SAFETY EVALUATION FOR THE
REQUEST FOR 10 CFR 20.2002 ALTERNATE DISPOSAL APPROVAL
AND EXEMPTIONS FROM 10 CFR PART 30
FOR DISPOSAL OF VERMONT YANKEE POWER STATION WASTE
AT THE U.S. ECOLOGY IDAHO FACILITY
DOCKET NO. 50-271

Background

On January 14, 2016, Entergy Nuclear Operators, Inc (ENO) submitted a request for NRC approval of alternate disposal of waste from the Vermont Yankee Power Station (VY) at the U.S. Ecology Idaho (USEI) facility in accordance with 10 CFR 20.2002 (ML16029A071). The USEI facility is a Resource Conservation and Recovery Act (RCRA) Subtitle C hazardous waste disposal facility permitted by the State of Idaho. The USEI facility is not an NRC-licensed disposal facility. On June 28, 2016, ENO submitted responses to NRC staff's questions on the request (ML16182A035). On August 11, 2016, ENO provided additional information to the NRC (ML16231A028).

The waste included in this 20.2002 request consists of approximately 200,000 gallons (757,000 L) of water associated with the decommissioning of VY and contains low concentrations of fission and activation products resulting from VY operations. The waste will be transported from VY to USEI in tanker trucks, and the water will be solidified with clay at USEI prior to disposal.

To obtain approval for 20.2002 alternate disposals, the NRC requires the licensee to demonstrate that doses will be maintained as low as reasonably achievable (ALARA). The NRC has determined that for 20.2002 alternate disposal approvals this limit requires a licensee to demonstrate that the dose to a member of the public (including all exposure groups) is no more than "a few millirem per year" (see SECY-07-0060, Attachment 1, and NUREG-1757).

On January 14, 2016, USEI submitted letter a request for an exemption from the licensing requirements of 10 CFR 30.3 to allow for the transfer of the waste containing byproduct material to USEI and disposal of the byproduct material at the USEI facility (ML16021A173). Specific exemptions to the licensing requirements of 10 CFR 30.3 are provided for under 10 CFR 30.11. When evaluating 10 CFR 30.11 exemption requests in conjunction with 20.2002 alternative disposal requests, the NRC has applied a similar standard to both reviews. As discussed above, the NRC applies a dose standard of "not more than a few millirem per year" to any member of the public to its 20.2002 alternate disposal reviews.

Source Term

The water that VY intends to dispose is currently stored in the former VY suppression chamber, or the torus. The torus has a capacity of 1.1 million gallons (4.16 million L) and contains water associated with decommissioning. The water in the torus circulated through a torus water

treatment system, which filters and demineralizes the water to minimize suspended solids. The pumps associated with this system are typically run continuously and recirculate the torus volume approximately every three days. In their submittal, ENO stated that the maximum pump flow rate creates minimal disturbance of sediments and that the water for disposal will be pumped from the torus at an elevation that minimizes entrainment of sediment.

In March and April 2016, the contents of the reactor pressure vessel were also drained to the torus. The addition of this water increased the activity in the water and changed the relative amounts of the radionuclides present from that reported in the original VY 20.2002 request. New sampling data and a revised source term were provided in VY's response to the NRC RAI. The water will be mixed with clay prior to disposal at USEI. However, the source term assumed in the analyses (Table 1) was assumed to be equal to the water concentration and credit for dilution with the clay was not taken. A total final volume of waste of 80,000 ft^3 (2.27 x 10^6 L) was assumed to account for the bulking that will occur when clay is added to the water.

Table 1 Radionuclides Potentially Present in VY Waste Water

Radionuclide	Concentration (pCi/g)	Concentration (Bq/g)
Co-58	0.09	0.003
Co-60	6.9	0.255
Cs-137	3	0.111
Fe-55	0.1	0.004
H-3	1870	69.2
Mn-54	0.47	0.017
Ni-63	0.79	0.029
Tc-99	3.89	0.144
U-238	0.38	0.014
Zn-65	1.95	0.072

In the original 20.2002 request, the results of a Part 61 analysis for a water sample was provided and served as the basis for the inventory assumed in the dose assessment initially submitted by ENO. The radiological composition of the water in the torus changed when additional water was added in March and April 2016, so additional analyses were performed. These analyses included an additional Part 61 analysis on a sample from April 2016 that was analyzed by an off-site lab as well as samples that were analyzed by technicians at VY. The sample results from the analyses performed at VY were provided in the RAI responses, while the Part 61 analysis results were provided to the NRC in the August submittal. The inventory assumed in the dose analyses was developed from the sample results (Table 1). In developing the inventory, it was assumed that the final concentration of the clay/water mixture that will be disposed of, will be equal to the concentration in the original water.

The April 2016 Part 61 analysis results were used as the basis for the assumed inventory for Co-58, Fe-55, Mn-54, Ni-63, Tc-99, U-238, and Zn-65. The value of 1870 pCi/g (1,870 pCi/mL) assumed for H-3 was based on the concentration measured in the November 2015 Part 61

analysis that was included in the initial VY 20.2002 request. All subsequent samples had lower H-3 concentrations than the November 2015 sample. For Cs-137, a concentration of 3 pCi/g (3 pCi/mL) was assumed, which was higher than the Cs-137 concentration observed in any of the samples. A concentration of 6.9 pCi/g (6.9 pCi/mL) was assumed for Co-60 based on the measured concentration in a sample obtained on May 12, 2016. This concentration data, provided by ENO as part of the response to the RAIs, show a maximum concentration of Co-60 in the torus of 21.5 pCi/mL in the April 11, 2016 sample. The concentration of Co-60 then decreased in subsequent samples as the torus demineralizers removed corrosion products from the torus.

In the email to the NRC on August 11, 2016, ENO committed to performing a representative sample prior to each shipment of water and confirming that the radionuclide concentrations result in doses that are equal to or less than the doses delineated within the Summary of Project Alternative Disposal Dose Results in the RAI responses submitted on June 28, 2016. This confirmation could be performed by verifying that the radionuclide concentrations are equal to or less than the concentrations assumed in the analysis submitted on June 28, 2016 (i.e., the concentrations in Table 1). Alternatively, the confirmation could be performed by inputting the sample radionuclide concentrations into the Site Specific Dose Assessment Methodology (SSDA) used in the June 28, 2016 submittal and verifying that the dose consequences are equal to or less than the doses delineated within the Summary of Project Alternative Disposal Dose Results included in the RAI responses submitted on June 28, 2016.

Scenarios, Modeling, and Results

The dose evaluation for this 20.2002 request was performed using USEI's Site Specific Dose Assessment Methodology (SSDA). The SSDA was previously reviewed and was approved by the NRC on August 24, 2015 (ML15125A364 and ML15125A466). In its review of the SSDA, the NRC staff concluded that the use of USEI's SSDA methodology was an appropriate method for evaluate future proposed disposals of waste at USEI.

Inputs required to the SSDA data input sheet for the evaluation of a specific disposal action include the volume of waste, type of waste (i.e., soil or debris), method of shipment, whether the waste is bulk or containerized, distance from the project site to USEI, the time required to complete the project, the waste density, the percentage of the waste requiring treatment, and the concentration of the individual radionuclides present in the waste. The only other change made to the SSDA in this request was that the number of trips required for the long-haul truck driver to transport the water to USEI was entered manually rather than being calculated by the spreadsheet. The spreadsheet is designed to calculate the number of trips from the volume of waste disposed. In this case, the volume of waste disposed is more than the volume of waste transported due to the solidification of the waste with clay, so it would not be accurate to calculate the number of trips from the waste volume disposed.

The waste was assumed to be transported and disposed in a single year. The analyses considered the potential dose to USEI workers, the potential dose to the public during transport

from VY to USEI, the post-closure dose at USEI, and the potential dose to inadvertent intruders at USEI.

USEI Worker Dose

The USEI workers evaluated in this assessment include treatment plant truck drivers, truck surveyors, treatment workers, and landfill cell operators (Table 2). The projected dose to the truck surveyors, treatment workers, and landfill cell operators were based on the assumptions and methodology included in the SSDA. The treatment plant truck driver was modeled using the Microshield external dose modeling results from the "Back-End Dray Truck Drivers" because the geometries of the trucks are virtually identical.

Table 2 USEI Job Function Scenario Assumptions

Job Function	Number of Workers in Group	Time (hrs)	Distance (m)	Number of Repetitions per Year
Treatment plant truck drivers	2	0.2	0.6	100
Truck surveyors	8	0.08	1	40
Treatment workers	6	0.75	2	50
Landfill cell operators	4	0.25	1	50

The projected annual dose for the USEI workers was much less than 1 mrem/yr (0.01 mSv/yr) for each of the job functions evaluated (Table 3).

Table 3 Projected USEI Worker Dose

Job Function	Annual Dose mrem/yr (mSv/yr)
Treatment plant truck drivers	7.76×10^{-3} (7.76×10^{-5})
Truck surveyors	2.50×10^{-3} (2.50×10^{-5})
Treatment workers	1.58×10^{-2} (1.58×10^{-4})
Landfill cell operators	8.41×10^{-3} (8.41×10^{-5})

Transport Dose to the Public

The transport dose to the public was evaluated by considering the dose to the truck driver who is responsible for transporting the waste from VY to USEI. Two different geometries were assumed when evaluating the potential dose to the truck driver: an assumed distance of 0.6 m between the waste and the truck driver and an assumed distance of 3.3 m between the waste and the truck driver. The 0.6 meter distance is representative of a day cab without a sleeper cabin, while a distance of 3.3 m is more representative of a truck that has a sleeper cabin. The truck driver was assumed to spend 78.36 hours in the truck. This time includes the time to drive the truck from VY to USEI plus 32 hours of rest that are spent in the truck. The 32 hours includes three nights of sleeping for 8 hours each plus an additional 8 hours of rest during which the driver is assumed to remain in the truck.

Table 4 Transport Dose Job Function Scenario Assumptions

Job Function	Number of Workers in Group	Time (hrs)	Distance (m)	Number of Repetitions per Year
Long-haul truck drivers (0.6 m)	8	78.36	0.6	40
Long-haul truck drivers (3.3 m)	8	78.36	3.3	40

The projected dose to the truck driver assuming a distance of 0.6 m is 3.13 mrem/yr (0.0313 mSv/yr), and the projected dose to the truck driver assuming a distance of 3.3 m is 1.29 mrem/yr (0.0129 mSv/yr).

Table 5 Projected Transport Dose

Job Function	Annual Dose mrem/yr (mSv/yr)
Long-haul truck drivers (0.6 m)	3.13 (0.0313)
Long-haul truck drivers (3.3 m)	1.29 (0.0129)

Post-Closure Dose to the Public

The projected dose to a member of the public and to potential inadvertent intruders was calculated using the SSDA. Three inadvertent intruder scenarios were considered: a construction scenario, a well driller scenario, and a driller occupancy scenario.

Table 6 Projected Post-Closure and Inadvertent Intruder Doses

Scenario	Annual Dose mrem/yr (mSv/yr)
Post-Closure Dose	8.42×10^{-2} (8.42×10^{-4})
Inadvertent Intruder - Construction Scenario	2.01×10^{-1} (2.01×10^{-3})
Inadvertent Intruder – Well Driller Scenario	1.07×10^{-1} (1.07×10^{-3})
Inadvertent Intruder – Driller Occupancy Scenario	1.30×10^{-2} (1.30×10^{-4})

NRC Evaluation of Dose Modeling

The NRC staff reviewed the sample data used to generate the concentrations of radionuclides assumed in the waste. The NRC staff concluded that the concentrations of Co-58, Fe-55, Mn-54, Ni-63, Tc-99, U-238, and Zn-65 were appropriately determined from the April 2016 Part 61 sample analysis. Additionally, the NRC staff concluded that the assumed concentrations of H-3 and Cs-137 were appropriate because they were equal to or higher than the maximum measured concentration. The NRC staff notes that the assumed Co-60 concentration is based on the most recent sample and is less than the maximum observed. It is expected that the Co-60 concentration in the water will decrease as the torus water over time as the water is circulated through the demineralizers. However, sufficient data was not provided to demonstrate that the concentration of Co-60 would be consistently lower than the assumed concentration. To address this NRC concern, ENO committed to performing a representative sample prior to each shipment of water and confirming that the radionuclide concentrations result in doses that are equal to or less than the doses delineated within the Summary of Project

Alternative Disposal Dose Results in the RAI responses submitted on June 28, 2016. The NRC staff finds that this commitment addresses the concern that the Co-60 concentration may be higher than assumed and provides assurance that the actual dose from the waste will be bounded by the dose presented in the 20.2002 request.

The NRC staff finds that the use of the previously approved SSDA methodology is acceptable to evaluate the disposal of the VY waste in the current 20.2002 request at USEI because the waste included in the current request is consistent with the waste characteristics and assumptions considered in the SSDA methodology. The NRC staff further finds that the job functions considered and parameter values selected for USEI workers are appropriate because they represent the workers that would be exposed. The hours and number of trips for the truck driver appropriately bound the amount of time required to transport the waste from VY to USEI. The potential dose to a member of the public during transportation is bounded by the long haul truck driver scenario that assumes a distance of 0.6 m between the waste and the driver. The NRC staff concludes that the potential dose estimated using a distance of 3.3 m between the waste and the driver more accurately represents the configuration of the truck.

The NRC staff concludes that the projected doses for all scenarios are consistent with "a few millirem per year" criteria for 20.2002 requests and are ALARA. The projected doses were much less than 1 mrem/yr (0.01 mSv/yr) for all scenarios except for the potential dose during transport. The dose during transport was slightly above 1 mrem/yr (0.01 mSv/yr) when assuming a distance of 3.3 m between the waste and the driver and was is 3.13 mrem/yr (0.0313 mSv/yr) when assuming a distance of 0.6 m between the waste and the driver. The scenario in which the driver spends the entire time of 78.36 hours at a distance of 0.6 m from the waste is not a likely scenario. If the truck only had a day cab and did not have a sleeping compartment, it is more likely that the driver would probably spend their rest times outside the cab.

Conclusions

ENO requested that NRC approve alternate disposal, in accordance with 10 CFR 20.2002, of 200,000 gallons (757,000 L) of water associated with the decommissioning of VY at the USEI facility near Grand View, Idaho. ENO has provided an adequate description of the waste to be disposed of and the proposed manner and conditions of waste disposal. ENO further committed to performing a representative sample prior to each shipment of water and confirming that the radionuclide concentrations result in doses that are equal to or less than the doses delineated within the Summary of Project Alternative Disposal Dose Results in the RAI responses submitted on June 28, 2016.

The NRC staff concludes that the use of the SSDA methodology to evaluate the projected dose from the disposal of the waste included in this request is acceptable. The NRC staff reviewed the input parameters including in this modeling and found that they are appropriate for the scenarios considered. The NRC staff has evaluated the potential doses associated with transportation, waste handling and disposal as a part of the review of this 10 CFR 20.2002

request. As described above, NRC staff found that the projected doses to individual transportation and USEI workers have been appropriately estimated and are demonstrated to meet the NRC's alternate disposal requirement of contributing a dose of not more than "a few millirem per year" to any member of the public and are ALARA. The NRC staff also concluded that the projected doses from the post-closure and intruder scenarios are also within "a few millirem per year" over a period of 1,000 years.

When evaluating 10 CFR 30.11 exemption requests in conjunction with 20.2002 alternative disposal requests, the NRC has applied a similar standard to both reviews. The NRC staff therefore also concludes that, in accordance with 10 CFR 30.11, this material for disposal will not endanger life or property or the common defense and security and disposal is otherwise in the public interest.