



NorthStar Nuclear Decommissioning Co., LLC
Vermont Yankee Nuclear Power Station
320 Governor Hunt Rd.
Vernon, VT 05354
802-451-5354

Corey R. Daniels
ISFSI Manager

10 CFR 20.2002

BVY 20-007

May 20, 2020

ATTN: Document Control Desk,
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: 10 CFR 20.2002 Request for Alternate Waste Disposal at US Ecology, Idaho
Vermont Yankee Nuclear Power Station
Docket No. 50-271
License No. DPR-28

- REFERENCES:
1. Letter, Entergy Nuclear Operations, Inc. to USNRC, "10 CFR 20.2002 Request for Alternate Disposal at US Ecology Idaho," BVY 16-001, dated January 14, 2016 (ML16029A071)
 2. Letter, Entergy Nuclear Operations, Inc. to USNRC, "Response to Request for Additional Information Related to 10 CFR 20.2002 Alternate Disposal at US Ecology Idaho," BVY 16-021, dated June 28, 2016 (ML16029A071)
 3. Letter, USNRC to Entergy Nuclear Operations, Inc., "Vermont Yankee Nuclear Power Station – Request for 10 CFR 20.2002 Alternate Disposal at US Ecology Idaho," (NVY 17-011), dated June 20, 2017 (ML17087A178)

Dear Sir or Madam:

In accordance with 10 CFR 20.2002, "Method for obtaining approval of proposed disposal procedures" NorthStar Nuclear Decommissioning Co., LLC requests NRC approval of alternate waste disposal at the US Ecology, Inc (USEI) Resource Conservation and Recovery Act (RCRA), Subtitle C hazardous waste disposal facility located near Grand View, Idaho. The waste will consist of approximately 2,000,000 gallons of low-activity radioactive wastewater containing byproduct material from activities associated with the decommissioning process at Vermont Yankee Nuclear Power Station (VY).

VY is collaborating with USEI on this request. Since the USEI facility is not an NRC-licensed disposal facility, USEI will submit under separate letter a request for an exemption pursuant to 10 CFR 30.11 to allow for the disposal of the byproduct material at the USEI facility. Attachment 1 to this letter provides a conservative radiological assessment of the planned disposal and a description of the waste material. The description includes the physical and

EDD-01
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NRR

chemical properties important to risk evaluation, along with the proposed manner and conditions of waste disposal.

This request is similar to our previous request for alternate disposal to the same USEI facility by letter dated January 14, 2016 (Reference 1), as supplemented by a letter dated June 28, 2016 (Reference 2). The NRC approved that request in a letter dated June 20, 2017 (Reference 3). The primary difference between our previous request and this submittal is the volume of the material to be disposed and the acknowledgement that the transportation of the material will occur via rail rather than by roadways.

The new regulatory commitments contained within this submittal, pending approval, are contained in Section 6 of Attachment 1.

Should you have any questions concerning this letter, or require additional information, please contact Mr. Thomas B. Silko at (802) 451-5354, Ext 2506.

Sincerely,



CRD/tbs

Attachments:

1. Evaluation in Support of 10 CFR 20.2002 Request for Alternate Waste Disposal.
2. USEI Site-Specific Dose Assessment Workbook - Data Input Worksheet.
3. USEI Site-Specific Dose Assessment Workbook - Summary of Project Disposal Dose Results.

cc: Regional Administrator, Region 1
U.S. Nuclear Regulatory Commission
2100 Renaissance Blvd, Suite 100
King of Prussia, PA 19406-2713

Mr. Jack D. Parrott, Senior Project Manager
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Mail Stop T-5A10
Washington, DC 20555

Ms. June Tierney, Commissioner
Vermont Department of Public Service
112 State Street – Drawer 20
Montpelier, Vermont 05602-2601

Attachment 1

Vermont Yankee Nuclear Power Station

Evaluation in Support of 10 CFR 20.2002 Request for Alternate Waste Disposal

VERMONT YANKEE NUCLEAR POWER STATION
EVALUATION IN SUPPORT OF 10 CFR 20.2002 REQUEST FOR ALTERNATE WASTE
DISPOSAL
DOCKET NO. 50-271

1. INTRODUCTION

NorthStar Nuclear Decommissioning Co., LLC requests NRC authorization for alternate disposal of certain low-activity waste containing byproduct material from Vermont Yankee Nuclear Power Station (VY) at the US Ecology, Inc (USEI) Resource Conservation and Recovery Act (RCRA), Subtitle C hazardous waste disposal facility located near Grand View, Idaho. VY is collaborating with USEI on this request. USEI will submit a request for exemption to 10 CFR 30.11 to allow for disposal of byproduct material at the USEI facility under a separate letter. The authority of 10 CFR 20.2002 and the exemptions requested from 10 CFR 30.11 licensing requirements for byproduct material would allow VY to transfer these wastes to the USEI facility for disposal.

The dose evaluation for this request for alternate disposal was performed using US Ecology's NRC-Approved *Site Specific Dose Assessment Methodology (SSDA)*, Revision 3 for USEI (Reference 1). The SSDA provides a consolidated dose assessment framework for all occupational, transportation, and post-closure dose receptors required in 10 CFR 20.2002(d) - "*Analyses and procedures to ensure that doses are maintained ALARA and within the dose limits in this part.*" The information provided in the SSDA as well as the Safety Evaluation Report and Environmental Assessment produced by the NRC serve to satisfy the requirements in §20.2002(a), (b), and (c). The NRC approved the SSDA for use on September 20, 2018 (Reference 2).

Characteristics and operating parameters of the USEI disposal site are summarized in Section 2 of this Attachment. Environmental conditions at the USEI site are well documented in previous submittals to the NRC, including the Hematite decommissioning Project (Docket #07000036) and the Humboldt Bay Nuclear Power Plant Decommissioning Project (Docket #50-133).

A description of the material to be disposed is included in Section 3. The material description includes physical and chemical properties of the material important to risk evaluation and the proposed conditions of waste disposal. The SSDA Data Input Worksheet with all of the project inputs for the VY wastewater project is provided in Attachment 2. Results of the SSDA dose evaluation are summarized in Attachment 3 for all occupational and transportation workers as well as postulated members of the public based on USEI's ResRad model (Ver. 6.5) and Inadvertent Intruder Scenarios described in NUREG-0782, "Draft Environmental Impact Statement on 10 CFR Part 61 Licensing Requirements for Land Disposal of Radioactive Waste," and NUREG/CR-4370, "Update of Part 61 Impacts Analysis Methodology - Methodology Report." The conclusion confirms doses to workers and members of the public will be well below NRC limits.

Shipments under this alternate disposal request (ADR) are expected to be made over two (2) calendar years.

2. DISPOSAL SITE CHARACTERISTICS

The USEI site is located in the Owyhee Desert of southwestern Idaho. It is at the end of Lemley

Road, approximately 17 kilometers (10.5 miles) northwest of Grand View, (Owyhee County) Idaho. Grand View has a population of approximately 340. Owyhee County is a ranching and agricultural area of approximately 19,900 square kilometers (7,678 square miles). The county is sparsely populated, with an average population of 0.5 people per square kilometer.

This region has an arid climate with an average annual precipitation rate of 7.4 inches. The USEI site is located on a 1.6 kilometer (1 mile) wide plateau. Maximum surface relief on the facility is 27 meters (90 feet) and the mean surface elevation is 790 meters (2,600 feet) above sea level. The nearest residence is 1.6 kilometers (1 mile) southwest of the site. There are no other land uses in the immediate vicinity of the site.

The operational performance characteristics of the USEI site have been reviewed by the NRC and determined to be protective within the NRC 's "*less than a few millirem (mrem) per year*" policy for Alternate Disposal Requests first stated in NRC Regulatory Issue Summary (RIS) 2004-08, "Results of the License Termination Rule Analysis," and reaffirmed in SECY-07-0060, "Basis for Justification and Approval Process for 10 CFR 20.2002 Authorizations and Options for Change." The NRC has granted USEI several 10 CFR 30.11 byproduct material exemptions for purposes of disposal of various licensee waste streams. Two key documents are referenced from previous NRC submittals:

- Hazardous Waste Facility Siting License Application for Cell 16 (American Geotechnics, dated June 30, 2006); This document describes USEI's environmental setting and was accepted by the Idaho Department of Environmental Quality (IDEQ) as part of the 2005 siting process, which resulted in IDEQ approval (December 6, 2006) of USEI's request to expand its landfill operations (ADAMS Accession No. ML100320540 - Attachment 7).
- Summary of Hydrogeologic Conditions and Groundwater Flow Model for US Ecology Idaho Facility, Grand View, Idaho (Eagle Resources, dated January 13, 2010. This document provides a detailed description of USEI's site geology and hydrogeology (ADAMS Accession No. ML101170554 - Exhibit B).

3. DESCRIPTION OF THE WASTE

The subject waste consists of approximately 2,000,000 gallons (~267,000 ft³) of water associated with decommissioning of VY. The subject water is comprised of plant process water and infiltration water. The wastewater being considered under this request will include fission and activation products resulting from VY operations. The waste concentrations are expected to be low. Water is assumed to have a density of 1.0 g/cc. Given the two-year project schedule, VY will be able to ship up to 1,000,000 gallons in a calendar year. While the radiological characterization of the waste stream was performed through routine sampling and analysis of project waste materials as part of VY's 10 CFR 61 characterization program for plant process water, the assumed waste concentration for this request has been purposefully selected at a higher level. The evaluated waste concentrations have been selected to bound what may be experienced at the station as a result of ongoing demolition activities including reactor vessel segmentation and removal. A comparison of the primary radiological constituents between the waste concentrations of plant process water (Measured Concentration) and the concentrations of waste evaluated in this submittal (Evaluated Concentration) is shown in the below table.

Table 1: Measured vs. Evaluated Radiological Concentrations

Radionuclide	Measured Concentration (pCi/ml)	Lab MDC (if applicable) (pCi/ml)	Evaluated Concentration (pCi/ml)
Co-58	<MDC	.61	1.00
Co-60	437.00	N/A	500.00
Cs-137	49.3	N/A	75.00
Fe-55	<MDC	.73	50.00
H-3	1220	N/A	1300
Mn-54	<MDC	5.03	10.00
Ni-63	33.3	N/A	50.00
Tc-99	<MDC	1.47	5.00
U-238	<MDC	.04	1.00
Zn-65	<MDC	16.1	30.00

The wastewater will be solidified with clay at USEI and disposed as a soil-like waste upon receipt. The liquid solidification process at USEI is routinely used for applicable shipments. A limit of 1,000,000 gallons is conservatively assumed to be transported in a single year, since actual shipments will indeed be lower. To account for the solidification process at USEI, a total waste mass for the entire project of 4.25E+07 pounds (lb) was entered into the SSDA workbook to account for the 'bulking' that will occur from the clay used to solidify the water (a bulking factor of 2.5 is used in the SSDA). For conservatism, the wastewater concentrations were kept at the Evaluated Concentrations discussed above and not diluted by the clay.

All shipments will have radioactivity concentrations well within the levels allowed in the site Waste Acceptance Criteria set forth in USEI's permit issued by the Idaho Department of Environmental Quality. The actual concentrations in the water shipments at the time of disposal will be reduced through the solidification process.

As part of this submittal, VY commits 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 attached Summary of Project Alternative Disposal Dose Results. This confirmation could be performed by verifying that the radionuclide concentrations are equal to or less than the concentrations evaluated in the analysis (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 this submittal and verifying that the dose consequences are equal to or less than the doses delineated within the attached Summary of Project Alternative Disposal Dose Results. These dose assessment calculations would be documented and maintained on site under the records retention requirements of 10 CFR 20.2108 and be available for inspection by the NRC.

4. RADIOLOGICAL ASSESSMENT

As described in the following exposure scenarios, the dose equivalent for the Maximally Exposed Individual (MEI) has been demonstrated to not exceed "a few mrem per year." The standard of a "few mrem per year" to a member of the public was first set forth in NRC

RIS 2004-08, "Results of the License Termination Rule Analysis" and confirmed in NRC's Revised Guidance for Reviews of Proposed Disposal Procedures of Radioactive Material under 20.2002 (Reference 3). The transportation workers and USEI workers are treated as members of the public because the USEI site, while permitted by the State of Idaho under RCRA to accept certain radioactive materials, is not licensed by the NRC.

External exposure assessments in the SSDA were performed using MicroShield Code, Version 7.02. Evaluations of potential external and internal dose hazards are discussed in the sections that follow while all inputs to the SSDA workbook are provided in Attachment 2. A summary of total estimated doses for all transporters, as well as USEI workers performing surveying, handling, treatment and disposal tasks on the VY waste is provided in Attachment 3.

4.1 Transport Dose to the Public

All materials will be transported by rail to the USEI rail transfer facility located in Mayfield, Idaho. All conveyances will be verified to comply with DOT external loose surface contamination limits prior to shipment. Because of the very low average concentrations of radionuclides, rail transport will not pose the potential for internal dose to the train conductors or other members of the public.

It is noted that following receipt of the water at the USEI rail transfer facility, the water would be transferred into tanker trucks for the final ~35 mile drive to the USEI disposal facility (referred to as 'Back-End Dray'). The Back-End Dray utilizes a standard tanker truck and is modeled in the SSDA and discussed below, as this constitutes USEI worker dose.

4.2 USEI Worker Dose Assessment

Upon receipt of the water at the rail transfer facility, the material will be surveyed and screened prior to transporting the waste to the stabilization facility on the USEI site. Twenty minutes is required to perform a survey of each rail tanker car (Gondola Railcar Surveyors). Based on current practice, a surveyor is assumed to stand at a distance of one meter from the tanker during the survey, with four surveyors sharing the task. External dose (i.e. total dose) to each surveyor is estimated to be 1.23 mrem/year. The SSDA uses the same model for 'Gondola Railcar Surveyors' as for the Rail Tankers.

Following receipt of the water at the USEI rail transfer facility, the water would be transferred into tanker trucks for the final ~35 mile drive to the USEI disposal facility (referred to as 'Back-End Dray'). The Back-End Dray utilizes a standard tanker truck and is modeled in the SSDA with the results identified in the Summary of Doses in Attachment 3. For shipments of water to USEI, the Back-End Dray doses are calculated using the 'Tanker Truck Driver - Drive Time' line in the SSDA Dose Summary tab (4.90 mrem/year). This calculation was performed in this manner since the tankers used for back-end dray are identical to those used for long-haul water shipments.

For the purposes of this assessment, it is conservatively assumed that all wastewater from VY will require treatment (via solidification) for incoming water shipments. All water shipments will require solidification with clay soils before burial in the landfill. After surveying, the wastewater is delivered to the solidification area by the tanker truck driver. The waste to be treated will be placed into a steel pan where it will be mixed with dry clay. The stabilization process requires

approximately 45 minutes, during which time the excavator operator, who is in an enclosed cab and wearing a respirator, is approximately 2.8 meters from the waste. Six operators share the stabilization task. External dose to each stabilization operator is estimated to be 3.89 mrem/year (Treatment Workers).

Personnel who work in the stabilization area may also be exposed to airborne activity from "dusting." Significantly, all USEI employees who work with any hazardous materials are required to participate in an Occupational Safety and Health Administration (OSHA) compliant respiratory protection program. Although this proven form of protection is required, conservatively no credit is taken in the internal dose assessment. Internal dose to each stabilization operator (Treatment Workers) is estimated to be $3.19\text{E-}03$ mrem/year.

After stabilization, the excavator operator (also modeled as Treatment Workers) removes the treated waste from the stabilization tank and places into an on-site haul truck for transport to the disposal cell for burial. Water that has been solidified is transferred from the treatment pans into an awaiting dump truck for transit to the landfill for disposal. Each dump truck can carry 25 tons of solidified waste to the landfill per trip. Average transit time from the Treatment Plant to the landfill is 10 minutes. Two drivers perform this task at USEI with each assumed to receive equal portions of the total project dose. The VY project will require 504 trips/year between the Treatment Plant and the Landfill to dispose of the 10,500 tons/year of solidified water (and clay). The expected total effective dose equivalent (TEDE) to each truck driver (Treatment Plant Truck Driver) is 1.63 mrem/year.

After delivery to the disposal cell, a bulldozer operator wearing a respirator within an enclosed cab, spreads and compacts the waste. External dose is calculated for the two bulldozer operators who share the task of spreading and compacting the stabilized waste material once it has been deposited within the disposal cell. The average time to spread and compact 50 tons of material (which is the capacity of 2.5 Intermodal Containers) is 15 minutes. Personnel working in the disposal cells are also required to wear air purifying respirators at all times. Again, no credit is taken for this proven form of protection and internal dose is estimated to be $3.40\text{E-}03$ mrem/year. The estimated total dose to each disposal cell operator (Landfill Cell Operator) is 4.61 mrem/year.

4.3 Post Closure Dose to the General Public

USEI's RCRA permit requires that it demonstrate that no person will receive an annual dose exceeding 15 mrem/year total effective dose equivalent (TEDE) for 1,000 years after closure of the facility. This standard is more restrictive than the annual 25 mrem/year TEDE as stated in 10 CFR 20.1402 for NRC license termination, as well as the limits for near surface disposal of low-level radioactive waste set forth in 10 CFR 61. RESRAD code Version 6.5 was used for modeling the Grand View site for potential long-term post-closure doses. A number of default parameters in the Grand View model have been replaced with site-specific parameters consistent with the facility's 2005 permit modification and a report prepared by its consultant (previously submitted to the NRC as part of an RAI response for the exemption request for the Westinghouse Hematite project, Docket #070-00036).

The SSSA contains a screening RESRAD model to assess the impact of the solidified VY waste on the USEI site. The model is consistent with USEI's post-closure dose model included in the Part B RCRA permit, which assumes that all of the VY waste is distributed evenly within the contaminated zone (area = $88,221\text{ m}^2$, depth = 33.6 m). 'Screening' in the SSSA means that all

nuclides are evaluated at their peak dose-to-source ratio regardless of when it occurs. The radionuclide concentrations in Attachment 2 are automatically adjusted in the SSDA Workbook to reflect aggregation into the entire landfill volume, resulting in a dilution factor of $5.9E-02$. All other RESRAD code parameters remain the same. The results of the screening model show a maximum annual dose of $9.41E-01$ mrem/year. Due to the very low dose projection from the screening model, a separate project-specific dose model was not necessary.

Three post-closure inadvertent intruder scenarios were also conducted using the framework from NUREG-0782, "Draft Environmental Impact Statement on 10 CFR Part 61 Licensing Requirements for Land Disposal of Radioactive Waste," and NUREG/CR-4370, Volume 1, "Update of Part 61 Impacts Analysis Methodology" built into the SSDA. These scenarios include:

- **Intruder Construction Scenario** - An inadvertent intruder may excavate or construct a building on a disposal site following a breakdown in institutional controls. Under these circumstances, dust will be generated from the application of mechanical forces to the surface materials (soil, rock) through tools and implements (wheels, blades) that pulverize and abrade these materials. The dust particles generated may then be entrained by localized turbulent air currents and thus become available for inhalation by the intruder. The intruder may also be exposed to direct gamma radiation resulting from airborne particulates and by working directly in the waste-soil mixture. The Construction Worker scenario uses the Air Uptake and Direct Gamma Exposure pathways to estimate a total dose to the intruder.
- **Intruder Well Drilling Scenario** - An intruder accesses the site and develops a well. The intruder is exposed to contaminated drill cuttings spread over the ground surface and contaminated airborne dust. The scenario presented in NUREG/CR- 4370 was modified to exclude consideration of exposure to cuttings in a mud pit due to the standard practices in the area around the waste site. The assumption that drill cuttings are spread over the ground will result in higher dose estimates than if the cuttings were assumed to be in a mud pit because of the decrease in the shielding factor. The driller is assumed to work on site for a period of 40 hours and it is assumed that the contaminated layer is drilled through in 8 hours. As such, it is assumed that driller is exposed to the undiluted cuttings for 8 hours and to diluted material for the balance of the exposure duration. The dilution is calculated based on the ratio of the depth of the waste layer to the total well depth. No dilution in the USEI landfill is assumed. The Well Driller scenario includes contributions from Internal and External dose to the intruder.
- **Intruder Driller Occupancy Scenario** - An inadvertent intruder occupies the site upon which a well had been drilled through waste materials. The Driller Occupancy Scenario uses the same concentrations in the exhumed well cuttings (C_w') as the Well Driller scenario. The Driller Occupancy scenario uses the Air Uptake and Direct Gamma Exposure pathways to estimate a total dose to the intruder.

No credit was taken for dilution of the radionuclide concentrations in any of the intruder calculations. The estimated inadvertent intruder doses are therefore 7.67 mrem/year for the Construction Scenario, 7.20 mrem/year for the Well Driller Scenario, and $4.98E-01$ mrem/year for the Driller Occupancy Scenario (section 'd' of the SSDA included as Attachment 3). The inadvertent intruder doses are not intended to be applied to the "less than a few millirem," (i.e. <5 mrem/year) criteria for ADRs. These calculations are provided by VY / USEI as a

supplemental post-closure evaluation. All of these values satisfy USEI's RCRA permit in that no person will receive an annual dose exceeding 15 mrem/year total effective dose equivalent (TEDE) for 1,000 years after closure of the facility. These values also satisfy the annual 25 mrem/year TEDE limit as stated in 10 CFR 20.1402 for NRC license termination, as well as the limits for near surface disposal of low-level radioactive waste set forth in 10 CFR 61.

5. CONCLUSION

VY developed this request and related evaluation in consultation with USEI, including health physics personnel responsible for the Grand View disposal facility's waste acceptance and radiological performance assessment programs. This assessment team performed a radiological dose assessment of the material to be shipped and determined that the potential dose equivalent for the Maximally Exposed Individual involved in the transportation and placement of the material will not exceed "*a few mrem per year.*"

The radiological assessment of the potential dose to members of the general public after site closure is less than eight mrem per year TEDE for 1,000 years after closure of the facility. This dose is a fraction of USEI's RCRA permit limit of 15 mrem/year TEDE as well as a fraction of the NRC's 25 mrem/year TEDE limit as stated in 10 CFR 20.1402 for license termination.

6. COMMITMENTS

VY commits that the total amount or quantity of water to be transported under this request will be limited to 2,000,000 gallons.

VY commits that the maximum quantity of water to be transported under this request will be limited to $\leq 1,000,000$ gallons in any calendar year.

VY commits to perform a representative sample prior to each shipment of water and confirm 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 Attachment 3 of this submittal. This confirmation can be performed by verifying that the radionuclide concentrations are equal to or less than the concentrations assumed in this analysis (i.e., the concentrations identified in the Data Input Worksheet of Attachment 2) or, the confirmation can be performed by inputting the sample radionuclide concentrations into the SSDA, used in this 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.

VY commits that the dose assessment calculations will be documented and maintained on site under the records retention requirements of 10 CFR 20.2108 and be available for inspection by the NRC.

7. REFERENCES

1. Letter, US Ecology, Inc. to USNRC, "Review of Revision 3 of US Ecology's Site Specific Dose Assessment Methodology," dated August 4, 2017 (ML17230A221)

2. Letter, USNRC to US Ecology, Inc., "US Ecology, Inc. – Technical Evaluation Report of Revision Three of US Ecology's Site Specific Dose Assessment Methodology," dated September 20, 2018 (ML18164A070)
3. USNRC Document, "Guidance for the Reviews of Proposed Disposal Procedures and Transfers of Radioactive Material under 10 CFR 20.2002 and 10 CFR 40.13(a)," Division of Decommissioning, Uranium Recovery, and Waste Programs, Office of Nuclear Material Safety and Safeguards, April 2020 (ML19295F109)

Attachment 2

Vermont Yankee Nuclear Power Station

USEI Site-Specific Dose Assessment Workbook - Data Input Worksheet

USEI Site-Specific Dose Assessment Workbook
Data Input Worksheet

Rev. 3

Date: 1/28/2020

Customer: Northstar
Project: Vermont Yankee Torus and Infiltration Water - 2M gal by Rail

Section I - Waste Stream Information	
Is the SSDA being used for the MPF?	No
Maximum annual dose assumed for assessment (mrem/yr):	5
Volume of waste [cubic feet (ft ³):	272,109
Volume of waste [cubic yards (yd ³):	10,078
Volume of waste [cubic meters (m ³):	7,703
Does waste primarily consist of Soil, Debris, a Mix of Soil/Debris, or Water?	Water
Will shipments be made by rail, truck, or a combination of both?	Rail
If Both, how many miles of front-end dray are required? (N/A if direct shipped)	0 0
Is waste containerized or will it be shipped as bulk?	Bulk
If 'Containerized', is it being shipped in an intermodal, B-25 box, or drum? N/A if 'Bulk'	N/A
If shipped direct via truck or tanker, how many miles from project site to USEI?	0 0
If shipped direct via truck or tanker, will the driver sleep in the cab of his truck?	No
Number of years required to complete project?	2
Will waste require RCRA treatment?	Yes
Percentage of waste volume requiring treatment?	100%
Waste Density (lb/ft ³):	62.5
Waste Density (g/cm ³):	1.00
Waste Mass (lbs):	4.25E+07
Waste Mass (tons):	2.13E+04
Waste Mass (g):	1.93E+10
Does the waste contain Source Material (Uranium or Thorium)? (Yes/No)	Yes
Does the waste contain Special Nuclear Material? (Yes/No)	No

Worksheet User Instructions and Notes:

1. Enter data into Yellow shaded cells ONLY. All other cells in the workbook are automated and/or protected.
2. Answer all questions in Section I - Waste Stream Information first. Enter values in yellow cells or select answer from drop-down lists provided. Notes are also provided in key cells to assist the user.
3. Enter concentrations (in pCi/g) for all nuclides in your characterized waste stream into Section II - Waste Profile Nuclide Evaluation.
4. The Maximum Acceptable Concentration for each nuclide is determined by either the USEI Waste Acceptance Criteria (WAC) or a general exemption value, if applicable. Logic in the SSDA workbook will automatically choose the most appropriate value for each nuclide.
5. USEI is limited to a total of 3,000 pCi/g of source material summed over all parent & progeny nuclides (Th+U).
6. USEI is limited to a total of 3,000 pCi/g of SNM summed over all fissile nuclides and their isotopic mixture nuclides, i.e., U-234, U-235, and U-238 for enriched uranium.
7. Cross-checks against all USEI Dose and WAC limits are automatically calculated in the indicators below. The activity concentration cross-checks only apply to individual shipments for USEI WAC compliance purposes.

Section II - Waste Profile Nuclide Evaluation			
Nuclide	Customer Waste Profile Concentration (pCi/g) ³	Maximum Acceptable Concentration (pCi/g) ⁴	Ratio to USEI Max Concentration
Ac-227		3000	
Ag-108m		3000	
Ag-110m		3000	
Am-241		3000	
Am-243		3000	
Au-195		3000	
Ba-133		3000	
Be-7		3000	
C-14		3000	
Ca-41		3000	
Cd-109		3000	
Cd-139		3000	
Ce-141		3000	
Ce-144		3000	
Cf-252		3000	
Cl-36		3000	
Cm-242		3000	
Cm-243		3000	
Cm-244		3000	
Cm-245		3000	
Cm-246		3000	
Cm-247		3000	
Co-57		3000	
Co-58	1.00	3000	0.000
Co-60	500.00	3000	0.167
Cr-51		3000	
Cs-134		3000	
Cs-135		3000	
Cs-137	75.00	3000	0.025
Eu-152		3000	
Eu-154		3000	
Eu-155		3000	
Fe-55	50.00	3000	0.017
Fe-59		3000	
Gd-152		3000	
Gd-153		3000	
Ge-68		3000	
H-3	1300	3000	0.433
I-125		3000	
I-129		3000	
I-131		3000	
Ir-192		3000	
K-40		3000	
Mn-54	10.00	3000	0.003
Na-22		3000	
Nb-93m		3000	

USEI Annual Dose Limit Check	MEI Dose (mrem/yr)
OK	4.90

SOR Check for All USEI Nuclides ⁷
0.678

USEI Byproduct Material WAC Check ⁷
OK

USEI Source Material WAC Check ⁷
OK

USEI SNM WAC Check ⁷
OK

Nb-94		3000	
Nb-95		3000	
Ni-59		3000	
Ni-63	50.00	3000	0.017
Np-237		3000	
Pa-231		3000	
Pb-210		3000	
Pm-147		3000	
Pu-238		3000	
Pu-239 ⁶		3000	
Pu-240		3000	
Pu-241		3000	
Pu-242		3000	
Pu-244		3000	
Ra-226		3000	
Ra-228		3000	
Ru-103		3000	
Ru-106		3000	
S-35		3000	
Sb-122		3000	
Sb-124		3000	
Sb-125		3000	
Sc-46		3000	
Sm-147		3000	
Sm-151		3000	
Sn-113		3000	
Sr-89		3000	
Sr-90		3000	
Tc-99	5.00	3000	0.002
Te-123		3000	
Th-228 ⁵		3000	
Th-229 ⁵		3000	
Th-230 ⁵		3000	
Th-232 ⁵		272	
Tl-204		3000	
U-233 ⁵		3000	
U-234 ⁵		212	
U-235 ⁵		3000	
U-236 ⁵		3000	
U-238 ⁵	1.00	212	0.005
Natural Uranium (sum) ⁵		3000	
Refined Uranium (sum) ⁵		3000	
Depleted Uranium (sum) ⁵		3000	
Zn-65	30.00	3000	0.010
Zr-95		3000	
Total Concentration (pCi/g)	2022.0		
Total Source Material (pCi/g)	14		
Total Special Nuclear Material (pCi/g)	0		
Total Activity (μCi)	3.90E+07		
		SOR:	0.678

Attachment 3

Vermont Yankee Nuclear Power Station

USEI Site-Specific Dose Assessment Workbook - Summary of Project Disposal Dose Results

USEI Site-Specific Dose Assessment Workbook

Rev. 3

Date: 1/28/2020

Summary of Project Alternate Disposal Dose Results

Customer:	Northstar
Project:	Vermont Yankee Torus and Infiltration Water - 2M gal by Rail
Number of Project Years:	2
Max Dose Allowed (mrem/yr):	5

Used for MPF?: No

a) USEI Worker Total Project Dose

Function	Minimum Number of Workers	Waste Contact Time (hr)	External Exposure Rate (mR/hr)	Internal Dose Rate (mrem/hr)	Distance (m)	Total No. of Repetitions	Total External Dose per Worker (mrem)	Total Internal Dose per Worker (mrem)	Total Project Dose per Worker (mrem)	% of Max Annual MEI Dose
Front-End Dray Truck Drivers	4	0.00	0.00E+00	0.00E+00	0.6	0	0.00E+00	0.00E+00	0.00E+00	0.0%
Long-Haul Direct Truck Drivers - Drive Time	8	0.00	0.00E+00	0.00E+00	0.0	0	0.00E+00	0.00E+00	0.00E+00	0.0%
<i>Long-Haul Direct Truck Drivers - Sleep Time</i>	8	0.00	0.00E+00	0.00E+00	0.0	0	0.00E+00	0.00E+00	---	---
Tanker Truck Driver - Drive Time	8	0.75	2.61E-01	0.00E+00	3.3	400	9.80E+00	0.00E+00	9.80E+00	195.9%
<i>Tanker Truck Driver - Sleep Time</i>	8	0.00	2.61E-01	0.00E+00	3.3	0	0.00E+00	0.00E+00	---	---
Gondola Railcar Surveyors	4	0.33	4.47E-01	0.00E+00	1.0	67	2.47E+00	0.00E+00	2.47E+00	49.4%
Bulk/IMC Truck Surveyors	8	0.08	3.60E-01	0.00E+00	1.0	0	0.00E+00	0.00E+00	0.00E+00	0.0%
Container Pad Operators	6	0.50	0.00E+00	6.39E-05	1.0	0	0.00E+00	0.00E+00	0.00E+00	0.0%
RTF Excavator Operator	2	0.75	2.63E-01	6.39E-05	2.0	0	0.00E+00	0.00E+00	0.00E+00	0.0%
Gondola Railcar Cleanout	4	0.16	8.96E-02	6.39E-05	0.3	0	0.00E+00	0.00E+00	0.00E+00	0.0%
Rail Transfer Equipment Operator	4	0.25	4.30E-02	0.00E+00	4.9	0	0.00E+00	0.00E+00	0.00E+00	0.0%
Back-End Dray Truck Drivers	8	0.75	5.14E-01	0.00E+00	0.6	0	0.00E+00	0.00E+00	0.00E+00	0.0%
Treatment Workers	6	0.75	1.56E-01	6.39E-05	2.0	400	7.78E+00	3.19E-03	7.79E+00	155.7%
Treatment Plant Truck Driver	2	0.16	4.02E-02	6.39E-05	0.6	1008	3.25E+00	5.15E-03	3.25E+00	65.0%
Container Pad Truck Driver	2	0.16	0.00E+00	0.00E+00	2.0	0	0.00E+00	0.00E+00	0.00E+00	0.0%
Landfill Cell Operators	2	0.25	1.73E-01	6.39E-05	1.0	426	9.23E+00	3.40E-03	9.23E+00	184.6%

b) USEI Worker Total Dose per Project Year (if applicable)

Function	Minimum Number of Workers	Waste Contact Time (hr)	External Exposure Rate (mR/hr)	Internal Dose Rate (mrem/hr)	Distance (m)	Total No. of Repetitions	Annual External Dose per Worker (mrem)	Annual Internal Dose per Worker (mrem)	Total Annual Dose per Worker (mrem)	% of Max Annual MEI Dose ¹
Front-End Dray Truck Drivers	4	0.00	0.00E+00	0.00E+00	0.6	0	0.00E+00	0.00E+00	0.00E+00	0.0%
Long-Haul Direct Truck Drivers - Drive Time	8	0.00	0.00E+00	0.00E+00	0.0	0	0.00E+00	0.00E+00	0.00E+00	0.0%
<i>Long-Haul Direct Truck Drivers - Sleep Time</i>	8	0.00	0.00E+00	0.00E+00	0.0	0	0.00E+00	0.00E+00	---	---
Tanker Truck Driver - Drive Time	8	0.75	2.61E-01	0.00E+00	3.3	400	9.80E+00	0.00E+00	4.90E+00	98.0%
<i>Tanker Truck Driver - Sleep Time</i>	8	0.00	2.61E-01	0.00E+00	3.3	0	0.00E+00	0.00E+00	---	---
Gondola Railcar Surveyors	4	0.33	4.47E-01	0.00E+00	1.0	67	2.47E+00	0.00E+00	1.23E+00	24.7%
Bulk/IMC Truck Surveyors	8	0.08	3.60E-01	0.00E+00	1.0	0	0.00E+00	0.00E+00	0.00E+00	0.0%
Container Pad Operators	6	0.50	0.00E+00	6.39E-05	1.0	0	0.00E+00	0.00E+00	0.00E+00	0.0%
RTF Excavator Operator	2	0.75	2.63E-01	6.39E-05	2.0	0	0.00E+00	0.00E+00	0.00E+00	0.0%
Gondola Railcar Cleanout	4	0.16	8.96E-02	6.39E-05	0.3	0	0.00E+00	0.00E+00	0.00E+00	0.0%
Rail Transfer Equipment Operator	4	0.25	4.30E-02	0.00E+00	4.9	0	0.00E+00	0.00E+00	0.00E+00	0.0%
Back-End Dray Truck Drivers	8	0.75	5.14E-01	0.00E+00	0.6	0	0.00E+00	0.00E+00	0.00E+00	0.0%
Treatment Workers	6	0.75	1.56E-01	6.39E-05	2.0	400	7.78E+00	3.19E-03	3.89E+00	77.9%
Treatment Plant Truck Driver	2	0.16	4.02E-02	6.39E-05	0.6	1008	3.25E+00	5.15E-03	1.63E+00	32.5%
Container Pad Truck Driver	2	0.16	0.00E+00	0.00E+00	2.0	0	0.00E+00	0.00E+00	0.00E+00	0.0%
Landfill Cell Operators	2	0.25	1.73E-01	6.39E-05	1.0	426	9.23E+00	3.40E-03	4.61E+00	92.3%

c) USEI RESRAD Post-Closure Screening Dose 9.41E-01 mrem/yr

d) Inadvertant Intruder Doses

(d) 1. Construction Scenario	7.67E+00	mrem/yr
(d) 2. Well Driller Scenario	7.20E+00	mrem/yr
(d) 3. Driller Occupancy Scenario	4.98E-01	mrem/yr