July 21, 2000

Ms. Elizabeth A. Lowes, Acting Director
West Valley Demonstration Project
U.S. Department of Energy
Ohio Field Office
10282 Rock Springs Road
West Valley, New York 14171-9799

SUBJECT: SAFETY EVALUATION REPORT ON THE WEST VALLEY DEMONSTRATION PROJECT PRELIMINARY SAFETY ANALYSIS REPORT FOR THE REMOTE-HANDLED WASTE FACILITY

Dear Ms. Lowes:

Enclosed is a copy of our "Safety Evaluation Report on the West Valley Demonstration Project Preliminary Safety Analysis Report for the Remote-Handled Waste Facility," dated June 2000. This report evaluates the information contained in the "Preliminary Safety Analysis Report (PSAR) for the Remote-Handled Waste Facility at the West Valley Demonstration Project," (WVNS-SAR-023, Rev. 0, Draft C), as well as other information supplied by the Department of Energy (DOE) West Valley Demonstration Project (WVDP).

Nuclear Regulatory Commission (NRC) staff has concluded that the construction of the remote-handled waste facility (RHWF) meets the needs of the WVDP, and as designed will not negatively impact the public's health and safety. However, we have some comments that should be considered prior to the radiological operation of the RHWF. The majority of our comments relate to the radiological operation of the RHWF, and are not appropriate for the review of the aforementioned PSAR. DOE may find our comments useful for preparing the final safety analysis report for the RHWF prior to submission to the NRC. Therefore, a response to these questions is not needed at this time.

If you have any question regarding the details of this letter, please contact John Contardi of my staff at (301) 415-6680.

Sincerely,

/RA/

Larry W. Camper, Chief
Decommissioning Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Project M-32

Enclosure: Safety Evaluation Report on the West Valley Demonstration Project
Preliminary Safety Analysis Report for the Remote-Handled Waste Facility

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Larry W. Camper, Chief
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Project M-32

Enclosure: Safety Evaluation Report on the West Valley Demonstration Project
Preliminary Safety Analysis Report for the Remote-Handled Waste Facility

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Enclosure

Safety Evaluation Report on the West Valley Demonstration Project Preliminary Safety Analysis Report for the Remote Handled Waste Facility

A Review of
WVNS-SAR-023, Rev. 0, Draft C

Prepared by the

U.S. Nuclear Regulatory Commission

June 2000

INTRODUCTION

This Safety Evaluation Report (SER) was prepared by the staff of the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Material Safety and Safeguards. The NRC staff has reviewed the information provided in the Preliminary Safety Analysis Report (PSAR) for the Remote-Handled Waste Facility (RHWF) at the West Valley Demonstration Project (WVDP) (WVNS-SAR-023, Rev. 0, Draft C). Based on this review, the NRC staff has determined that the U.S. Department of Energy (DOE) WVDP has described the remote-handled waste facility sufficient to allow the NRC staff to evaluate the facility's: 1) appropriateness; 2) decommissioning; 3) waste form characteristics; 4) design and conceptual operation; and 5) hazard analysis. The purpose of this SER is to evaluate the radiological hazards and impacts the RHWF will have on public health and safety, and also consider potential impacts to the environment and workers.

BACKGROUND

The WVDP was authorized through the 1980 West Valley Demonstration Project Act. The Act gave the DOE the responsibility to solidify, transport, and dispose of the high-level waste (HLW) at the site, and decontaminate and decommission the HLW storage and solidification facilities. This site was the only site to commercially reprocess spent nuclear fuel in the United States. In preparation for the solidification process, the removal of equipment and legacy waste from the reprocessing buildings was required. However, before these waste forms can be disposed of, they must be processed for disposal. Many of these wastes are not suitable for contact handling and must therefore be processed and packaged remotely. The proposed RHWF will serve this purpose. One of NRC's roles under the Act, and other agreements, is to review and comment on Safety Analysis Reports (SARs) for WVDP facilities.

REVIEW METHODOLOGY

The staff separated the review of the RHWF PSAR into several sections: 1) facility appropriateness; 2) waste form characteristics; 3) facility design and conceptual operations; 4) facility decontamination and decommissioning; and 5) hazard analysis. The primary focus of each area was to review the radiological hazards posed by the facility on members of the public. Other considerations evaluated by the staff included the radiological impacts the facility would have on the environment as well as the facility workers.

EVALUATION

Facility Appropriateness

The DOE proposes to use this facility as a means for processing and repackaging of waste that can not be treated at other onsite facilities. DOE provides two primary reasons for the justification of the RHWF. The first reason is that the waste forms intended for the RHWF are too radioactively contaminated to be handled at other facilities. Secondly, current onsite facilities capable of handling the waste may not be able to economically handle the waste in a timely manner. The only onsite facility capable of remotely handling wastes is the vitrification cell. Currently, the vitrification cell is being used for the solidification of HLW from the tank farm. Therefore, use of the vitrification cell for non-solidification operations would have to wait until the solidification campaign is over. Another problem with using the vitrification cell is that extensive modifications may be required for handling a new waste form. Although the staff did

not review the economical impact of creating the RHWF, the staff believes that the project costs of the facility are reasonable and would not represent a burden to the progress of the project. It is not currently known where the repackaged waste will be disposed of. While the staff believes that a once through waste handling procedure should be implemented when possible, requesting the WVDP to demonstrate a once through procedure may be overly burdensome to the project at this time. Therefore, it would not be appropriate for the staff to request the WVDP to demonstrate the ability to meet waste acceptance criteria for a disposal location that may not accept the waste. The staff concludes that the RHWF is appropriate and will provide a facility capable of meeting the operational needs of the site without hindering the progress of the project.

Waste Form Characteristics

The waste forms to be processed through the RHWF vary from low-level waste to transuranic (TRU) waste and even HLW contaminated equipment such as the HLW tank farm pumps and spent nuclear fuel dissolver vessels. Table 1 provides a qualitative description of the expected waste forms. The bounding waste stream is the one originating from the chemical process cell waste storage area (CPC WSA). The isotopic characterization of the wastes from the CPC WSA are provided in Table 2. Due to the nature of the WVDP a similar type of isotopic spectrum would be expected for the other waste forms (e.g. fission products and TRU). Staff considered waste stream 21 to represent the greatest risk for unanticipated accidents. Waste stream 21 consists of dry resins that may be capable of producing explosive gases. The PSAR indicates that the shielded boxes (resins) may potentially be gas tight. This suggests the possibility of an explosive mixture buildup in the waste package. The design features of the RHWF appear adequate for handling a waste package of this type. However, staff feels that this particular waste stream, and the possibility of an explosive scenario, should be further investigated prior to the beginning of radiological operations of the RHWF or at the very least prior to the handling and repackaging of these wastes.

A consistent hazard posed by all the waste is that of penetrating radiation (e.g. high energy gamma rays). The facility is being designed to handle this hazard. For day to day operations the greatest hazards posed by the waste are from direct exposure to penetrating radiation and from the inhalation of airborne radionuclides. These hazards should be minimized through the use of administrative controls and as low as reasonably achievable practices. Therefore, the staff has concluded that the facility as designed is adequate. Other hazards may be delineated by the radiological protection program administered by the DOE and therefore are not necessarily a function of the facility.

TABLE 1. RHWF Waste Stream Description

Waste Stream Number	Waste Stream Description
12	CPC Jumper Boxes (TRU)
13	CPC Jumper Boxes (LLW)
14	CPC Dissolver Vessel Boxes
15	CPC Vessel Boxes (TRU)
16	CPC Vessel Boxes (LLW)
17	Vent Filter Boxes
18	Vent Filter (in cement) Boxes
19	Shield Boxes
20	Shielded Boxes (Dry Active Wastes)
21	Shielded Boxes (Resins)
22	Shielded Drums
23	Waste Tank Farm Pumps
24	Main Plant Closure Wastes

Tal l e l . Waste l l aracteristics l or l l l WSA Wastes

Radionuclide	Inventory (@ year 2003), Ci
^{90}Sr	165
^{137}Cs	181
^{228}Th	0.051
^{232}U	0.0506
^{233}U	0.0796
^{234}U	0.0383
^{238}Pu	11.4
^{239}Pu	3.19
^{240}Pu	2.43
^{241}Pu	70.7
^{241}Am	3.91
^{242}Am	0.027
^{242m}Am	0.0272
^{243}Am	0.017
^{244}Cm	.0354

Facility Design and Conceptual Operation

Although the RWHF facility has one mission, the facility itself has many different operating areas. The staff performed individual reviews for each of these areas: 1) receiving cell; 2) buffer cell; 3) work cell; 4) maintenance area; 5) packaging area; and 6) load-out area.

1. Receiving Cell

The receiving cell is the area where the waste will be delivered to the RHWF. The vehicles transporting the waste will dock at the receiving cell where the waste will be off loaded by a 20-ton overhead bridge crane. A power conveyor system will then move the waste into the buffer cell. The radiological impacts from this portion of the facility are minimal. The greatest radiological hazard posed to workers would be from a waste package structural failure in transit or at the receiving cell. The projected total effective dose equivalent (TEDE) for a structural failure are 0.88 mSv (88.0 mrem) for members of the public and 1.5 mSv (150 mrem) to workers. The probability of a structural failure has been determined to be 0.1 - 0.01 events per year. The radiological evaluation guidelines for an event with a probability of 0.1 - 0.01 events per year is 5 mSv/yr (500 mrem/yr). The off-site radiological evaluation guidelines used by DOE are summarized in Table 3 and are comparable to the limits established in 10 CFR 100.11(a) and EPA protective action guidelines.

The PSAR does not address the possibility of direct radiation exposures to workers in the receiving cell area. The staff believes that with adequate physical controls and detection equipment an overexposure in the receiving area is highly unlikely. The greatest possibility of direct exposure would result from the removal from storage and loading of waste packages onto the transportation vehicle and would therefore not affect the operations or design criteria of the RHWF. The staff has concluded that the design and conceptual operations of the receiving area pose no significant risk to the public, environment, or workers.

Table 3. Site Radiological Evaluation Guidelines

Description	Event Probability (per year)	Radiological Guideline (rem)
Anticipated	10^{-1} - 10^{-2}	0.5
Unlikely	10^{-2} - 10^{-4}	5.0
Extremely Unlikely	10^{-4} - 10^{-6}	25.0
Incredible	$<10^{-6}$	Not Credible

2. Buffer Cell

The buffer cell acts as a containment barrier between the work cell and the receiving cell. The buffer cell has reinforced shielded doors and walls. There are no plausible accident scenarios for this cell that would be more conservative and result in higher exposures than the receiving area or work cell. The primary methods for containment are shielding and ventilation.

Radioactive mobility in the buffer cell is influenced by the ventilation system such that a negative pressure differential is used between the work cell and the buffer cell. Failure of the ventilation system would not result in significant doses to the public or workers. The low doses are driven by the fact that the waste packages in the buffer cell will not be processed in any manner and therefore the source term will be confined in the waste package until transported to the work cell. A roll-up door allows the overhead bridge crane to run between the work cell and buffer cell. The amount of shielding provided by the upper roll-up door may not be sufficient for some types of waste packages. The staff has recommended that DOE consider the possibility of a gamma radiation overexposure scenario for an individual occupying the buffer cell while a high gamma emitting waste package is located in the work cell. The staff does not believe that the lack of shielding for the roll-up door is a flaw in the design but rather an operational constraint that may need to be addressed administratively. The staff has concluded that the design of the buffer cell poses no significant risk to the public, environment, or workers.

3. Work Cell

The work cell is the primary area where waste processing efforts will be made. The construction and operation of the work cell is very similar to a hot cell. The cell is shielded and lined with stainless steel. Any concrete surfaces will be sealed. The incoming waste packages in the work cell will be size reduced and decontaminated as needed. An operating aisle located adjacent to the work cell will allow workers to monitor and remotely perform the necessary work. The majority of the waste will be size reduced and placed into waste package liners for placement into clean waste containers. Under normal operating conditions, the shield walls and ventilation will protect the workers from exposure. In the event that packages containing greater than 10^{12} dpm/100 cm^2 are handled in the work cell, temporary shielding may be required to protect the workers in the facility. DOE has committed to keeping annual doses to workers below 5 mSv (500 mrem). Under special circumstances, higher annual doses may be allowed (e.g. greater than 5 mSv/yr). The expected and unexpected hazards associated with the work cell are relatively small. The expected annual dose to a maximally exposed member of the public under normal operating conditions is 1.7×10^{-6} mSv/yr (1.7×10^{-4} mrem/yr). These off-site dose assessments for members of the public were performed in accordance with 40 CFR Part 61, Subpart H.

The largest dose to a member of the public would result from a criticality accident. The scenario used for the criticality accident assumed a source term based on NRC Regulatory Guide 3.33, *Assumptions Used for Evaluating the Potential Radiological Consequences of Accidental Nuclear Criticality in a Fuel Reprocessing Plant*. This assumed source term is conservative considering that the amount of fissionable material entering the RHWF through its operational lifetime is not expected to be great enough to result in a criticality accident even under worst case conditions, and the probability of this type of accident is considered less than one chance in a million. Nonetheless, the offsite TEDE to a member of the public for a criticality accident assuming a source term from Regulatory Guide 3.33 is 0.16 Sv (16 rem) and 0.26 Sv (26 rem) for onsite workers. DOE does not have radiological criteria for an accident with such low probabilities of occurrence. However, the radiological impact for a criticality accident are below the radiological guidelines for a more frequent accident type, Table 3. Therefore, the radiological impacts from a criticality accident have been found acceptable. The criticality accident represents the bounding hazard scenario. To provide further confidence in the hazard analysis, none of the safety systems were assumed to be functioning at the time of

the accident. Therefore, the staff has found that the design and conceptual operation of the work cell poses no significant threat to the health and safety of the public, environment, or workers.

4. Maintenance Cell

The maintenance cell will be used for maintaining and replacing equipment used in the work cell. No waste packages are expected to be brought into the maintenance cell. The major radiological consideration for the maintenance area is for worker exposure due to fixed contamination on the equipment. As with the buffer cell, there is a possibility of increased exposure to a worker due to gamma radiation from the work cell. DOE is encouraged to address this issue and provide operational measures capable of preventing this from occurring in the final SAR for this facility. As with the buffer cell, the staff does not consider this to be an inadequacy with the design but rather an operational constraint that should be addressed administratively. Provided that the administrative controls are adequately utilized the staff has concluded that there is no significant risk posed by the maintenance cell to workers. Due to the mission of this cell there are no significant hazards presented by the maintenance cell to the public or environment.

5. Waste Packaging and Survey Area

The waste packaging and survey area will be used for packaging wastes such that they may be safely handled in the load out/truck bay. The waste packaging and survey area is where the repackaged waste is transferred out of the work cell and placed into shielded containers. The repackaged waste is also surveyed to insure no radioactive material has contaminated the outside of the waste package. Surveying is also performed to assess the degree of caution required to handle the repackaged wastes. The waste inventory contained in the waste packaging area is expected to be less than in other areas of the facility and lacks a mechanism for releasing radioactive material from the area. Therefore, the staff has concluded that the waste packaging and survey area does not represent a significant hazard to the health and safety of the public or the environment.

6. Load Out/Truck Bay

The load out/truck bay provides for an area where repackaged wastes can be temporarily stored and removed from the facility. The greatest accident hazard posed by this portion of the facility is a fire that occurs with a significant number of waste packages in the load out/truck bay area. The most likely source for the fire would be from the fuel used by the transportation vehicle. The TEDE to a member of the public for a fire in the load out/truck bay would be 3.1 mSv (0.31 rem). This value is well within DOE's evaluation guidelines (Table 3) for a member of the public for an accident of this probability (extremely unlikely). The TEDE to a worker is only slightly higher, 5.1 mSv (0.51 rem), than the TEDE to a member of the public. Therefore, the staff has concluded that the load out/truck bay does not represent a significant hazard to the health and safety of the public or the environment.

Facility Decontamination and Decommissioning

The staff has also reviewed the RHWF in regards to the decommissioning of the facility. The RWHF is being designed to allow for ease of decontamination and decommissioning when the

facility operations cease. The staff has identified four areas that will likely be the most contaminated at the end of the facilities operating period. These four areas are the buffer cell, work cell, ventilation system, and liquid storage tanks. The buffer cell will be built with reinforced concrete. To prevent gross contamination of the concrete from fixed radioactivity the concrete will be sealed such that any contamination on the walls or floor of the buffer cell may be easily decontaminated with little risk to workers. The sealant applied to the concrete will not only allow for ease of decontamination but will also require less removal of contaminated material. The work cell will be lined with stainless steel and non-lined areas will be sealed in a similar fashion as the buffer cell. The stainless steel lined walls will allow for ease of decontamination and removal. The ventilation system will utilize pre-filters in the work cell and will thus minimize the amount of ventilation duct work that is contaminated. The liquid storage tanks will also be placed in sealed vaults and not buried. The staff has concluded that the RHWF has been designed adequately to significantly enhance the decontamination and decommissioning process when the facility requires such actions.

Hazard Analysis

The most significant portion of the PSAR relates to the associated hazards that the use of the facility may represent to the public, environment, and workers. Due to the nature of the material being processed through the RHWF there is little hazard posed by the facility. The hazard analysis performed for the RHWF facility did not take credit for any of the safety equipment installed at the facility. Of the hazard scenarios developed by DOE for the remote handled waste processing activities, only two are directly related to the RHWF. All the other scenarios are accidents that could occur in situations independent of the facility and therefore the use of the facility will only help to decrease the hazard. The two exceptions are a criticality accident and a natural gas explosion in the facility resulting from the leakage of natural gas from the natural gas lines used to heat the air in the facility. The natural gas explosion scenario, even when taking no credit for any safety systems, would result in a calculated TEDE to a member of the public of 5.6 mSv (0.56 rem) and 9.3 mSv (0.93 rem) to a worker. As with the criticality accident scenario, the probability of occurrence for a natural gas explosion is less than one event in a million years. For accident scenarios with such low probability, there are no radiological evaluation guidelines. However, the radiological impacts from a natural gas explosion are within the radiological evaluation guidelines for a more frequent accident, Table 3, and therefore represent an acceptable risk. Taking into account the types of activities planned for the facility (e.g. decontamination methods and repackaging operations), and the type of waste, both activity and form, the use of the RWHF for processing wastes will only provide a net benefit to the site, the environment, and the public. The staff has concluded that the hazards posed by the RHWF are acceptable and will only help to protect the health and safety of the general public.

CONCLUSIONS

The RHWF being designed for the WVDP will be used to process wastes such that they may be disposed of properly. The types of waste involved are generally not suitable for contact handling and thus require remote operations to perform the aforementioned duties. The waste is typically stable, in a solid form, and is not readily mobile. The facility itself will not use any technologies that would significantly change the mobility of the waste. Some decontamination will be required and water washing may be used. The amount of water required for

decontamination purposes is expected to be small and should not result in large quantities of significantly contaminated liquids. The purpose of the PSAR is to allow for construction and cold operations only. A final SAR will be issued prior to radiological startup of the facility. The comments the staff has regarding the RHWF would not prohibit the construction of the RHWF and are therefore submitted as comments that should be taken into consideration prior to the issuance of the final SAR for the RHWF. Thus, DOE does not at this time need to reply or address these comments.

Given the purpose and content of the PSAR, the staff has concluded that there are no safety issues related to the public, environment, or the workers that would prohibit the construction of the RHWF. The staff has also concluded that the RHWF will only provide a net benefit to the mission of the WVDP, the public, environment, and the workers.