitate in-tank high-level waste and wash down tank internals.

SLURRY - A watery mixture of insoluble matter (e.g., suspension of sludge in liquid during sluicing operation).

SOLIDIFICATION - Conversion of radioactive wastes (normally, liquid) to a dry, stable solid.

SPENT FUEL - Fuel from a nuclear reactor that has been used up to the point of no longer contributing to the fission process.

STOCHASTIC - Involving a random variable--probabilistic.

STRESS CORROSION- Chemical corrosion of metal that is accelerated by concentration of physical stress.

SUPERNATE - The upper, overlying liquid layer of a two-phase system. In West Valley high-level wastes, the relatively solids-free liquid above a layer of precipitated sludge.

SYNROC - High-level solid waste form resembling natural rock, synthetic rock.

TANK FARM - An installation of underground tanks and piping for the storage of liquid radioactive wastes.

TERMINAL WASTE FORM - A solid, radioactive waste form suitable for shipment and final disposal, and compatible with the characteristics of a terminal repository.

THOREX PROCESS - A chemical separations process for thorium-based spent reactor fuels.

TILL - Unstratified glacial drift consisting of clay, sand, gravel, and boulders intermingled.

TRANSURANIC (TRU) ELEMENTS - Chemical elements with atomic numbers greater than 92 (uranium).

TRANSURANIC (TRU) WASTES - Fuel cycle wastes contaminated by materials containing transuranic elements. As used in this EIS, waste material containing more than 10 nanocuries of transuranic elements per gram of wastes.

TREATMENT, WASTE - An operation designed to enhance safety and economy by changing the form or characteristics of radioactive waste.

TRENCH, SHALLOW-LAND BURIAL - A long, narrow excavation with unsupported walls, into which solid radioactive wastes are emplaced and covered with excavated earth.

TRITIUM (H-3) - A radioactive isotope of hydrogen having an atomic weight of 3 (1 proton and 2 neutrons). A weak beta emitter with a half-life of 12.5 years. Because it is chemically identical to natural hydrogen, tritium can easily be taken into the body in any ingestion pathway.

VITRIFICATION - Conversion, by heat and fusion, of materials into glass or glassy substances.

VOLATILES - Constituents of a mixture that evolve as a gas or vapor upon heating.

WATER TABLE - The upper surface of an aquifer.

ZEOLITE - An ion-exchange material, either in natural or manufactured form.

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