



Annual Summary Report for the Remote-Handled Low-Level Waste Disposal Facility—FY 2023

March 2024

A. Jeffrey Sondrup, Jonathan Jacobson, Kira Overin, Allen Prather,
and Tim Arsenault

Idaho National Laboratory



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EXECUTIVE SUMMARY

This Fiscal Year (FY) 2023 annual summary report (ASR) documents the continued adequacy of the performance assessment (PA), the composite analysis (CA)^a and associated operating disposal-authorization statement (ODAS) technical-basis documents for the Remote-Handled (RH) Low-Level Waste (LLW) Disposal Facility at Idaho National Laboratory. Annual review of the adequacy of the PA and CA for the Remote-Handled Low-Level Waste (RHLLW) Disposal Facility ensures that conclusions of the analyses remain valid in accordance with requirements of Department of Energy (DOE) Order 435.1, “Radioactive Waste Management.”

In FY 2023, no significant operational changes or other activities occurred that would cause deviation from the assumptions in the PA and CA pertaining to disposal geometry, verification of waste characteristics, tracking disposal inventories against total limits, facility-closure design, or institutional controls. Eleven waste canister shipments were received at the RHLLW Disposal Facility, and ten waste canisters were emplaced in disposal vaults.

Except for an update to the waste acceptance criteria (WAC) document (PLN-5446, “Waste Acceptance Criteria for the Remote-Handled Low-Level Waste Disposal Facility”), there were no updates to the PA, CA, ODAS, radioactive-waste-management basis (RWMB) or other technical-basis documents in FY 2023. The update of PLN-5446 is discussed in Section 2.9.2. (See also Table 2. Unreviewed disposal question screens and evaluations performed during FY 2023.) Current revisions of the documents as of FY 2023 are as follows:

- Performance Assessment for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility, DOE/ID-11421, Revision 2
- Composite Analysis for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility, DOE/ID-11422, Revision 0
- Addendum to the Composite Analysis for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility, DOE/ID-11577, Revision 0
- PLN-3368, “Maintenance Plan for the Remote-Handled Low-Level Waste Disposal Facility Performance Assessment and Composite Analysis,” Revision 3
- PLN-5501, “Monitoring Plan for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility,” Revision 2
- PLN-3370, “Preliminary Closure Plan for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility,” Revision 0
- PLN-5503, “Addendum to the Preliminary Closure Plan for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility,” Revision 0
- PLN-5446, “Waste Acceptance Criteria for the Remote-Handled Low-Level Waste Disposal Facility,” Revision 2
- “DOE Order 435.1 Documentation Change Control Process for the RHLLW Disposal Facility,” RH-ADM-5214, Revision 0.

^a The facility CA comprises the original CA (DOE/ID-11422, Revision 0) and the subsequently issued addendum (DOE/ID-11577, Revision 0). All references to the CA herein are intended to reflect the technical content of both documents.

Ongoing Activities

In FY 2023, routine PA and CA maintenance activities remained unchanged in accordance with PLN-3368, “Maintenance Plan for the Remote-Handled Low-Level Waste Disposal Facility Performance Assessment and Composite Analysis,” the PA/CA maintenance plan, and PLN-5501, the facility-monitoring plan. No new activities or information were identified in FY 2023 that might change assumptions and conclusions of the PA, CA, ODAS, or RWMB. Further, no activities or information were identified that would impact assumptions and conclusions of the PA and CA, including land use plans, waste acceptance criteria (WAC), future disposals, disposed-of inventory changes, or interim and final closure plans.

New proposed activities, changes in existing activities, facility configuration changes, or new information that could potentially impact the conclusions or assumptions of the PA, CA, ODAS, or RWMB were identified and evaluated through the unreviewed disposal question screening/unreviewed disposal question evaluation (unreviewed disposal question screening [UDQS]/unreviewed disposal question evaluation [UDQE]) process, as detailed in RH-ADM-5214, “DOE Order 435.1 Documentation Change Control Process for the RHLLW Disposal Facility.”

Eight UDQS/UDQEs were in progress at the end of FY 2022, and 12 were initiated in FY 2023, for a total of 20. Two that were in progress at the end of FY 2022 are still on hold until additional information is obtained from the waste generator. Of the remaining 18 UDQS/UDQEs, three were screened negative and were approved, ten were screened positive, and five are still in the process of being screened. Of the ten that screened positive, nine required evaluation and one required a special analysis (see Section 2.7). The nine evaluations and one special analysis were determined to be negative, meaning the change, activity, or new information was determined to be within the bounds of the PA, CA, and ODAS.

Waste Receipts

The only waste streams approved for shipment to the RHLLW Disposal Facility in FY 2023 were activated metals and surface-contaminated debris in Hot Fuel Examination Facility (HFEF)-5 canisters from the Materials and Fuels Complex (MFC), and 55-ton canisters from Naval Reactors Facility (NRF). In FY 2023, five HFEF-5 waste canisters were shipped to the facility and disposed of in the HFEF-vault array (Array 2). This brings the total number of HFEF-5 waste canister disposals to 65 at the end of FY 2023, and leaves space for 115 additional canisters of this type or size. Six 55-ton canisters were shipped to the facility in FY 2023, and five were disposed of in the 55-ton vault array (Array 3). These were the first 55-ton canisters disposed of at the facility. No other vault arrays received waste, and the facility is at 7.45% of capacity based on the number of canisters.

A running total of radionuclide activities by vault array, generator, and waste form is recorded and tracked using the facility-inventory management system, RHLLW Inventory Online (RHINO)^b (TFR-981 2018). In FY 2023, 227 radionuclides were reported in activated metals and 135 radionuclides as surface contamination for a total activity of 50,631 Ci in all ten waste canisters emplaced during the fiscal year. Eight of the reported radionuclides are non-system radionuclides, meaning they were not considered in the PA and are not included in the RHINO database. Non-system radionuclides are evaluated using the UDQE process (see Section 2.1).

^b RHINO (Remote-Handled Low-Level Waste Disposal Facility Inventory Online) is an NQA-1 software application for accepting, managing, and tracking the receipt of waste and its disposal location. The technical and functional requirements for RHINO are found in TFR-981, “Remote-Handled-LLW Inventory Online Database.”

In FY 2023, all 14 of the radionuclides fully analyzed in the PA for the groundwater (all-pathway) dose were reported in the waste canisters. All five radionuclides that contribute most to the PA intruder-pathway dose (Co-60, Cs-137, Nb-94, Ni-63, and Sr-90) were reported. All three radionuclides that most contribute to the PA air-pathway dose (C-14, tritium [H-3], and I-129) were reported. All nine radionuclides that contribute to the PA beta-gamma dose equivalent, and the beta-gamma effective dose (C-14, Cl-36, H-3, I-129, Mo-93, Nb-94, Ni-59, and Tc-99) were also reported.

The cumulative inventory of radionuclides in NRF 55-ton canisters is approximately as expected or less than expected for most of the 14 groundwater-pathway radionuclides based on projections used in the PA. Inventories of four radionuclides (Np-237, U-235, Mo-93, and Cl-36) are larger than PA projections. For HFEF-5 canisters, inventories of eight radionuclides as surface contamination (H-3, I-129, Np-237, Pu-239, Pu-240, U-234, U-235 and U-238) are larger than PA projections. However, most of the inventory of these radionuclides were from disposals prior to FY 2023. All occurrences of canisters with higher-than-expected inventories are flagged by RHINO and evaluated through the UDQE process. Although the inventories are greater than expected, they are typically small compared to the total PA inventories for all generators and canisters.

Facility performance was calculated and tracked using RHINO. The calculated maximum dose and concentration performance measures from the 10 waste canisters disposed of in FY 2023 are a very small fraction of the applicable performance objectives, and the impact of disposals is within the bounds of PA predictions. There are no impacts to the assumptions or conclusions of the PA.

Facility and Environmental Monitoring

Facility monitoring consists of annual inspections of the vault-yard road apron, a topographic survey and compaction measurements, inspection of vault shield-plug surfaces for damage, and the vault yard and side slopes for evidence of biotic activity (e.g., burrowing insects, animals, and plants). The FY 2023 inspection of the vault-yard road apron showed typical rutting, settling, erosion, sedimentation, and uneven surfaces consistent with past annual inspections. All findings were deemed not significant in nature and expected for gravel surfaces, especially in industrial areas where heavy equipment is being operated. The topographic survey and compaction measurements were completed and show there are no significant issues and only typically expected changes from initial configuration/conditions. The vault inspection revealed damage to three vault shield plugs. The damage is relatively minor, and repairs will be completed in FY 2024. Moderate vegetation (weed) growth was observed in a few areas of the vault-yard perimeter, and the vegetation was sprayed and/or removed. No evidence of burrowing insects or animals was identified.

Environmental monitoring was conducted in FY 2023 in accordance with PLN-5501. Compliance monitoring consists of annual sampling of three aquifer wells (one upgradient, two downgradient) near the facility. Samples are collected annually from each well and analyzed to confirm compliance with state groundwater-quality standards (IDAPA 58.01.11). Semiannual groundwater sampling was also performed in FY 2023 due to some lysimeter samples exceeding the gross-alpha action level.

Groundwater samples were analyzed for indicator analytes gross alpha and gross beta, and for target analytes C-14, H-3, I-129, and Tc-99. Tritium was detected in all three aquifer wells at levels less than the drinking-water maximum-contaminant level, and concentrations continue to exhibit a decreasing trend. Gross beta was positively detected in all three aquifer wells, while gross alpha was positively detected in two wells. C-14, I-129, and Tc-99 were not detected in any samples. All results are consistent with concentrations in the aquifer established prior to facility completion (INL 2017).

Performance monitoring was conducted by collecting and analyzing soil-porewater samples, where sufficient water was present, from vadose-zone lysimeters installed in native materials adjacent to, but below the base of the vault arrays. Samples were analyzed for the same indicator and target analytes as the aquifer samples (gross alpha, gross beta, H-3, C-14, I-129, and Tc-99) according to sample availability. In general, FY 2023 sample collection from shallow-alluvium lysimeters continued to be reasonably good, sample collection from deep-alluvium lysimeters continued to be poor, and sample collection from the sedimentary-interbed lysimeters improved.

All performance-monitoring sample results were less than action levels with two exceptions. The porewater sample from shallow-alluvium lysimeter PA-North and a combined sample from all eight deep-alluvium lysimeters exceeded the gross-alpha action level of 10 pCi/L. These results are consistent with results from previous years.

In addition to routine lysimeter sampling in the spring, six lysimeters were sampled in the fall of 2022 (FY 2023) and analyzed for tritium and other analytes as sample volumes permitted. This “non-routine” sampling effort was conducted in response to an unexpectedly high tritium result from lysimeter HFEF-South in spring FY 2020. Because the tritium concentration in HFEF-South has steadily decreased from a high of 47,100 pCi/L in spring 2020 to 4,350 in the spring of 2023, semiannual sampling will be discontinued after fall 2023.

In FY 2023, groundwater and lysimeter data collected during the first 4 years of facility operations (FY 2019 through FY 2022) were evaluated to establish a “baseline” condition for the facility as specified in the facility monitoring plan. Based on this evaluation (INL 2023b), the project will move to the post-baseline monitoring phase for lysimeters, as outlined in the monitoring plan, and samples will be collected from lysimeters near waste emplacements and analyzed only for indicator analytes gross alpha, gross beta, and tritium. Tritium was added to post-baseline monitoring based on a recommendation in INL (2023b). Additionally, INL (2023b) recommended the lysimeter action level for gross alpha be increased from 10 pCi/L to 20 pCi/L. These changes will be added to the monitoring plan in FY 2024.

Design, Operations, and Closure Conditions

During FY 2023, there were no changes in the design, construction, or operation of the RHLLW Disposal Facility that were not considered in the PA or CA. While the commencement of shipment and disposal of 55-ton waste canisters from NRF in FY 2023 constitutes a change in daily operations at the facility, this activity was anticipated and considered during preparation of the PA and CA. Therefore, it has no impact on the adequacy of the PA or CA.

PLN-3370, the preliminary closure plan, and PLN-5503, the preliminary closure plan addendum, outline the timeline and general procedure for the closure of the RHLLW Disposal Facility. When used together, these two plans form the closure basis for the facility.

In FY 2023, one special analysis was performed to address a request by NRF Waste Programs for a revision to limits of removable surface contamination on the exterior of waste canisters shipped to the RHLLW Disposal Facility as specified in the WAC (PLN-5446). The special analysis (INL 2022b) determined the increase in canister exterior-contamination limits requested by NRF are well within the bounds of the current PA and will not result in a violation of performance objectives. The results also show the increased limits do not reflect or necessitate a fundamental change to the PA conceptual model, nor a change to the way exterior contamination is not included in PA dose calculations. The UDQE was approved, and the WAC (PLN-5446) was revised to include the requested limits.

Research and Development Activities

No research and development activities were conducted at the RHLLW Disposal Facility in FY 2023.

Planned or Contemplated Changes

Planned or contemplated changes for FY 2023 include updates to PLN-5501 and PLN-5446. Waste generator certification of the Advanced Test Reactor (ATR) Complex should be finalized in FY 2024, allowing shipment and disposal of ATR-5 waste canisters to commence. An evaluation of projected inventory discrepancies in HFEF-5 canisters will also be evaluated through the change-control process. No changes are planned or contemplated for facility design, construction, or closure.

Status of ODAS Conditions, Key, and Secondary Issues

No conditions or limitations placed on disposal operations at the RHLLW Disposal Facility were identified in the ODAS. No outstanding key or secondary issues are associated with the PA, CA, or ODAS technical-basis documents.

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ACRONYMS

AM	activated metal
ASR	Annual Summary Report
ATR	Advanced Test Reactor
BEA	Battelle Energy Alliance, LLC
CA	composite analysis
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CIC	Core Internals Changeout
CLUES	Comprehensive Land Use and Environmental Stewardship
CVAS	Cask-to-Vault Adapter System
DE	dose equivalent
DOE	Department of Energy
DOE-EM	Department of Energy Environmental Management
DOE-ID	Department of Energy Idaho Operations Office
DOE-NE	Department of Energy Nuclear Energy
DOE-NR	Department of Energy Naval Reactors
ECAR	Engineering Calculations and Analysis Report
ECF	Expended Core Facility
ED	effective dose
EPA	Environmental Protection Agency
FCF	Fuel Conditioning Facility
FE	facility evaluation
FTC	Facility Transfer Container
FY	fiscal year
HFEF	Hot Fuel Examination Facility
IDAPA	Idaho Administrative Procedures Act
INL	Idaho National Laboratory
LCC	large concept cask
LFRG	(DOE) Low-Level Waste Disposal Facility Federal Review Group
LLW	low-level waste
MCL	maximum contaminant level
MFC	Materials and Fuels Complex
MFTC	Modified Facility Transfer Container
MWO	model work order
NRF	Naval Reactors Facility
ODAS	operating disposal-authorization statement

PA	performance assessment
PM	preventative maintenance
RH	remote-handled
RHINO	Remote-Handled Low-Level Waste Disposal Facility Inventory Online
RHLLW	Remote-Handled Low-Level Waste
RWDS	Radioactive Water Demineralizer System
RWMB	radioactive-waste-management basis
SC	surface-contaminated
SCR	software-change request
UCL	upper confidence level
UDQE	unreviewed disposal question evaluation
UDQS	unreviewed disposal question screening
VSP	vault shield plug
WAC	waste acceptance criteria
WO	work order

Annual Summary Report for the Remote-Handled Low-Level Waste Disposal Facility—FY 2023

1. INTRODUCTION

The U.S. Department of Energy (DOE) requires the performance assessment (PA) (Department of Energy Idaho Operations Office [DOE-ID] 2018a), composite analysis (CA) (DOE-ID 2012), and CA addendum (DOE-ID 2018b)^c for the Remote-Handled (RH) Low-Level Waste (LLW) Disposal Facility at the Idaho National Laboratory (INL) Site shall be maintained to evaluate changes that could affect the performance, design, and operating basis for the facility (DOE Manual 435.1-1 Change 3, “Radioactive Waste Management Manual,” Section IV.P. [4]).

The Remote-Handled Low-Level Waste (RHLLW) Disposal Facility became operational in September 2018 after the completion of operational readiness activities required by DOE Order 425.1D, “Verification of Readiness to Start Up or Restart Nuclear Facilities,” and the issuance of the startup authorization by the Startup Approval Authority (Boston 2018). The first waste disposals at the RHLLW Disposal Facility began in Fiscal Year (FY) 2019.

In FY 2023, no significant operational changes or other activities occurred that would cause deviation from the assumptions in the PA and CA pertaining to disposal geometry, verification of waste characteristics, tracking disposal inventories against total limits, facility-closure design, or institutional controls.

This FY 2023 annual summary report (ASR) documents the continued adequacy of the PA, CA, operating disposal-authorization statement (ODAS) (ODAS 2018), ODAS technical-basis documents, and the radioactive-waste-management basis (RWMB) (RWMB, INL 2020a) to meet DOE Order 435.1, “Radioactive Waste Management,” performance objectives for the RHLLW Disposal Facility. Annual review of the adequacy of the PA and CA at the RHLLW Disposal Facility ensures that conclusions of the analyses remain valid, in accordance with requirements of DOE Order 435.1.

1.1. Site and Facility Background

The INL Site is a DOE facility occupying approximately 2,305 km² (890 mi²) of mostly undeveloped, high-desert terrain in southeastern Idaho (see Figure 1). The RHLLW Disposal Facility is located 0.48 km (0.3 miles) from the southwest corner of the Advanced Test Reactor (ATR) Complex (see Figure 2). The facility was designed to receive waste canisters generated at the ATR Complex, Naval Reactors Facility (NRF), and Materials and Fuels Complex (MFC) (see Table 1). All waste received at the RHLLW Disposal Facility will be permanently disposed of in stainless-steel canisters placed in precast concrete, below-grade disposal vaults. Each concrete vault consists of a hexagonal base with an integral riser, an upper riser section, and a removable vault shield plug for access and shielding. The vaults are arranged in four arrays by the waste-canister type and size they will accept (see Figure 3).

^c The facility CA comprises the original CA (DOE/ID-11422, Revision 0) and the subsequently issued addendum (DOE/ID-11577, Revision 0). All references to the CA herein are intended to reflect the technical content of both documents.

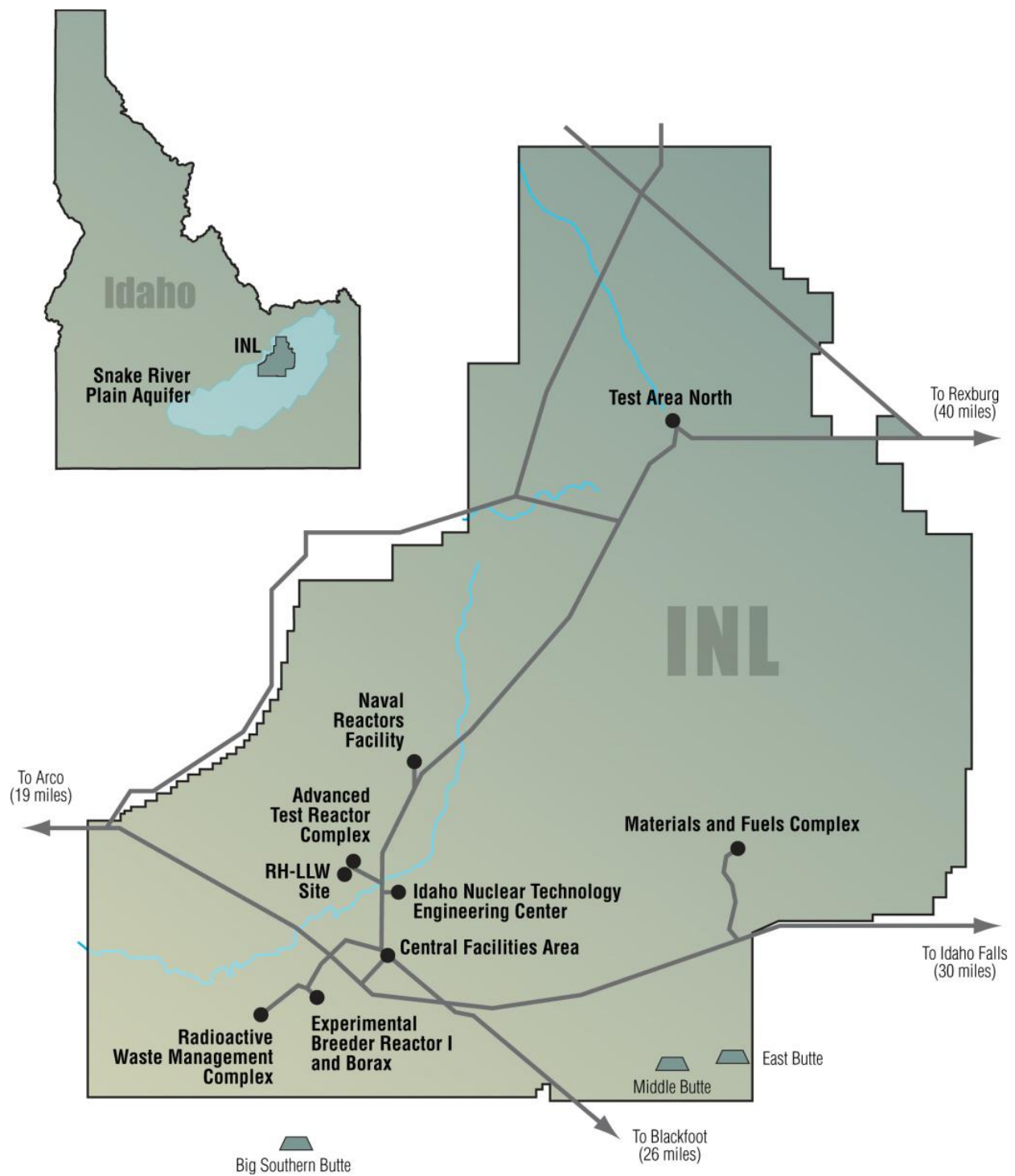


Figure 1. Map of INL Site showing the locations of major facilities including the RHLLW Disposal Facility.



Figure 2. RHLLW Disposal Facility showing administration and maintenance building (background) and vault yard (foreground). The ATR Complex is in the far background.

Table 1. Waste cask/canister systems in use or planned for use at the RHLLW Disposal Facility.

Waste Generation Facility	Waste Canister Type	Waste Type	Array
ATR Complex	NuPac 14-210L Cask/Canisters	Ion-Exchange Resins	Array 1 (NuPac Vaults)
NRF	Large Concept Cask (LCC) Cask/Canisters	Ion-Exchange Resins/ Activated Metals/Debris	Array 2 (LCC Vaults)
NRF	55-ton Scrap Cask/Canisters	Ion-Exchange Resins/ Activated Metals/Debris	Array 3 (55-ton Vaults)
MFC	Modified Facility Transfer Container (MFTC)/Large Liners	Activated Metals/Debris	Array 4 (MFTC Vaults)
ATR Complex	ATR-5 Cask/Canisters	Activated Metals	Array 2 (HFEF Vaults)
MFC	Hot Fuel Examination Facility (HFEF)-5 Cask/Canisters	Activated Metals/Debris	Array 2 (HFEF Vaults)

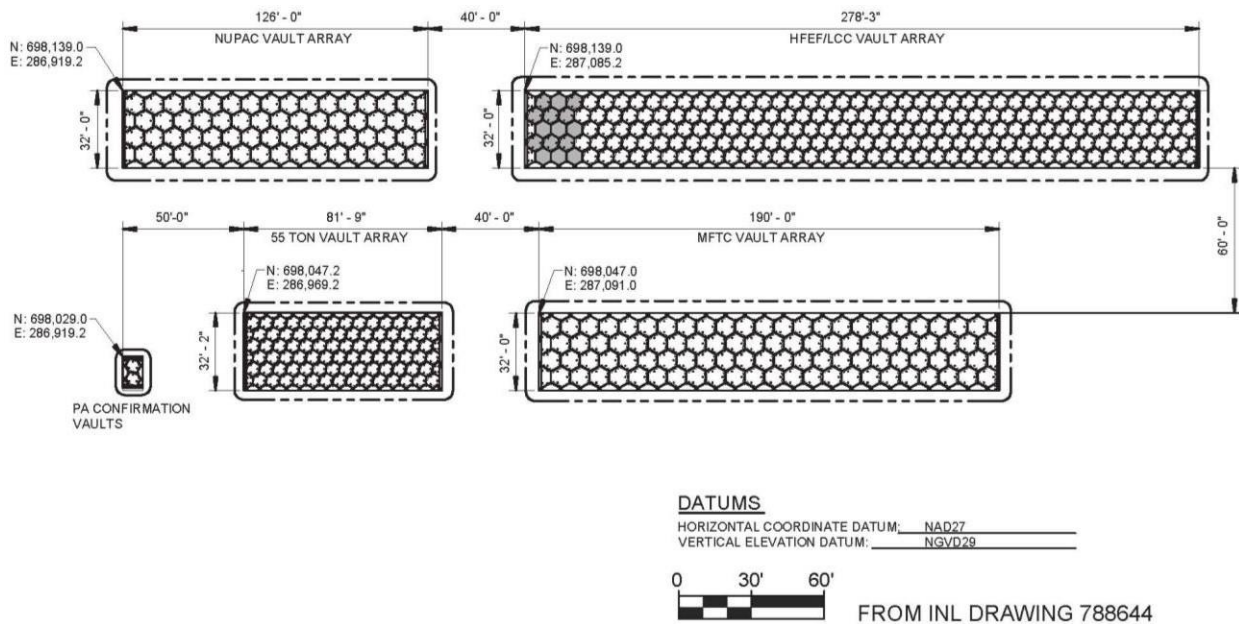


Figure 3. Horizontal layout of the disposal vault arrays at the RHLLW Disposal Facility.

1.2. Purpose and Scope

The purpose of this FY 2023 ASR is to summarize operations and activities conducted during the year in the context of modeling and the assumptions that form the basis for the conclusions of the PA and CA. This ASR evaluates the adequacy of the approved PA and CA and related documents, and it concludes FY 2023 RHLLW Disposal Facility operations were conducted within the bounds of the PA, CA, and ODAS. This ASR addresses RHLLW Disposal Facility operations for FY 2023 and includes an overview of PA- and CA-related activities for the RHLLW Disposal Facility in the same period.

The PLN-3368, “Maintenance Plan for the Remote-Handled Low-Level Waste Disposal Facility Performance Assessment and Composite Analysis” (i.e., the PA/CA maintenance plan), describes the activities to be performed to maintain the PA and CA for the RHLLW Disposal Facility. The PA/CA maintenance plan specifies that the ASR will be prepared in accordance with Chapter 9 of DOE-STD-5002-2017, “Disposal Authorization Statement and Tank Closure Documentation Technical Standard.”

This FY 2023 ASR is based on requirements contained within all technical-basis documents associated with the PA and CA and provides the following information:

- Section 2—Summary of changes that could potentially impact the PA, CA, ODAS, or RWMB that occurred in FY 2023
- Section 3—Discussion of the cumulative effect of changes that occurred in FY 2023
- Section 4—Waste receipts, disposal capacity, key radionuclide inventories, and facility performance
- Section 5—Summary of facility, compliance, and performance monitoring
- Section 6—Research and development activities that might impact the PA and CA results and conclusions
- Section 7—Planned or contemplated changes to the technical-basis documents
- Section 8—Status of the ODAS conditions and key and secondary issues

- Section 9—Annual determination of the continued adequacy of the PA and CA for FY 2023 based on summary information presented in this report.

2. CHANGES POTENTIALLY AFFECTING THE PA, CA, ODAS, OR RWMB

Ten waste canister disposals were performed in FY 2023 at the RHLLW Disposal Facility. This brings the total number of canister disposals to 70 by the end of FY 2023. There were no impacts to the RHLLW Disposal Facility PA, CA, ODAS, or RWMB resulting from operations or other activities in FY 2023.

Other than an update to the WAC document (PLN-5446) (see Table 2, UDQE-RHLLW-063), there were no updates to the PA, CA, ODAS, RWMB, or other technical-basis documents in FY 2023. The current revisions of the technical basis documents as of FY 2023 are as follows^d:

- DOE/ID-11421, “Performance Assessment for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility,” Revision 2.
- DOE/ID-11422, “Composite Analysis for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility,” Revision 0.
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- DOE Order 435.1, “Documentation Change Control Process for the RHLLW Disposal Facility,” RH-ADM-5214, Revision 0.

2.1. Unreviewed Disposal Question Screens and Evaluations

New proposed activities, changes in existing activities, facility configuration changes, or new information that could potentially impact the conclusions or assumptions of the PA and CA are evaluated using the facility change-control process documented in RH-ADM-5214, “DOE Order 435.1 Documentation Change Control Process for the RHLLW Disposal Facility.” As part of the process, several unreviewed disposal question screenings (UDQSs) and unreviewed disposal question evaluations (UDQEs) were performed to support operations in FY 2023. There was also one special analysis performed in FY 2023. A summary of all UDQSs and UDQEs that were in progress at the end of FY 2022 or initiated in FY 2023 is provided in Table 2. All UDQS/UDQE forms completed and approved in FY 2023 are provided in Appendix A, “Fiscal Year 2023 Unreviewed Disposal Question Screenings and Evaluations for the RHLLW Disposal Facility.”

^d The ODAS incorrectly referenced all technical basis documents as Revision 0. The approved versions of the documents at the time the ODAS was approved are confirmed in an email from S. Golian to J. Conner on May 24, 2018.

Eight UDQS/UDQEs were in progress at the end of FY 2022 and 12 were initiated in FY 2023 for a total of 20. Of the 20 UDQS/UDQEs, three were screened negative and were approved, eleven were screened positive, and six were still in the process of being screened at the end of FY 2023. Of the eleven that screened positive, ten required evaluation, and one required a special analysis (see Section 2.7). Nine of the evaluations and the special analysis were determined to be negative, meaning the change, activity, or new information was determined to be within the bounds of the PA, CA, and ODAS. One evaluation was still in progress at the end of FY 2023.

Nine of the UDQS/UDQEs that screened positive and required evaluation were for waste canisters with radionuclide inventories flagged by the RHLLW Inventory Online (RHINO^e) software. Prior to shipment, waste canister details are entered into RHINO, which performs WAC and PA checks to evaluate canisters for acceptance. WAC checks evaluate the radionuclide inventory of each canister against nuclear-safety threshold levels derived in Engineering Calculations and Analysis Report (ECAR)-1559, “Evaluation of Facility Inventory and Radiological Consequences to Support RHLLW Disposal Facility Safety Basis,” and presented in the WAC (PLN-5446, Appendix A). If the canister inventory for one or more radionuclides exceeds a threshold level in Appendix A of the WAC, a full dose-consequence calculation must be completed to verify the total dose consequence is within the bounding total dose-consequence values evaluated for that canister type and waste stream. PA checks performed by RHINO compare the radionuclide inventory of each canister against threshold values or action levels, or identify radionuclides not considered in the PA (DOE-ID 2018a). Canisters that are flagged by RHINO during PA checks must also be evaluated to determine whether the inventories and dose impacts are within the bounds of the PA.

Two of the 10 canisters evaluated for disposal in FY 2023 contained radionuclides whose inventories exceeded WAC threshold values and required a full dose consequence analysis. These analyses were documented in ECAR-6477, “Dose Consequence Analysis for Canister OWC-300-H5,” and ECAR-6505, “Dose Consequence Analysis for Canister OWC-090-H5.” All 10 canisters disposed of in FY 2023 were flagged by RHINO PA checks and required evaluation. After evaluation, the waste canisters were deemed acceptable for disposal from a safety-basis perspective, and inventories and dose impacts were considered acceptable and within the bounds of the PA.

In summary, it was determined there were no impacts to the PA, CA, ODAS, or RWMB based on the 13 UDQS/UDQEs and one special analysis completed and approved in FY 2023. The need for a special analyses or a determination of impacts to the PA, CA, ODAS, or RWMB, based on the other seven UDQS/UDQEs still in progress at the end of FY 2023, is to be determined and will be reported in the FY 2024 ASR.

^e RHINO is an NQA-1 software application for accepting, managing, and tracking the receipt of waste and its disposal location (Section 4.3). The technical and functional requirements for RHINO are found in TFR-981, “Remote Handled-LLW Inventory Online Database.”

Table 2. Unreviewed disposal question screens and evaluations performed during FY 2023.

UDQS/UDQE Identification Number ^a	Subject	Description and Screen/Evaluation Results	UDQS Result	UDQE Result	UDQE Status	Special Analysis (if Applicable)	PA, CA, ODAS or RWMB Impacts ^b
UDQE-RHLLW-029	Disposal of irradiated metal shavings collected from sizing operations at ATR Complex	The ATR RHLLW project has designed and fabricated underwater cutting tools for waste sizing and packaging. The biproduct of sizing will generate metal shavings. Disposal of the shavings is currently being evaluated for potential pyrophoricity. Shavings will not be allowed in waste canisters until this issue is resolved and the UDQE approved.	Positive	In Progress	In Progress	TBD	TBD
UDQE-RHLLW-040	Inclusion of remote-handled hafnium waste from ATR canal	The ATR-Canal Cleanout Project requested the ability to strategically package and ship hafnium-waste components from the ATR canal to the RHLLW Disposal Facility for disposal. The PA model was based on a specific list of components from changeouts of the ATR core and hafnium components were specifically excluded. The ATR-Canal Cleanout Project is exploring disposal options. Hafnium waste components will not be allowed in waste canisters until this issue is resolved and the UDQE approved.	In Progress	TBD	TBD	TBD	TBD
UDQE-RHLLW-055	Review the updated INL Site Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) 5-year review for potential impacts on the PA and CA	RHLLW Maintenance Plan (PLN-3368) requires evaluation of published INL CERCLA 5-year reviews to determine potential impacts on the RHLLW PA and/or CA, including review of upgradient ground-water monitoring data. The latest revision, "Five-Year Review of CERCLA Response Actions at the INL Site—Fiscal Years 2015–2019," (DOE-ID 2021) was completed in FY 2021. A review of DOE-ID (2021) found no information that could potentially impact the validity or conclusions of the RHLLW Disposal Facility PA or CA.	Negative	NA	Approved	NA	None

UDQS/UDQE Identification Number ^a	Subject	Description and Screen/Evaluation Results	UDQS Result	UDQE Result	UDQE Status	Special Analysis (if Applicable)	PA, CA, ODAS or RWMB Impacts ^b
UDQE-RHLLW-057	Review DOE-STD-1196-2022 and evaluate potential impacts to the PA and CA	Dose coefficients from DOE-STD-1196-2011 (2011) were used for PA dose calculations in DOE-ID (2018a). The standard was revised in 2021 (DOE-STD-1196-2021) and again in 2022 (DOE-STD-1196-2022). Although these revisions do not require PA calculations be updated, the project recommended the impact of new dose coefficients be evaluated for planning purposes should the current PA need revision in the future. This is expected to be completed in FY 2024.	In Progress	In Progress	In Progress	TBD	TBD
UDQE-RHLLW-058	Revision to FRM-2544	The facility change-control process document (RH-ADM-5214) requires revisions to FRM-2544, "Remote-Handled Low-Level Waste Canister Acceptance Sheet," to be evaluated. FRM-2544 was revised to update the limits for removable surface contamination for NRF waste canisters based on the outcome of UDQE-RHLLW-063 and add NRF as a certified waste generator based on successful certification (see ASMT-2022-0618). The review determined the changes do not impact the assumptions of conclusions of the PA or CA, or the validity of the RWMB or ODAS. The review also recommended RH-ADM-5214 be revised to remove FRM-2544 from the list of documents requiring mandatory screening (UDQS) because forms do not and will not include new proposed activities, changes in existing activities, facility configuration changes, or new information that would potentially affect the assumption and/or conclusions of the PA or CA. UDQE-RHLLW-058 will serve as the evaluation of the RH-ADM-5214 revision.	Negative	NA	Approved	NA	None

UDQS/UDQE Identification Number ^a	Subject	Description and Screen/Evaluation Results	UDQS Result	UDQE Result	UDQE Status	Special Analysis (if Applicable)	PA, CA, ODAS or RWMB Impacts ^b
UDQE-RHLLW-063	NRF request for exception to the RHLLW WAC Section 2.6 surface-contamination requirement	NRF Waste Programs requested a permanent exception to the limits of removable surface contamination on the exterior of waste canisters shipped from NRF to the RHLLW Disposal Facility as specified in the WAC, Section 2.6 (PLN-5446). NRF Waste Programs proposed revised surface-contamination limits that can be achieved at a 97.5% confidence level. The UDQS recommended a special analysis be performed to determine if the limits are within the bounds of the current PA. The special analysis determined the revised limits are within the bounds of the current PA and will not result in a violation of performance objectives, nor do they reflect or necessitate a fundamental change to the PA conceptual model, or a change to the exclusion of exterior contamination in PA dose calculations. The WAC was revised to include the updated limits for NRF waste canisters and UDQE-RHLLW-063 serves as evaluation of the WAC revision. It was also recommended the facility monitoring plan be updated to identify external canister contamination as a potential mobile source term that may be detected by monitoring earlier than potential releases from waste. This revision is scheduled for FY 2024.	Positive (Special Analysis Required)	NA	NA	Approved	None
UDQE-RHLLW-065	Vault shield plugs (VSPs) with Level 3 or greater damage identified during 2022 annual inspection	VSPs are inspected annually for damage. The 2022 inspection revealed damage (chips and cracks) to four VSPs: VSP-C1, VSP-D1, VSP-E1, and VSP-E2 in Vault Array 2. Damage and repairs are managed using the change-control process. All four VSPs were determined to be operable with respect to the safety-significant component criteria of SAR-419. Repairs were successfully completed in FY 2023 under WO 332969. The UDQE will be updated accordingly and processed in FY 2024.	In Progress	TBD	TBD	TBD	TBD

UDQS/UDQE Identification Number ^a	Subject	Description and Screen/Evaluation Results	UDQS Result	UDQE Result	UDQE Status	Special Analysis (if Applicable)	PA, CA, ODAS or RWMB Impacts ^b
UDQE-RHLLW-066	Cask-to-Vault System (CVAS) exhibiting Level 3 or greater damage identified during 2022 annual inspection	The HFEF CVAS is inspected annually for damage. The 2022 inspection identified Level 3 or greater damage (chip and crack). Damage and repairs are managed using the change-control process. The HFEF CVAS was determined to be operable with respect to the safety-significant component criteria of SAR-419. Repairs were successfully completed in FY 2023 under WO 342641. The UDQE will be updated accordingly and processed in FY 2024.	In Progress	TBD	TBD	TBD	TBD
UDQE-RHLLW-067	Canisters SN-181, OWC-090-H5 and OWC-300-H5 flagged by RHINO during acceptance testing	Three legacy HFEF-5 waste canisters from MFC (SN-181, OWC-090-H5 and OWC-300-H5) were flagged by RHINO while performing PA and WAC checks during acceptance testing. Radionuclide inventories were evaluated, and impacts were determined to be within the bounds of the PA. Dose consequences were evaluated for canisters OWC-090-H5 (ECAR-6505) and OWC-300-H5 (ECAR-6477) and determined to be within the bounds of the safety basis. The canister was deemed acceptable for disposal. No further action required.	Positive	Negative	Approved	NA	None
UDQE-RHLLW-068	Canister ECF-05-18-121 flagged by RHINO during acceptance testing	A 55-ton waste canister from the Expended Core Facility (ECF) at NRF (ECF-05-18-121) that contains activated metals and surface contaminated debris, was flagged by RHINO while performing PA checks during acceptance testing. Radionuclide inventories were evaluated, and impacts were determined to be small and within the bounds of the PA. The canister was deemed acceptable for disposal. No further action required.	Positive	Negative	Approved	NA	None
UDQE-RHLLW-069	Canister ECF-05-18-102 flagged by RHINO during acceptance testing	A 55-ton waste canister from NRF (ECF-05-18-102) that contains activated metals and surface-contaminated debris, was flagged by RHINO while performing PA checks during acceptance testing. Radionuclide inventories were evaluated, and impacts were determined to be small and within the bounds of the PA. The canister was deemed acceptable for disposal. No further action required.	Positive	Negative	Approved	NA	None

UDQS/UDQE Identification Number ^a	Subject	Description and Screen/Evaluation Results	UDQS Result	UDQE Result	UDQE Status	Special Analysis (if Applicable)	PA, CA, ODAS or RWMB Impacts ^b
UDQE-RHLLW-070	Canister ECF-05-18-106 flagged by RHINO during acceptance testing	A 55-ton waste canister from NRF (ECF-05-18-106) that contains activated metals and surface contaminated debris was flagged by RHINO while performing PA checks during acceptance testing. Radionuclide inventories were evaluated, and impacts were determined to be small and within the bounds of the PA. The canister was deemed acceptable for disposal. No further action required.	Positive	Negative	Approved	NA	None
UDQE-RHLLW-071	RHINO Software Change Request SCR-RHINO-006	All RHINO software-change requests (SCRs) are subject to the change-control process as identified in RH-ADM-5214 (also see INL 2023a: Table 2, UDQE-RHLLW-054). Proposed changes are reviewed to determine if they involve a change to the PA, impact the conclusions of the PA, or necessitate changes to the WAC, closure plan, CA, or PA/CA maintenance plan. The software changes made to RHINO were for convenience and consistency, and none of the changes involve a change to the PA or impact the conclusions of the PA or necessitate changes to other technical-basis documents. No further action required.	Negative	NA	Approved	NA	None
UDQE-RHLLW-072	CVAS exhibiting Level 3 or greater damage identified during 2023 annual inspection	The HFEF CVAS is inspected annually for damage. The 2023 inspection identified Level 3 or greater damage (chip and cracks). Damage and repairs are managed using the change-control process. Repairs were successfully completed under WO 342641. The HFEF CVAS was determined to be operable with respect to the safety-significant component criteria of SAR-419. The UDQE will be updated accordingly and processed in FY 2024.	In Progress	TBD	TBD	TBD	TBD
UDQE-RHLLW-073	Vault shield plugs (VSPs) with Level 3 or greater damage identified during 2023 annual inspection	VSPs are inspected annually for damage. The 2023 inspection revealed damage (chips and cracks) to three VSPs: D2 in Array 2 and C4 and C5 in Array 3. Damage and repairs are managed using the change-control process. Repairs were successfully completed under WO 349402. All three VSPs were determined to be operable with respect to the safety-significant component criteria of SAR-419. The UDQE will be updated accordingly and processed in FY 2024.	In Progress	TBD	TBD	TBD	TBD

UDQS/UDQE Identification Number ^a	Subject	Description and Screen/Evaluation Results	UDQS Result	UDQE Result	UDQE Status	Special Analysis (if Applicable)	PA, CA, ODAS or RWMB Impacts ^b
UDQE-RHLLW-074	Canister ECF-05-18-112 flagged by RHINO during acceptance testing	A 55-ton waste canister from NRF (ECF-05-18-112) that contains activated metals and surface-contaminated debris was flagged by RHINO while performing PA checks during acceptance testing. Radionuclide inventories were evaluated, and impacts were determined to be small and within the bounds of the PA. The canister was deemed acceptable for disposal. No further action required.	Positive	Negative	Approved	NA	None
UDQE-RHLLW-075	Canister ECF-05-18-122 flagged by RHINO during acceptance testing	A 55-ton waste canister from NRF (ECF-05-18-122) that contains activated metals and surface-contaminated debris was flagged by RHINO while performing PA checks during acceptance testing. Radionuclide inventories were evaluated, and impacts were determined to be small and within the bounds of the PA. The canister was deemed acceptable for disposal. No further action required.	Positive	Negative	Approved	NA	None
UDQE-RHLLW-076	Canister MFC170303 radionuclide inventory flagged by RHINO during acceptance testing	A new-generation (non-legacy) HFEF-5 waste canister from MFC (MFC170303) that contains activated metals and surface-contaminated debris was flagged by RHINO while performing PA checks during acceptance testing. Radionuclide inventories were evaluated, and impacts were determined to be small and within the bounds of the PA. The canister was deemed acceptable for disposal. No further action required.	Positive	Negative	Approved	NA	None

UDQS/UDQE Identification Number ^a	Subject	Description and Screen/Evaluation Results	UDQS Result	UDQE Result	UDQE Status	Special Analysis (if Applicable)	PA, CA, ODAS or RWMB Impacts ^b
UDQE-RHLLW-077	Canister OWC-301-H5 radionuclide inventory flagged by RHINO during acceptance testing	A new-generation (non-legacy) HFEF-5 waste canister from MFC (OWC-301-H5) that contains activated metals and surface-contaminated debris was flagged by RHINO while performing PA checks during acceptance testing. Radionuclide inventories were evaluated, and impacts were determined to be small and within the bounds of the PA. The canister was deemed acceptable for disposal. No further action required.	Positive	Negative	Approved	NA	None
UDQE-RHLLW-078	Canister ECF-05-18-120 flagged by RHINO during acceptance testing	A 55-ton waste canister from NRF (ECF-05-18-120) that contains activated metals and surface-contaminated debris was flagged by RHINO while performing PA checks during acceptance testing. Radionuclide inventories were evaluated, and impacts were determined to be small and within the bounds of the PA. The canister was deemed acceptable for disposal. No further action required.	Positive	Negative	Approved	NA	None
<p>N/A indicates an evaluation was not required due to a negative screen.</p> <p>a. UDQES/UDQEs are presented sequentially without regard to status. Identification numbers missing from the sequence were completed in a previous FY.</p> <p>b. "None" includes impact determination described as minimal, insignificant, not-discernable, etc.</p>							

2.2. Land Use Plans for the INL Site

Land use at the INL Site is currently managed by the management and operations contractor, Battelle Energy Alliance, LLC (BEA), in collaboration with DOE Idaho Operations Office (DOE-ID) (Charter [CTR]-274). The primary use of INL Site land is to support DOE Nuclear Energy (DOE-NE) activities focused on nuclear energy research, sustainable energy systems, and National and Homeland Security missions; DOE Environmental Management (DOE-EM) activities focused on legacy-waste management, spent nuclear fuel management, and environmental remediation of contaminated waste sites; and DOE Naval Reactors (DOE-NR) programs managing naval spent fuel. Land use for the INL Site is further described in the “INL Comprehensive Land Use and Environmental Stewardship” (CLUES) Report Update (INL 2020b), and the “INL Site-Wide Institutional Controls, and Operations and Maintenance Plan for CERCLA Response Actions” (DOE-ID 2022). The RHLLW Disposal Facility and associated long-term controls have been incorporated into the updated CLUES report. A review of the CLUES report was conducted in FY 2022 and determined current land-use activities, planning, and decisions described in the report are consistent with the assumptions in the RHLLW Disposal Facility PA, CA, and closure plan. Currently, no impacts to the PA, CA, or closure plan are anticipated based on the information reviewed (see INL 2023a: Table 2, UDQE-RHLLW-056).

Recent congressional actions,^f proposed congressional actions, presidential executive orders,^g DOE-ID site-use permits,^h construction of new nuclear energy research infrastructure at INL, and DOE’s Cleanup to Clean Energy initiativeⁱ may result in private energy generation and private nuclear energy research and development, as well as ongoing DOE-generated RHLLW. These will be evaluated as projects are announced and more information becomes available.

Development-forecast planning for land use assumes that key areas of the INL Site, including the ATR Complex, will remain under government control in perpetuity with no new private developments (residential or nonresidential) in areas adjacent to the INL Site. Future land use during the 1,000-year compliance period is expected to remain essentially the same as the current use (INL 2020b). Other potential, but less-likely land uses within the INL Site include agricultural use and the return of areas to their natural, undeveloped state.

Future land use identified in the CA is consistent with the most current land use plans for the INL Site. As of FY 2023, no changes are needed to ensure the continued adequacy of the CA with respect to land use assumptions.

^f Public Law 115-248, September 28, 2018, *Nuclear Energy Innovation Capabilities Act (NEICA) of 2017*, which amends the *Energy Policy Act of 2005* revising objectives for civilian nuclear energy research development, demonstration, and commercial application programs of the DOE to emphasize research infrastructure and enable private-sector partnerships with national laboratories to demonstrate novel reactor concepts. The Act named INL as the National Reactor Innovation Center (NRIC) for DOE-NE. NRIC provides access and resources to private-sector technology developers for testing, demonstration, and performance assessment to accelerate deployment of new advanced nuclear technology concepts.

Public Law 115-439, January 14, 2019, *Nuclear Energy Innovations and Modernization Act (NEIMA)*, which requires the Nuclear Regulatory Commission (NRC) to develop regulation for advanced nuclear reactor technologies. These technologies may be developed/tested on INL under DOE, Department of Defense, or NRC rules.

^g See, e.g., Executive Order 14057, “Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability,” 86 Fed. Reg. 70935 (Dec. 13, 2021).

^h Use Permit No. DE-NE700105, Use Permit Authorized by US DOE to Oklo Inc (2019).

ⁱ See Cleanup to Clean Energy – Expanding Clean Energy Generation on DOE Lands, <https://www.energy.gov/management/osp/cleanup-clean-energy-expanding-clean-energy-generation-doe-lands>.

2.3. Waste Acceptance Criteria

Only RHLLW in approved stainless-steel waste canisters is accepted for disposal in the concrete vaults at the RHLLW Disposal Facility. PLN-5446, referred to as the WAC, specifically addresses the acceptance of RHLLW. No other waste is addressed in the WAC or will be accepted in the future. The WAC was originally issued in FY 2018. It was revised in FY 2023 to update acceptable limits for surface contamination for NRF waste canisters (see Section 2.7).

2.4. Impact of Future Disposals

Ten waste canister disposals were performed in FY 2023 at the RHLLW Disposal Facility. Future disposals at the RHLLW Disposal Facility are projected to come from the ATR Complex, NRF, and MFC, as stated in Section 1.1, and are to be within the constraints of the ODAS (ODAS 2018). The only waste streams currently approved for disposal are activated metals and surface-contaminated debris in HFEF-5 canisters from MFC and 55-ton canisters of from NRF (see Section 4.1). No changes in the waste forms are expected for future disposals.

2.5. Composite Analysis Inventory and Waste Form

The sources of contamination considered in the CA are still valid, and no new significant sources have been identified. The PA and CA for the Idaho Nuclear Technology and Engineering Center Calcined Solids Storage Facility were approved by the DOE Low-Level Waste Disposal Facility Federal Review Group (LFRG) in FY 2023. This information will be reviewed to determine potential impacts on the RHLLW Disposal Facility's CA. The results will be documented in a UDQS/UDQE in FY 2024.

The PA/CA maintenance plan (PLN-3368) includes a requirement to evaluate the potential impact of published INL Site CERCLA 5-year reviews on the PA and CA, including review of upgradient-groundwater monitoring data. The most recent 5-year review of CERCLA response actions for the INL Site was published in 2021 and addressed FYs 2015–2019 (DOE-ID 2021). A review of DOE-ID (2021) was conducted in FY 2022 and found no information that could potentially impact the validity or conclusions of the RHLLW Disposal Facility PA or CA (see Table 2, UDQE-RHLLW-055).

2.6. Interim and Final Closure

The preliminary closure plan (PLN-3370) and closure-plan addendum (PLN-5503) outline the timeline and general procedure for the closure of the RHLLW Disposal Facility. When used together, PLN-3370 and PLN-5503 form the closure basis for the facility. The plans will be updated as necessary during the operational phase of the facility in response to changes in operations, information developed from monitoring data, and/or improved understanding of RHLLW Disposal Facility performance.

As specified in the closure-plan addendum, no interim or operational closure is planned. An interim closure cover is not required to meet vault-system design performance. Installation of an interim cover would require development of an interim closure plan for the facility and evaluation in accordance with the facility change-control process (RH-ADM-5214).

Final closure of the RHLLW Disposal Facility will be conducted at the end of the operational life of the facility in accordance with a final closure plan that meets the requirements of DOE Order 435.1. A final PA and CA will be prepared after the end of operations in support of facility closure. Revisions to the PA will provide final disposal inventories and any updates in parameter values based on research and monitoring results. The final closure plan will specify steps to be taken to ensure long-term stability of the facility and the INL Site, as well as any ongoing maintenance and monitoring activities to be performed during the period of institutional control.

2.7. Special Analyses and Reviews

Special analyses for the RHLLW Disposal Facility are used to evaluate special-case waste disposals and to evaluate changes at the INL Site that could affect the PA or CA conceptual models and, potentially, the results of the PA and CA. The WAC allows for special-case disposals on a case-by-case basis after a documented request for deviation and subsequent approval of a special analysis. In FY 2023, one special analysis was performed to address a request by NRF Waste Programs for a permanent exception to limits of removable surface contamination on the exterior of waste canisters shipped to the RHLLW Disposal Facility as specified in the WAC (PLN-5446).

Waste-generator certification of NRF as a generator of 55-ton waste canisters containing activated metals and surface-contaminated debris began in FY 2022. RHLLW Disposal Facility personnel performed a peer review of NRF waste-certification programs as a prelude to the actual certification. The review indicated that surface contamination on the 55-ton waste canisters would likely exceed acceptability limits, as defined in Section 2.6 of the RHLLW WAC (PLN-5446), without additional mitigating steps above those currently employed by NRF Waste Programs. NRF waste canisters are loaded underwater due to extremely high radiation levels, and NRF is not able to directly measure the surface contamination on the canisters after they are loaded into the shipping cask directly above the water. The high radiation levels prohibit safely lifting the loaded waste canister out of the water pools for contamination surveys to validate contamination levels. NRF reduces the amount of contamination on the outside of the canisters by placing radioactive water demineralizer systems in waste loading zones of the water pool, performing an underwater high-pressure wash (hydroblitz) of the canister exteriors, and performing a low-pressure rinse of the canister exterior as it is lifted from the pool into the shipping cask. NRF Waste Programs performed underwater swipes after the hydroblitz step to measure the removable surface contamination on waste canisters, and it was determined that levels would not consistently meet the limits identified in the WAC. Based on the evaluation of the underwater swipe data, NRF requested a permanent exception to the WAC Section 2.6 surface-contamination levels for all waste canisters and provided proposed surface contamination limits that could be achieved at a 97.5% confidence level. UDQE-RHLLW-063 was initiated to evaluate this request, and the screening recommended a special analysis be performed.

The special analysis, documented in INL (2022b), calculated the groundwater all-pathways dose contribution from surface contamination on the exterior of NRF canisters for the case where the exteriors of all NRF waste canisters are contaminated to the 10 CFR 835, Appendix D, allowable limits in the current WAC, and the case where the exteriors of all NRF waste canisters are contaminated to the limits requested by NRF Waste Programs. It was determined that the increase in canister exterior contamination limits requested by NRF are well within the bounds of the current PA and will not result in a violation of performance objectives. The results also show the increased limits do not reflect or necessitate a fundamental change to the PA conceptual model, nor a change to the way exterior contamination is not included in PA dose calculations. The WAC was revised to include the requested limits. It was also recommended that the monitoring plan be revised to identify external canister contamination as a potential mobile source term that may be detected by monitoring earlier than potential releases from waste. This is scheduled for FY 2024.

2.8. Other Relevant Factors—Design and Operations

Other relevant factors to be considered regarding the adequacy of the PA and CA include operational and design considerations. During FY 2023 there were no changes in the design, construction, or operation of the RHLLW Disposal Facility that were not considered in the PA or CA. While the commencement of shipment and disposal of 55-ton waste canisters from NRF in FY 2023 constitutes a change in daily operations at the facility, this activity was anticipated and considered during preparation of the PA and CA. Therefore, it has no impact on the adequacy of the PA or CA.

2.9. Other Maintenance Activities

Maintenance activities for the RHLLW Disposal Facility are delineated in PLN-3368, Revision 3. The plan addresses both physical preventative and corrective maintenance at the facility, as well as maintenance of the PA, CA, RWMB, and ODAS.

2.9.1. Planned Evaluations and Reviews

In accordance with the RHLLW Disposal Facility WAC (PLN-5446), facility evaluations (FEs) of waste generators are performed as part of the initial- and annual-certification process according to MCP-4211, “Conduct of RHLLW Disposal Facility Waste Generator Facility Evaluations.” FEs are conducted to ensure each generator’s waste certification program and waste streams are compliant with WAC by evaluating and measuring the adequacy of processes and their implementation and identifying conditions adverse to quality.

A successful recertification for approved waste generator (MFC) was conducted in FY 2023, and the results are documented in ASMT-2023-0490. An initial waste-generator certification assessment for NRF was initiated in FY 2022 (ASMT-2022-0618) and completed in FY 2023. As a result, waste shipments from NRF began in FY 2023. An initial waste-generator certification of ATR Complex Waste Programs began in FY 2023 and is expected to be completed in FY 2024.

In addition to FEs, PLN-3368 includes a list of other evaluations and reviews to be conducted annually to support preparation of the ASR. These include:

- Evaluate changes to dose coefficients (DOE-STD-1196)
- Evaluate changes to DOE Order 458.1, “Radiation Protection of the Public and the Environment”
- Evaluate changes to DOE Order 435.1, “Radioactive Waste Management”
- Evaluate changes to state of Idaho groundwater-quality regulations
- Review waste-disposal records
- Review air-emissions projections based on current inventory
- Review groundwater-pathway compliance and performance-monitoring data
- Review onsite (i.e., on-INL Site) air-monitoring data
- Review hydraulic drainage system-performance data.

The only standard, order, or regulation from the above list to be changed in FY 2023 was DOE-STD-1196. In December 2022 (FY 2023), the standard was updated to provide derived concentration standards and new dose coefficients for the ingestion of water, inhalations, and submersion in air, in a manner reflecting the current state of knowledge and practice in radiation protection. The RHLLW Disposal Facility PA is based on values from the 2011 standard (DOE-STD-1196-2011), which is the standard invoked by the current DOE Order 458.1. In FY 2023, the RHLLW Disposal Facility began an evaluation to determine the impact of revised dose coefficients from the new standard (DOE-STD-1196-2022) on dose calculations performed for the PA. The evaluation is expected to be completed in FY 2024.

A summary of waste-disposal records is presented and discussed in Section 4. Groundwater-pathway compliance and performance-monitoring data are presented and discussed in Section 5. A review of onsite INL Site air-monitoring data is performed annually and discussed in Section 5. Air emissions are not reported from the facility because the air pathway was screened from the PA, and no regulated emissions are expected. However, air-pathway doses are calculated and updated by RHINO as part of the acceptance process for each waste canister (see Section 4.4). Hydraulic drainage-system performance data are reviewed annually only to support lysimeter sampling.

2.9.2. Documentation Updates

Table 1 of the PA/CA maintenance plan (PLN-3368) lists requirements for documentation updates, as necessary. There are no ODAS conditions or limitations that were not closed as part of the LFRG review of the PA and CA that require tracking. Technical-basis documents that have been revised since issuance of the ODAS include the monitoring plan (PLN-5501) in FY 2020, the PA/CA maintenance plan (PLN-3368) in FY 2021, the change-control process document (RH-ADM-5214, formerly SD-52.1.4) in FY 2022, and the WAC (PLN-5446) in FY 2023. Previous revisions of the monitoring plan, PA/CA maintenance plan, and change-control document were addressed in the ASRs for FY 2020 (INL 2021), FY 2021 (INL 2022a), and FY 2022 (INL 2023a) respectively.

The WAC was updated in FY 2023 to include revised limits of removable surface contamination on the exterior of waste canisters shipped to the RHLLW Disposal Facility from NRF. The revised limits were evaluated in UDQE-RHLLW-063 (see Table 2), which recommended a special analysis be performed. The UDQE and special analysis (INL 2022b) determined the revised limits are within the bounds of the current PA and would not result in a violation of performance objectives. The results also showed the increased limits neither reflect nor necessitate a fundamental change to the PA conceptual model, nor a change to the way exterior contamination is not included in PA dose calculations.

Updates or revisions planned for technical-basis documents in FY 2024 include the monitoring plan (PLN-5501), WAC (PLN-5446), and the change-control document (RH-ADM-5214). Updates to the monitoring plan are based on recommendations from the report, “Assessment of Baseline Monitoring Data for the Remote-Handled Low-Level Waste Disposal Facility at Idaho National Laboratory,” (INL 2023b). Tables in Appendix B of the WAC will be updated to include new radionuclides identified on NRF surface-contaminated debris (see INL 2023a: Table 2, UDQE-RHLLW-052). The change-control document will be revised to remove FRM-2544 from the list of documents requiring mandatory screening (see UDQE-RHLLW-058). These expected changes are discussed in more detail in Section 7.

2.9.3. Planned and As-Needed Maintenance Activities

Table 1 of the PA/CA maintenance plan (PLN-3368) lists other PA/CA maintenance activities required on a planned (annual inspections or preventative maintenance [PM]) and as-needed (corrective maintenance) basis.

2.9.3.1. Planned Maintenance Activities

Annual inspection (and maintenance as necessary) of vault-yard apron slopes that promote water runoff and form the flood-water berm of the facility has been established as a preventative-maintenance activity directed by Model Work Order (MWO) 260064 (2018). The 2023 inspection was performed under annual Work Order (WO) 342547 (2023). Inspection of the vault-yard area showed typical rutting, settling, erosion, and some uneven surfaces in both the vault yard and in the apron; however, all were deemed not so significant in nature as to require immediate corrections and are expected for gravel surfaces over time, especially in industrial areas where heavy equipment is being operated. The vault-yard area and side slopes were also visually inspected for the presence of vegetation and animals or their nests or burrows. There was no indication of animal nesting. Some minor vegetation was present, which was removed immediately or sprayed with weed control chemicals by maintenance personnel. In addition, 10 random locations throughout the vault yard near the vault arrays were tested for compaction. All locations showed compaction measurements met or exceeded 95% criteria from the design specification of 95% of maximum dry unit weight per ASTM D698.

VSPs are also inspected annually for damage. These activities are directed by MWO 257898 (2018) and were performed in 2023 under annual WO 342129 (2023). The scope of the annual inspection requires the top surfaces of all VSPs on vaults that contain waste, as well as the top surfaces of VSPs on empty vaults adjacent to those with waste emplaced in them, to be inspected. The repair WOs direct qualified individuals to perform repairs followed by documented inspections by a qualified quality inspector to ensure these corrective-maintenance actions are completed properly and the VSP no longer exhibits issues that meet or exceed need-to-repair criteria.

The 2023 annual PM was performed under WO 342129. VSPs D2 and C5 in Vault Array 3 and VSP D2 in Vault Array 2 were identified as failing inspection criteria. These damages are typical superficial cracks and chips that do not expose rebar and are relatively shallow in nature. Operability Review OPR 2023-0173 evaluated these damages with respect to safety-analysis requirements in SAR-419 (2020) requirement and found all three VSPs can perform their safety function. Repairs are scheduled for FY 2024 and are performed by qualified personnel using approved materials. Even though the three VSPs were declared acceptable for continued use, repairs will be performed under the routine repair WO 349402 to ensure VSPs can be expected to provide protection against water ingress into the steel reinforcement material and result in no impact to long-term vault performance.

The 2022 annual VSP inspection results discussed in the FY 2022 ASR identified four VSPs in Vault Array 2 (C1, D1, E1 and E2) with damage exceeding the Level 3 criteria of the WO. These repairs were completed in FY 2023 under WO 332969, and post-maintenance inspections showed no failed criteria.

Table 1 of the PA/CA maintenance plan (PLN-3368) also identifies annual inspection (and maintenance, as necessary) of INL flood-protection measures, which supports a key assumption in the PA. During the spring and fall of each calendar year, each of the INL floodgates relevant to the RHLLW Disposal Facility are inspected, and PM activities are performed. Each floodgate and or diversion dam was inspected in the fall of 2022 and the spring 2023. During each inspection, routine PM was performed, and no major issues were identified. The inspections and PM of the diversion dams and floodgates were addressed under the following WO packages:

- PM Radioactive Waste Management Complex Diversion Dam Semi-Annual Floodgate Inspection (WO Package 330262, 2022), performed September 2022
- PM Radioactive Waste Management Complex Diversion Dam Semi-Annual Floodgate Inspection (WO Package 339137, 2023), performed March 2023
- PM Experimental Breeder Reactor-II Semi-Annual Floodgate Inspection (WO Package 331907, 2022), performed October 2022
- PM Experimental Breeder Reactor-II Semi-Annual Floodgate Inspection (WO Package 340968, 2023), performed April 2023
- PM Lost River Sinks Semi-Annual Floodgate Inspection (WO Package 331899, 2022), performed October 2022
- PM Lost River Sinks Semi-Annual Floodgate Inspection (WO Package 340960, 2023), performed April 2023
- PM Howe Semi-Annual Pole Line Road Floodgate Inspection (WO Package 331900, 2022), performed October 2022
- PM Howe Semi-Annual Pole Line Road Floodgate Inspection (WO Package 340961, 2023), performed April 2023.

The PA/CA maintenance plan further requires an annual evaluation of the potential impacts of proposed new facilities/projects with respect to the creation of perched water beneath the RHLLW Disposal Facility. Projects at the nearby ATR Complex that were initiated or continued in FY 2023 were evaluated. These include the:

- Continued construction of the new ATR Reactor Support Building, which is a general office building with a cafeteria
- ATR Parking Lot Refurbishment and Expansion
- ATR Core Internals Changeout (CIC) VI.

Except for the ATR CIC VI, wastewater generated from the projects consists of sanitary sewer wastewater discharged to lined treatment lagoons or storm runoff. Each of the construction projects incorporate general stormwater management features such as swales, ponds, or drainage basins for runoff control. The largest contributor to the perched water body below the ATR Complex is the Cold Waste Pond. While the ATR CIC VI contributed to additional flow to the Cold Waste Pond over the period of the outage, the total FY 2023 discharge was within both the historical operational discharges and the facility's wastewater-reuse permit limit (report year November–October) issued by Idaho Department of Environmental Quality. Therefore, the evaluation concluded that the impacts are insignificant regarding the creation of perched water beneath the RHLLW Disposal Facility.

2.9.3.2. As-Needed Maintenance Activities

As-needed maintenance activities that have not previously been addressed include maintenance actions for the facility-monitoring system and the facility-inventory-management system. In FY 2023, the laptop that communicates with the data-loggers that collect and store soil temperature, soil moisture, and soil water tension at the vault yard became inoperable, and a replacement will be procured in FY 2024. Currently, moisture-content data is used only to support lysimeter sampling and is not required. No other corrective maintenance items were identified in FY 2023.

3. CUMULATIVE EFFECTS OF CHANGES

As described in Section 2, there were no changes identified in FY 2023 that impact assumptions and conclusions of the PA and CA or impact the validity of the RWMB and ODAS. Therefore, there are no cumulative effects from the changes identified in Section 2.

4. WASTE CERTIFICATION AND RECEIPTS

4.1. Waste Certification

In accordance with the RHLLW Disposal Facility WAC (PLN-5446), annual FEs (see Section 2.9.1) are conducted according to MCP-4211 (2020) to initially certify or recertify waste-certification programs and waste streams are compliant with the WAC (PLN-5446). In FY 2023, NRF received initial certification (ASMT-2022-0618), and MFC was recertified (ASMT-2023-0490).

As a result, current waste streams approved for shipment and disposal to the RHLLW Disposal Facility are:

- Activated metals and surface-contaminated (SC) debris in HFEF-5 canisters from MFC
- Activated metals and SC debris in 55-ton canisters from NRF.

Initial waste-generator certification of ATR as a generator of ATR-5 waste canisters containing activated metals began in FY 2023 and is expected to be completed in FY 2024.

4.2. Waste Receipts

During FY 2023, 11 waste canisters were received at the RHLLW Disposal Facility, and 10 were disposed of. A 55-ton canister from NRF shipped and received 3 days before the end of FY 2023 was not placed in the vault until 10/3/23, in FY 2024. Table 3 contains information on these 11 canisters, including container type, waste form, disposal date, and disposal location.

Table 3. Waste receipts and disposals in FY 2023.

Generator	Generator Canister ID No.	Container Type	Waste Form ^a	Shiptask No.	Waste Receipt Date	Disposal Date	Vault Array	Disposal Position
NRF	ECF-05-18-121	55-ton	Combined	RHLLW-NRF-23-001	2/16/2023	3/7/2023	03	03-C04-1a (Bottom)
MFC	SN-181 (MFC100170)	HFEF-5	Combined	RHLLW-MFC-23-001	4/26/2023	4/26/2023	02	02-D03-1a (Bottom)
MFC	OWC-300-H5	HFEF-5	Combined	RHLLW-MFC-23-002	5/3/2023	5/3/2023	02	02-D03-1b (Top)
MFC	OWC-090-H5 (MFC100300)	HFEF-5	AM	RHLLW-MFC-23-003	5/18/2023	5/18/2023	02	02-D03-2a (Bottom)
NRF	ECF-05-18-102	55-ton	Combined	RHLLW-NRF-23-002	5/30/2023	5/31/2023	03	03-C03-1a (Bottom)
NRF	ECF-05-18-106	55-ton	Combined	RHLLW-NRF-23-003	6/21/2023	6/27/2023	03	03-C03-1b (Top)
NRF	ECF-05-18-112	55-ton	Combined	RHLLW-NRF-23-004	8/9/2023	8/10/2023	03	03-C04-1b (Top)
NRF	ECF-05-18-122	55-ton	Combined	RHLLW-NRF-23-005	8/30/2023	9/5/2023	03	03-F07-1a (Bottom)
MFC	MFC170303	HFEF-5	Combined	RHLLW-MFC-23-004	9/18/2023	9/19/2023	02	02-D03-2b (Top)
MFC	OWC-301-H5	HFEF-5	Combined	RHLLW-MFC-23-005	9/20/2023	9/25/2023	02	02-D03-3a (Bottom)
NRF	ECF-05-18-120	55-ton	Combined	RHLLW-NRF-23-006	9/27/2023	10/3/2023 ^b	03	03-F07-1b (Top)
a. AM = Activated Metals, SC = Surface-Contaminated Debris, Combined = Activated Metals and Surface-Contaminated Debris.								
b. Disposal in FY 2024.								

The HFEF vault array (Vault Array 02) consists of 15 vaults with positions for 12 canisters in each vault, resulting in a total capacity of 180 canisters. One of the five HFEF-5 canisters placed in FY 2023 contained activated metals, and the other four contained combined activated metals and SC debris. Three of the HFEF-5 canisters were legacy-waste canisters from the Radioactive Scrap and Waste Facility, and two (Canister IDs MFC170303 and OWC-301-H5) were new-generation (non-legacy) canisters from the Fuel Conditioning Facility (FCF) at MFC. The three legacy HFEF-5 waste canisters placed in FY 2023 were the last of the 59 legacy canisters stored at the Radioactive Scrap and Waste Facility to be shipped to the RHLLW Disposal Facility. The remaining empty HFEF vaults will be filled with HFEF-5 canisters of new generation waste from MFC, and waste in ATR-5 canisters from the ATR Complex. The ATR Canal Cleanup Project is currently undergoing certification (see Section 7).

The five 55-ton waste canisters shown in Table 3 are the first waste canisters from NRF disposed of in the RHLLW Disposal Facility. They all contain activated metals with small amounts of SC debris.

A summary of the canisters placed, and facility capacity are presented in Table 4. This contains the vault capacity, the total vaults/positions filled through FY 2023 and the percentage of vaults/positions filled. The location of all canister placements through FY 2023 is shown in Figure 4. Table 5 contains a summary of the volume of canisters placed in the vaults.

Table 4. Vault capacity summary through FY 2023.

Vault Array	Vault Type	Vault Description	Positions Filled FY 2023	Positions Filled Cumulative Through FY 2023	Empty Positions Remaining Through FY 2023	Total Positions	Percent Positions Filled Through FY 2023
01	NuPac	1 Hole (2 Levels)	0	0	120	120	0.0%
02	HFEF-5	6 Holes (2 Levels)	5	65	115	180	36.1%
	LCC	1 Hole (Single Storage)	0	0	195	195	0.0%
03	55-ton	1 Hole (2 Levels)	5	5	163	168	2.98%
04	Modified FTC	3 Holes (1 Level)	0	0	276	276	0.0%
Facility Totals			10	70	869	939	7.45%

Table 5. Placed canister volume summary through FY 2023.

2023 55-ton Canister Volume Summary through FY 2023					
Vault Array	Vault Type	Canister Type, Generator, Waste Form	Generator	Gross Volume (m ³) FY 2023	Cumulative Gross Volume (m ³) Through FY 2023
02	HFEF-5	HFEF-5 – MFC Activated Metals w/ lead plug	MFC	0	0.462
		HFEF-5 – MFC Activated Metals w/ steel plug	MFC	0.154	4.31
		HFEF-5 – MFC Combined w/ lead plug ^a	MFC	0	0.462
		HFEF-5 – MFC Combined w/ steel plug ^a	MFC	0.616	3.54
		HFEF-5 – MFC Surface Contaminated w/ lead plug	MFC	0	0.154
		HFEF-5 – MFC Surface Contaminated w/ steel plug	MFC	0	1.08
		Vault Array Total			0.770
03	55-ton	NRF 55-ton Canister – Activated Metals	NRF	13.9	13.9
		Vault Array Total			13.9
Facility Totals				14.6	23.9
a. Waste form is combined activated metals and SC debris.					

a. Waste form is combined activated metals and SC debris.

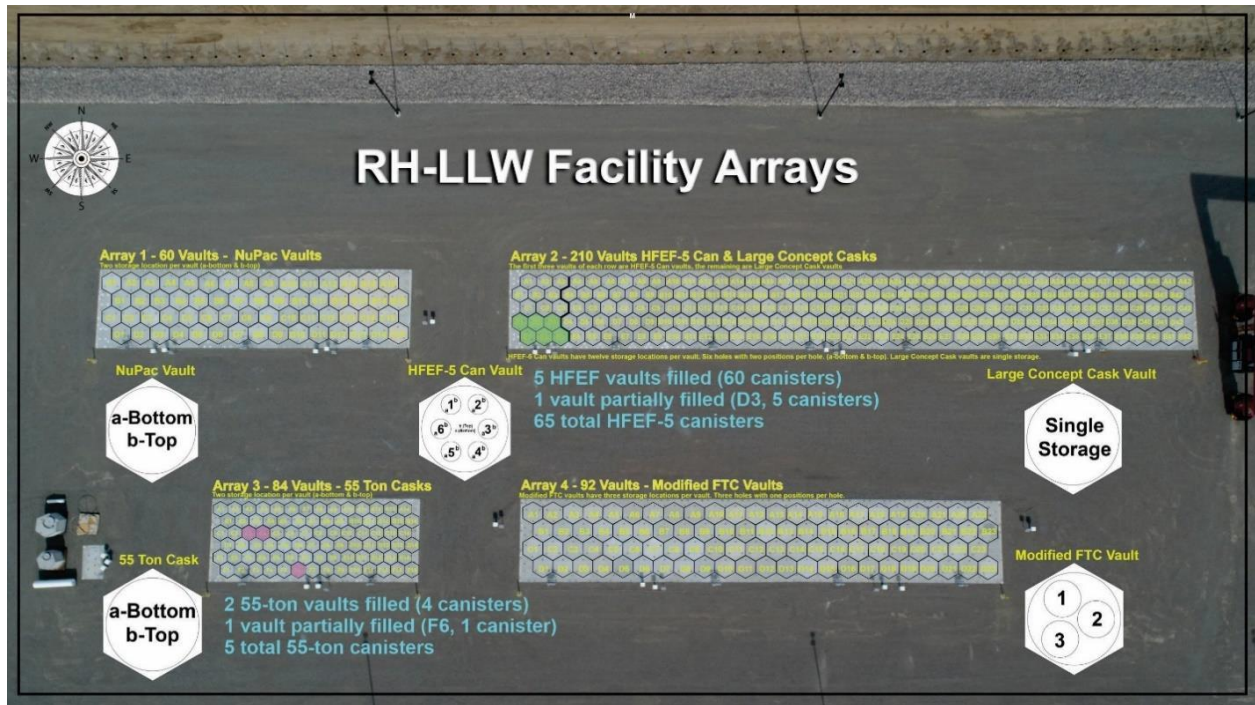


Figure 4. RHLLW canister-disposal locations through FY 2023.

4.3. Radionuclide Inventory Tracking Using RHINO

A running total of radionuclide activities by vault array, generator, and waste form is recorded and tracked using the facility-inventory management system, RHINO (TFR-981 2018). In FY 2023, 227 radionuclides were reported in activated metals and 135 radionuclides as surface contamination, for a total activity of 50,631 Ci in all ten waste canisters. The five HFEF-5 waste canisters reported 48,759 Ci in 14 radionuclides as activated metals and 98 radionuclides as surface contamination. Nearly all of the activity (99.3%) was reported in a single canister (OWC-300-H5) and most of that was reported as Fe-55 and Ni-63. Four radionuclides were reported as both activated metal and surface contamination. Eight of the reported radionuclides are non-system radionuclides, meaning they were not considered in the PA and are not included in the RHINO database. Non-system radionuclides are evaluated using the UDQE process (see Section 2.1). In the five 55-ton canisters placed in FY 2023, 1,873 Ci were reported for 225 radionuclides in activated metals and 93 radionuclides as surface contamination. The 93 radionuclides reported as surface contamination were also reported as activated metals. Radionuclide reporting requirements are documented in the WAC (PLN-5446).

As part of the canister-acceptance process, dose calculations are performed by RHINO based on the reported activities of the 14 radionuclides fully analyzed in the PA for the groundwater pathway, the five radionuclides that account for 99% of the chronic-intruder dose (limiting intruder scenario), and the three radionuclides considered in the final air-pathway screening in the PA. The air pathway was screened out in the PA, but the three radionuclides considered in the final air-pathway screening step are included in the 14 groundwater-pathway radionuclides and potential doses via the air pathway are calculated by RHINO. Table 6 contains the inventory placed in FY 2023 and cumulative inventory for the 14 groundwater-pathway radionuclides fully analyzed in the PA. These are recorded and presented by array, generator, and waste form.

At the end of FY 2023, the NRF 55-ton vault array was 3% full based on canister capacity (see Table 4). The radionuclide inventories for this generator, canister, and waste form as a percentage of the PA base-case inventory (see Table 6, last column) are near this percentage, with some exceptions. The percentages in activated metal (A) of Tc-99 (9.68%), Np-239 (11.1%), U-235 (13.3%), Mo-93 (14.3%), and Cl-36 (56.2%) are greater than the 3%. The high Cl-36 comes from two canisters (ECF-05-18-102 and ECF-05-18-106) which account for 97.7% of the Cl-36 inventory disposed of from NRF in FY 2023. The Cl-36 inventory in these two canisters was flagged by RHINO and evaluated in UDQE-RHLLW-069 and UDQE-RHLLW-070 (see Table 2). Because radionuclide contents can vary greatly from canister to canister, continued monitoring will reveal if high inventories in a few canisters are anomalous or indicative of a change in waste generation rates.

Table 6 also shows the cumulative inventory of several radionuclide/waste-form combinations in HFEF-5 canisters as a percentage of the PA base-case inventory are much greater than expected. However, of the three largest percentages (Np-237 [2626%], Pu-240 [1037%], and I-129 [908%]), the Np-237 and I-129 percentages were the same as last year, and Pu-240 only increased 9.0% from the previous year. This indicates the high percentages were the result of canisters placed previous to FY 2023. As discussed in the FY 2022 ASR, the high percentages for many of the radionuclides in HFEF-5 canisters is due primarily to larger-than-expected inventories in new-generation (non-legacy) waste canisters. As a result of these differences, the radionuclide inventories in legacy and new-generation waste in HFEF-5 canisters was reassessed in ECAR-5959, "Evaluation of Remote Handled Low-Level Waste (RHLLW) Radionuclide Inventory Data Generated at Materials and Fuels Complex." The information in ECAR-5959 will be evaluated in a UDQE in FY 2024.

All occurrences of canisters with higher-than-expected inventories are flagged by RHINO and evaluated through the UDQE process. Although the inventories are greater than expected, they are typically small compared to the total PA inventories for all generators and canisters. This explains why the projected all-pathway dose contributed by these radionuclides is not significant with respect to performance objectives (see Section 4.4).

Table 6. Radionuclide activities disposed of by array, generator, and waste form through FY 2023 compared to inventory analyzed in the PA for the groundwater pathway.

Nuclide	Vault Array	Waste Generator	Waste Form ^a	FY 2023 Inventory (Ci)	Cumulative Inventory Through FY 2023 (Ci)	PA Inventory (Ci) ^b	Cumulative Inventory Through FY 2023 as % of PA Inventory
C-14	55-ton	NRF	A	7.07E-01	7.07E-01	4.78E+01	1.48%
			R	—	—	2.36E-02	—
			S	4.81E-02	4.81E-02	8.09E-01	5.94%
	HFEF-5	ATR	A	—	—	2.36E+01	—
		MFC	A	4.66E-02	5.97E-01	2.75E+00	21.7%
	LCC	NRF	A	—	—	1.12E+02	—
			R	—	—	5.40E-02	—
			S	—	—	6.98E+00	—
	Modified FTC	MFC	A	—	—	1.95E+01	—
			S	—	—	2.87E-01	—
	NuPac	ATR	R	—	—	9.77E-01	—
Cl-36	55-ton	NRF	A	1.24E-02	1.24E-02	2.21E-02	56.2%
	HFEF-5	ATR	A	—	—	3.40E-06	—
	LCC	NRF	A	—	—	9.24E-02	—

Nuclide	Vault Array	Waste Generator	Waste Form ^a	FY 2023 Inventory (Ci)	Cumulative Inventory Through FY 2023 (Ci)	PA Inventory (Ci) ^b	Cumulative Inventory Through FY 2023 as % of PA Inventory
H-3	55-ton	NRF	A	4.67E-01	4.67E-01	6.12E+01	0.76%
			R	—	—	1.14E+00	—
			S	8.41E-06	8.41E-06	0 ^c	NA ^c
	HFEF-5	ATR	A	—	—	1.76E+03	—
		MFC	A	1.36E-02	3.32E-01	1.21E+01	2.75%
	LCC	NRF	S	—	2.88E-05	3.49E-05	82.6%
			A	—	—	1.47E+02	—
	NuPac	ATR	R	—	—	2.61E+00	—
I-129	55-ton	NRF	A	3.91E-08	3.91E-08	1.09E-01	—
			R	—	—	1.76E+03	—
			S	1.91E-07	1.91E-07	2.66E-06	7.18%
	HFEF-5	ATR	A	—	—	5.52E-07	—
		MFC	S	2.10E-14	4.00E-08	2.47E-15	—
	LCC	NRF	A	—	—	4.40E-09	908%
			R	—	—	5.87E-06	—
			S	—	—	1.27E-06	—
	Modified FTC	MFC	S	—	—	1.94E-05	—
	NuPac	ATR	R	—	—	4.83E-04	—
Mo-93	55-ton	NRF	A	3.03E-02	3.03E-02	5.33E-02	—
	HFEF-5	ATR	A	—	—	2.11E-01	14.3%
		MFC	A	3.78E-02	1.29E+00	5.41E-01	—
	LCC	NRF	A	—	—	2.78E+00	46.4%
	Modified FTC	MFC	A	—	—	2.61E-01	—
			S	—	—	2.17E+01	—
Nb-94	55-ton	NRF	A	1.73E-01	1.73E-01	3.19E-01	—
			R	—	—	3.71E+00	4.65%
			S	9.65E-04	9.65E-04	6.16E-10	—
	HFEF-5	ATR	A	—	—	1.15E-02	8.39%
		MFC	A	2.53E-01	7.06E-01	3.82E+01	—
	LCC	NRF	A	—	—	1.11E+00	63.7%
			R	—	—	8.31E+00	—
			S	—	—	1.41E-09	—
	Modified FTC	MFC	A	—	—	1.46E-01	—
			S	—	—	4.74E+00	—
	NuPac	ATR	R	—	—	7.02E-02	—
						8.48E-01	—

Nuclide	Vault Array	Waste Generator	Waste Form ^a	FY 2023 Inventory (Ci)	Cumulative Inventory Through FY 2023 (Ci)	PA Inventory (Ci) ^b	Cumulative Inventory Through FY 2023 as % of PA Inventory
Ni-59	55-ton	NRF	A	1.61E+01	1.61E+01	5.83E+02	2.77%
			R	—	—	3.39E+00	—
			S	1.45E-02	1.45E-02	3.16E-01	4.58%
	HFEF-5	ATR	A	—	—	1.90E+02	—
		MFC	A	3.72E-01	2.51E+00	8.85E+00	28.3%
	LCC	NRF	A	—	—	9.30E+02	—
			R	—	—	7.76E+00	—
			S	—	—	3.19E+00	—
	Modified FTC	MFC	A	—	—	9.05E+01	—
			S	—	—	1.33E+00	—
	NuPac	ATR	R	—	—	7.61E-01	—
Np-237	55-ton	NRF	A	1.95E-07	1.95E-07	1.76E-06	11.1%
			R	—	—	4.49E-06	—
			S	2.34E-10	2.34E-10	3.35E-09	6.97%
	HFEF-5	MFC	S	1.09E-11	1.80E-06	6.86E-08	2626%
			A	—	—	4.49E-06	—
			R	—	—	1.03E-05	—
	LCC	NRF	S	—	—	6.89E-08	—
			A	—	—	4.49E-06	—
			R	—	—	1.03E-05	—
	Modified FTC	MFC	S	—	—	5.82E-04	—
	NuPac	ATR	R	—	—	9.18E-05	—
Pu-239	55-ton	NRF	A	2.38E-03	2.38E-03	6.60E-02	3.61%
			R	—	—	3.09E-05	—
			S	2.04E-06	2.04E-06	7.04E-05	2.90%
	HFEF-5	MFC	S	1.25E-03	1.45E-02	1.56E-02	92.9%
			A	—	—	1.47E-01	—
			R	—	—	7.07E-05	—
	LCC	NRF	S	—	—	3.78E-04	—
			A	—	—	1.47E-01	—
			R	—	—	7.07E-05	—
	Modified FTC	MFC	S	—	—	2.99E-01	—
	NuPac	ATR	R	—	—	2.88E-02	—
Pu-240	55-ton	NRF	A	5.39E-04	5.39E-04	5.67E-02	0.95%
			R	—	—	6.31E-05	—
			S	1.22E-06	1.22E-06	6.22E-05	1.96%
	HFEF-5	MFC	S	5.23E-05	6.33E-04	6.11E-05	1037%
			A	—	—	1.15E-01	—
			R	—	—	1.45E-04	—
	LCC	NRF	S	—	—	3.13E-04	—
			A	—	—	1.15E-01	—
			R	—	—	1.45E-04	—
	Modified FTC	MFC	S	—	—	1.85E-03	—
	NuPac	ATR	R	—	—	1.81E-03	—

Nuclide	Vault Array	Waste Generator	Waste Form ^a	FY 2023 Inventory (Ci)	Cumulative Inventory Through FY 2023 (Ci)	PA Inventory (Ci) ^b	Cumulative Inventory Through FY 2023 as % of PA Inventory
Tc-99	55-ton	NRF	A	3.43E-03	3.43E-03	3.54E-02	9.68%
			R	—	—	1.69E-02	—
			S	1.18E-04	1.18E-04	1.43E-03	8.25%
	HFEF-5	ATR	A	—	—	2.58E-02	—
		MFC	A	—	1.58E-02	0 ^d	NA ^d
			S	5.01E-02	1.66E-01	5.36E-01	30.9%
	LCC	NRF	A	—	—	3.73E-02	—
			R	—	—	3.87E-02	—
			S	—	—	8.29E-03	—
	Modified FTC	MFC	S	—	—	2.57E+00	—
	NuPac	ATR	R	—	—	1.97E+00	—
U-234	55-ton	NRF	A	1.63E-06	1.63E-06	2.64E-05	6.18%
			R	—	—	8.28E-05	—
			S	1.49E-08	1.49E-08	4.78E-07	3.12%
	HFEF-5	MFC	S	1.32E-04	2.27E-04	1.17E-04	193%
	LCC	NRF	A	—	—	9.36E-05	—
			R	—	—	1.90E-04	—
			S	—	—	1.59E-06	—
	Modified FTC	MFC	S	—	—	5.16E-06	—
	NuPac	ATR	R	—	—	9.18E-05	—
U-235	55-ton	NRF	A	5.97E-08	5.97E-08	4.49E-07	13.3%
			R	—	—	1.11E-06	—
			S	1.01E-12	1.01E-12	1.57E-10	0.64%
	HFEF-5	MFC	S	4.78E-07	2.96E-06	1.81E-06	163%
	LCC	NRF	A	—	—	2.53E-06	—
			R	—	—	2.54E-06	—
			S	—	—	2.18E-10	—
	Modified FTC	MFC	S	—	—	3.70E-03	—
	NuPac	ATR	R	—	—	4.53E-06	—

Nuclide	Vault Array	Waste Generator	Waste Form ^a	FY 2023 Inventory (Ci)	Cumulative Inventory Through FY 2023 (Ci)	PA Inventory (Ci) ^b	Cumulative Inventory Through FY 2023 as % of PA Inventory
U-238	55-ton	NRF	A	1.56E-06	1.56E-06	3.10E-05	5.04%
			R	—	—	5.13E-09	—
			S	2.35E-10	2.35E-10	1.40E-08	1.68%
	HFEF-5	MFC	S	7.25E-07	2.01E-06	9.11E-07	221%
	LCC	NRF	A	—	—	1.04E-04	—
			R	—	—	1.18E-08	—
			S	—	—	2.92E-08	—
	Modified FTC	MFC	S	—	—	7.40E-04	—
<p>a. Waste forms include A = activated metals, R = resin, S = surface contamination. Surface contamination may be on debris or activated metal components.</p> <p>b. Cumulative inventory from Table 3-2 in the PA (DOE-ID 2018a). For this table, the cumulative inventory for MFC waste in the HFEF-5 vault array is the combined HFEF-Legacy and HFEF-Future (new-generation) wastes from Table 3-2 of the PA (or Tables 8 and 9 of ECAR-3940, “Baseline Radionuclide Inventory for The Remote-Handled Low-Level Waste Disposal Facility for Use in the Facility Performance Assessment”). They are combined because both are treated the same for calculating the all-pathway PA dose.</p> <p>c. Tritium (H-3) as surface contamination was not reported in the proposed inventory for NRF 55-ton canisters evaluated for the PA. However, because tritium as surface contamination is listed in other waste streams, the dose is calculated by RHINO and included in the all-pathway dose contribution.</p> <p>d. Tc-99 as activated metal was not reported in the proposed inventory for MFC-legacy or new-generation HFEF-5 canisters evaluated for the PA. However, because Tc-99 is listed in the ATR waste stream also destined for the HFEF-vault array, the dose is calculated by RHINO and included in the all-pathway dose contribution.</p>							

Table 7 presents the FY 2023 and cumulative inventory for the five radionuclides that are the primary contributors to the chronic-intruder-pathway dose. These radionuclides and activities are only presented by vault array because the canister type and waste form are not important for calculating intruder dose. The inventory shows Cs-137 and Sr-90 are the highest percent of the HFEF-5 vault-array action level at 15.1% and 14.8%, respectively. Given the total number of HFEF-5 canisters placed through FY 2023 is 36.1% of the HFEF-vault array capacity (Table 4), the cumulative inventories of these two radionuclides are presently not a cause for concern, but the percentages will continue to be monitored.

Table 7. Radionuclide inventory of primary dose contributors to the chronic-intruder pathway through FY 2023.

Nuclide	Vault Array	FY-2023 Inventory (Ci)	Cumulative Inventory Through FY 2023 (Ci)	Vault Array Action Level ^a (Ci)	Cumulative Inventory Through FY 2023 as % of Vault Array Action Level
Co-60	55-ton	8.69E+01	8.69E+01	7.33E+05	0.01%
	HFEF-5	8.01E+02	8.47E+03	3.79E+06	0.22%
	LCC	—	—	1.17E+06	—
	Modified FTC	—	—	2.68E+04	—
	NuPac	—	—	4.24E+03	—
Cs-137	55-ton	2.60E-02	2.60E-02	1.27E+02	0.02%
	HFEF-5	4.80E-01	9.31E+00	6.12E+01	15.2%
	LCC	—	—	2.76E+02	—
	Modified FTC	—	—	1.69E+04	—
	NuPac	—	—	1.14E+02	—

Nuclide	Vault Array	FY-2023 Inventory (Ci)	Cumulative Inventory Through FY 2023 (Ci)	Vault Array Action Level ^a (Ci)	Cumulative Inventory Through FY 2023 as % of Vault Array Action Level
Nb-94	55-ton	1.74E-01	1.74E-01	6.88E+01	0.25%
	HFEF-5	2.53E-01	7.06E-01	7.27E+02	0.097%
	LCC	—	—	1.57E+02	—
	Modified FTC	—	—	8.90E+01	—
	NuPac	—	—	1.57E+01	—
Ni-63	55-ton	1.58E+03	1.58E+03	1.36E+06	0.12%
	HFEF-5	8.51E+03	8.65E+03	4.68E+05	1.85%
	LCC	—	—	2.11E+06	—
	Modified FTC	—	—	8.64E+04	—
	NuPac	—	—	6.29E+02	—
Sr-90	55-ton	1.56E-02	1.56E-02	8.53E+01	0.02%
	HFEF-5	5.32E-01	1.85E+01	1.25E+02	14.8%
	LCC	—	—	1.92E+02	—
	Modified FTC	—	—	1.17E+04	—
	NuPac	—	—	3.00E+02	—
a. Vault-array action levels (ECAR-2073, 2018 Table A-3 or INL 2018, Table 20) are based on the ratio of the chronic dose standard (100 mrem/year) to the total estimated chronic-intruder dose in the PA (5.42 mrem/year). This ratio, $100/5.42 = 18.5$, was multiplied by the estimated PA base-case inventory of each radionuclide in each vault array to calculate action levels. They are not disposal limits, but exceedance of an action level for one vault array would trigger a review of disposals in all vault arrays.					

4.4. Performance Objectives Tracking Using RHINO

The RHLLW Disposal Facility does not depend on the radionuclide sum-of-fractions rule^j to determine compliance with performance objectives. Rather, the facility uses the RHINO software to calculate facility performance with each shipment and disposal. In addition to tracking inventory and performing canister-acceptance checks based on the WAC, RHINO calculates the maximum all-pathways dose, air-pathway dose, chronic-intruder dose, and applicable groundwater concentrations as each canister is considered for shipment. RHINO can also calculate these performance measures for annual and cumulative disposals. The calculated values are compared to canister and facility-wide threshold values and regulatory-performance objectives to determine waste acceptance. The calculations are performed using abstractions of the PA model, so the results are as if the PA model were used. The calculations are performed only for the radionuclides not screened out in the PA, and account for the majority of the dose. The technical basis, methodology, and implementation used in RHINO is described in Methods, Implementation, and Testing to Support Determination of Performance Assessment Compliance for the RHLLW Disposal Facility WAC (INL 2018).

^j The sum-of-fraction rule for mixtures of radionuclides in waste is often used to determine the amount of each radionuclide that can be disposed of based on its limit derived from the PA. It is calculated by dividing each nuclide's concentration or dose contribution by the appropriate limit and adding each of the resulting values. If the sum is less than 1.0, then the limit has not been exceeded.

The reason the sum-of-fractions rule is not used to determine compliance is that, except for the intruder dose, the PA calculates dose and concentration performance measures based on vault array (location), canister type, and waste form for each radionuclide. For example, a curie of tritium in activated metal in a 55-ton waste canister in the 55-ton vault array does not have the same impact on the groundwater or air-pathway dose as a curie of tritium on SC debris in an HFEF-5 canister in the HFEF-vault array.

Table 8 summarizes the performance measures for all disposals in FY 2023 and cumulative disposals through FY 2023. As expected, the calculated-dose and concentration-performance measures for all canisters placed through FY 2023 are a small fraction of the applicable performance objectives. Based on this, the impact of cumulative disposals is not inconsistent with PA predictions, and there are no impacts to the assumptions or conclusions of the PA.

Table 8. Summary of facility performance through FY 2023.

Performance Objective or Measure	Performance Standard	Point of Assessment Location	Compliance Period			Post-Compliance Period		
			Maximum Based on FY-2023 Disposals	Maximum Based on Cumulative Disposals Through FY 2023	Cumulative Disposal Maximum as % of Standard	Maximum Based on FY-2023 Disposals	Maximum Based on Cumulative Disposals Through FY 2023	Cumulative Disposal Maximum as % of Standard
All-Pathway Dose	25 mrem/yr	100 m	4.09E-05	1.35E-04	0.0005%	2.38E-02	7.88E-02	0.32%
Air-Pathway Dose ^a	10 mrem/yr	100 m	5.72E-05 ^b	5.79E-05 ^b	0.001% ^b	NA ^c	NA ^c	NA ^c
Intruder Dose	100 mrem/yr	Facility	8.43E-02	1.36E-01	0.14%	NA ^c	NA ^c	NA ^c
Beta-Gamma DE ^d	4 mrem/yr	100 m	2.91E-05 ^e	9.62E-05 ^e	0.002% ^e	1.69E-02 ^e	5.60E-02 ^e	1.40% ^e
Beta-Gamma ED ^d	4 mrem/yr	100 m	1.59E-05 ^e	5.26E-05 ^e	0.0013% ^e	9.25E-03 ^e	3.06E-02 ^e	0.77% ^e
Gross Alpha	15 pCi/L	100 m	2.56E-30	4.52E-30	3.01E-29%	2.40E-06	6.33E-06	0.00004%
Ra-226/228	5 pCi/L	100 m	1.27E-32	2.17E-32	4.35E-31%	1.19E-06	2.03E-06	0.00004%
Uranium Mass	30 ug/L	100 m	2.85E-28	8.78E-28	2.93E-17%	5.38E-06	1.67E-05	0.00006%
<p>a. Although the air pathway was screened out in the PA, air-pathway doses are calculated by RHINO using the Phase III air-pathway screening model from the PA. RHINO does not calculate radon flux because the radon flux calculated in the PA was insignificant compared to the performance objective.</p> <p>b. The air-pathway dose in the PA is due to C-14, H-3 and I-129.</p> <p>c. Air-pathway and intruder doses peak during the compliance period. No doses are reported for the post-compliance period.</p> <p>d. DE = dose equivalent, ED = effective dose.</p> <p>e. Radionuclides that contribute to the beta-gamma DE and ED include C-14, Cl-36, H-3, I-129, Mo-93, Nb-94, Ni-59, and Tc-99 (DOE-ID 2018a, Sections 4.2.2 and 4.2.3).</p>								

5. MONITORING

Compliance and performance monitoring began in FY 2019 with commencement of operations of the facility and is conducted in accordance with the monitoring plan, PLN-5501. PLN-5501 was developed to meet the requirements for monitoring the RHLLW Disposal Facility according to the U.S. DOE Order 435.1, “Radioactive Waste Management,” and the guidance provided in the associated technical standard, “Disposal Authorization Statement and Tank Closure Documentation” (DOE-STD-5002-2017).

The most-important monitoring activities are associated with the groundwater exposure pathway. Water samples are collected from aquifer-monitoring wells and analyzed to determine compliance with groundwater-quality standards for radionuclides. Soil-porewater samples, collected from lysimeters in the vadose zone adjacent to and below the base of the vault arrays, are analyzed to establish background concentrations and evaluate facility performance. Data from subsurface moisture and temperature sensors are monitored to determine favorable conditions for lysimeter sample collection, as needed. Aquifer and lysimeter-sample results are summarized and discussed in Sections 5.1 and 5.2, respectively.

No air- or radon-emissions monitoring is performed for the facility because the air and radon pathways were screened from a detailed analysis in the PA. However, the INL Site ambient-air-monitoring program operates a network of low-volume air samplers to monitor the INL Site and surrounding region for atmospheric levels of radioactive particulates, radioiodine, and tritium released from INL facilities, natural radioactivity, and fallout from worldwide nuclear detonations or accidents. One of the particulate samplers is located immediately outside the facility fence south of the vault yard in the direction of the predominate wind direction. Results are presented in annual site environmental reports for each calendar year and reviewed for this ASR. The most recent results, from Calendar Year 2022 (DOE-ID 2023), indicate gross alpha and gross beta were detected in concentrations consistent with historical measurements. Compositing quarterly samples were analyzed for specific radionuclides, and results were again consistent with historical measurements. All results were well below derived concentration standards established by DOE for inhaled air (DOE-STD-1196-2021).

The biotic-intrusion pathway was also screened from a detailed analysis in the PA, but the vault yard and side slopes are inspected annually for biotic activity (e.g., burrowing insects, animals, and plants) as part of the annual inspection under MWO 260064 (2018), covered under WO 342547 (2023) for Calendar Year 2023. Some vegetation growth on a few areas of the vault-yard perimeter were found during the inspection, and the vegetation was sprayed and/or removed. The gaps around one vault shield plug were measured to be slightly out of tolerance; however, the measurements are consistent with normal variations and do not appear to be a migration issue.

The only other monitoring activities performed at the facility are annual visual inspections of the vault-yard road apron, a topographic survey and compaction measurements, and inspection of VSPs for damage. The road-apron inspection showed typical rutting, settling, erosion, sedimentation, and uneven surfaces consistent with past annual inspections. All findings were deemed not significant in nature and expected for gravel surfaces, especially in industrial areas where heavy equipment is being operated (see Section 2.9.3.1). The topographic survey and compaction measurements were completed and show there are no significant issues and only typically expected changes from initial configuration/conditions. The scope of the vault inspection requires all VSP top surfaces of vaults that contain waste to be inspected, as well as the top surfaces of empty adjacent vaults. The inspection found three VSPs with cracks or chips/spalls that required repair. Any damage and repairs (if necessary) are managed using the change-control process (RH-ADM-5214). Repairs are scheduled for December 2023 (see Section 2.9.3.1). UDQEs associated with vault damage or repairs are presented in Section 2.1. Two vaults (see Figure 3, PA Confirmation Vaults) are not designed to receive waste, but are available for monitoring and study, as necessary. Currently, no plans to monitor or study the condition of these vaults (including the concrete and reinforcement) are in place, but monitoring may be initiated if trend data from lysimeter or aquifer samples are unfavorable, according to PLN-5501.

5.1. Compliance Monitoring

Compliance monitoring for the groundwater pathway is performed by sampling three aquifer wells near the RHLW Disposal Facility (see Figure 5). Two wells, USGS-140 and USGS-141, are located approximately 100 m downgradient of the vault-yard fence, and one aquifer well, USGS-136, is located approximately 20 m upgradient of the vault yard. Samples are collected annually from each well and analyzed for target and indicator analytes to confirm compliance with state groundwater-quality standards

(IDAPA 58.01.11). If performance-monitoring concentrations (Section 5.2) exceed action levels, compliance monitoring frequency is increased from annual to semi-annual. Although, the performance-monitoring action levels only apply after the initial period to establish baseline concentrations, semi-annual groundwater sampling was performed in FY 2023 due to the gross-alpha action level being exceeded in some lysimeters.

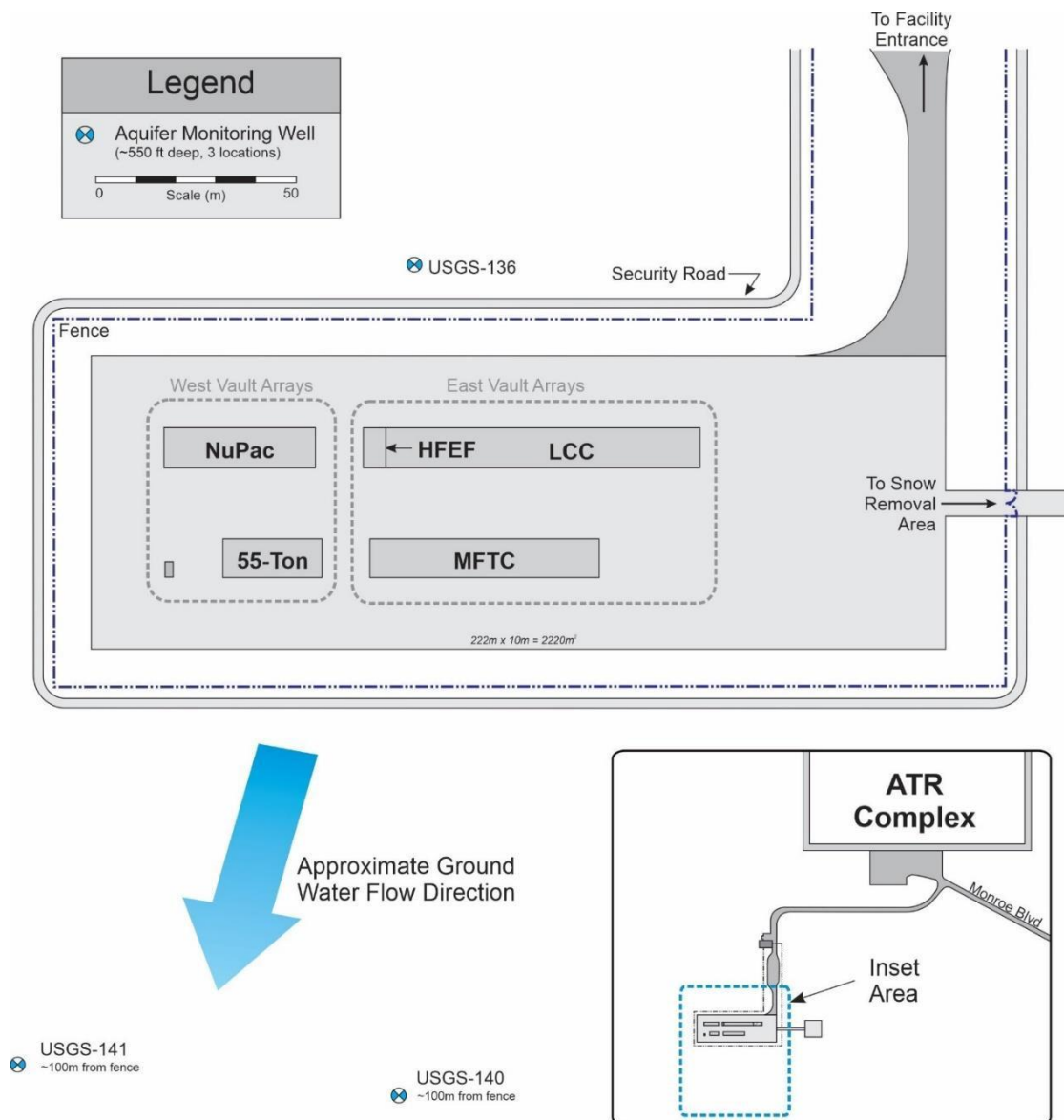


Figure 5. RHLLW Disposal Facility layout showing aquifer-monitoring well locations.

Table 3 of PLN-5501 lists 14 radionuclides as contaminants of potential concern for the groundwater pathway. These are the 14 radionuclides that failed the groundwater-pathway screening and were fully analyzed in the PA. For monitoring, four key radionuclides were selected as target analytes (e.g., H-3, C-14, Tc-99, and I-129) due to the largest degree of mobility and predicted impact on the aquifer and the all-pathways dose. In addition to target analytes, samples are analyzed for indicator analytes, gross alpha, and gross beta. The PA demonstrated that there are no principal contaminants of concern that undergo gamma decay that would be expected to affect the groundwater pathway; therefore, gamma monitoring is not included in the compliance monitoring.

Samples were collected from each of the three aquifer wells in May and September 2023. Results of the compliance monitoring are presented in Appendix B, “Compliance and Performance-Monitoring Data for the RHLLW Disposal Facility,” and summarized in Table 9. Tritium was detected in all three aquifer wells and concentrations continue to exhibit a decreasing trend since 2018, consistent with regional trends observed in DOE-ID (2021). Gross beta was positively detected in all three wells in FY 2023 while gross alpha was detected in two of the wells (USGS-136 and USGS-141). Historically, gross alpha and gross beta have been detected in all three wells at low levels (<5 pCi/L) with gross alpha being detected less frequently than gross beta. In FY 2023, C-14, I-129, and Tc-99 were not detected in any samples from the three wells. All results are consistent with concentrations in the aquifer established prior to facility completion (INL 2017).

5.2. Performance Monitoring

Performance monitoring of the facility is achieved by analysis of soil-porewater samples collected from vadose-zone lysimeters. All lysimeters are installed adjacent to vault arrays (see Figure 6) in native materials at three general depths: (1) shallow alluvium, below the drainage course material at the base of the vaults (~26–29 ft bls), (2) deep alluvium, above the upper basalt contact (~40–44 ft bls), and (3) sedimentary interbeds (~171–176 ft bls). The monitoring plan specifies that sample collection from vadose zone monitoring points is only required when sufficient porewater is present and can be collected.

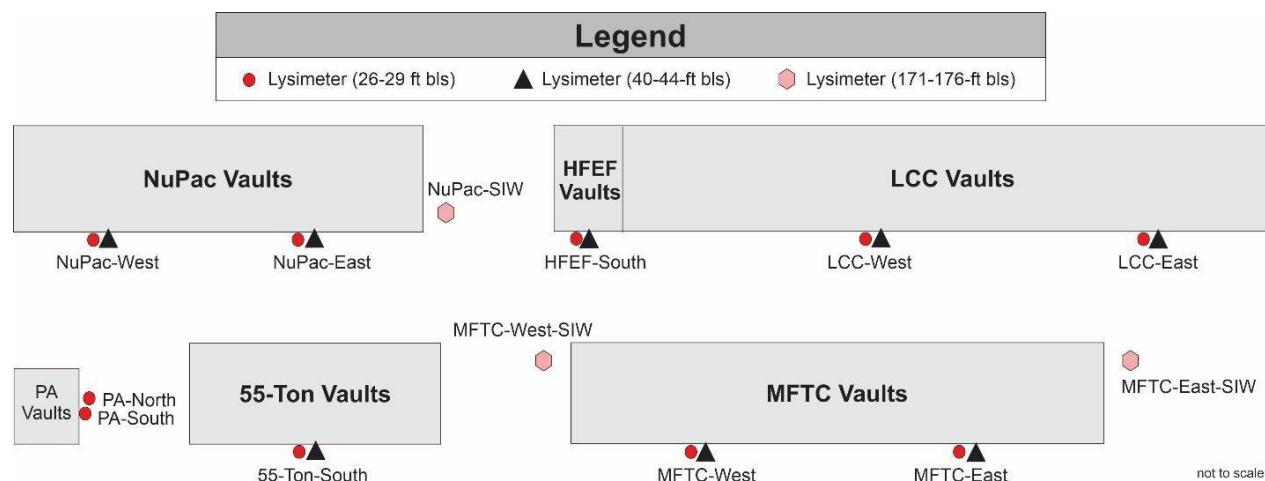


Figure 6. Plan view of the vault arrays showing the lysimeter locations.

FY 2019 began a 3-year period to establish baseline concentrations for all lysimeters. During this period, samples were to be collected annually and analyzed for the same target and indicator analytes as the aquifer samples. Approximately 530–730 mL of sample is required for the full suite of analytes. In the event of insufficient porewater for full analysis, the precedence for analysis is gross alpha/beta, C-14, I-129, H-3, and then Tc-99. After the baseline period, the monitoring plan specifies that annual sampling be conducted only at lysimeters near vaults that have received waste, and samples will be analyzed only for indicator analytes, gross alpha, and gross beta (as sample volumes permit). Annual sampling will continue as long as positive detections of either gross alpha or gross beta do not exceed action levels at any of the monitoring locations. If gross-alpha or gross-beta action levels are exceeded, as shown through trend analysis, sampling frequency will be increased to semiannually (as soil water is available) and continue as long as action levels are exceeded. Semiannual samples will be analyzed for target analytes H-3, C-14, Tc-99, and I-129, in addition to gross alpha and gross beta.

In FY 2022, a preliminary evaluation of lysimeter data collected during the 3-year period to establish baseline concentrations (FY 2019 through FY 2021) was performed, and it determined that insufficient data had been collected to establish baseline concentrations for several lysimeters and analytes (see INL

2023a, Appendix B, Table B-6). As a result, the baseline period was extended to 4 years, and routine sampling was performed in FY 2022. However, analyte priorities were modified for specific lysimeters so that samples would be analyzed for analytes with less data.

While the baseline data report was being prepared (INL 2023b), FY 2023 lysimeter samples continued to be analyzed for both indicator and target analytes. During spring sampling, all 10 lysimeters in the shallow-alluvium yielded water, and sufficient volume was collected from eight for the full suite of analytes. Sufficient volume was collected from four of those lysimeters to perform duplicate analyses for one or more analytes. All eight lysimeters in the deep-alluvium yielded water, but quantities were limited similar to previous years. Sample volumes from the eight lysimeters were combined and processed for the full suite of analytes. All three of the sedimentary-interbed lysimeters yielded water, but one (NuPac-SIW) produced only enough volume to analyze for tritium. MFTC-West-SIW produced enough volume to analyze for gross alpha/beta. The third lysimeter (MFTC-East-SIW) yielded enough water for the full suite of analytes and duplicate analyses for gross alpha/beta and tritium. This lysimeter has historically been the best producer of water of the three sedimentary-interbed lysimeters.

Of the 10 shallow-alluvium lysimeters, six positively detected gross alpha (down from eight in FY 2022), and all 10 detected gross beta (up from nine in FY 2022). The combined sample from all eight deep-alluvium lysimeters was positive for gross alpha and gross beta, as were both samples from two of the sedimentary-interbed lysimeters. C-14, I-129, and Tc-99 were not detected in any of the spring lysimeter samples. Tritium however was detected in four of the 10 shallow-alluvium lysimeters, down from five the previous year, and seven the year before that. Tritium was detected in the combined deep-alluvium lysimeter sample, but it was not detected in two samples from the sedimentary-interbed lysimeters.

In addition to the routine annual lysimeter sampling in the spring, all lysimeters were sampled in the fall of 2022 (FY 2023) and analyzed for tritium and other analytes as sample volumes permitted. This “non-routine” sampling was conducted in response to an unexpectedly high tritium result from lysimeter HFEF-South in spring FY 2020 and the need for additional analyses to complete the evaluation of baseline data. The original high tritium result is discussed in detail in Section 5.2.1 of the FY 2021 ASR (INL 2022a). Although there is no action level for tritium in soil porewater, a decision was made after the unexpectedly high tritium concentration to conduct semi-annual sampling of selected lysimeters until the tritium concentration in lysimeter HFEF-South declined to less than the federal drinking-water maximum-contaminant level (MCL) of 20,000 pCi/L. Because the latest tritium result for HFEF-South (4,350 pCi/L, spring 2023) meets this criteria, semiannual sampling will be discontinued after fall 2023 if this condition continues to be met (see Figure 7).

All performance-monitoring results for FY 2023 are presented in Appendix B and summarized in Table 10. All sample concentrations were less than current action levels, with two exceptions. The gross-alpha result from the PA-North lysimeter sample (12.9 pCi/L) exceeds the action level of 10 pCi/L. This result is consistent with the previous 4 years that were also slightly above the action level for this lysimeter. According to the monitoring plan (PLN-5501), this lysimeter is not scheduled to be sampled after baseline concentrations are established because no waste will be placed in the vault near this lysimeter. The other gross-alpha result that exceeded the action level was the combined sample from all eight deep-alluvium lysimeters (14.0 pCi/L). This is less than the FY-2022 gross-alpha result (17.9 pCi/L) from a sample that combined water from six of the eight deep-alluvium lysimeters.

The evaluation of 4 years of baseline data is documented in the report, “Assessment of Baseline Monitoring Data for the Remote-Handled Low-Level Waste Disposal Facility at Idaho National Laboratory,” (INL 2023b). INL (2023b) concluded that sufficient data had been collected over the first

^k Detection is defined as the result being statistically positive at the 95% confidence interval and above the minimum detectable concentration. This generally corresponds to the result being greater than 3 times the measurement uncertainty. U- and UJ-qualified data are not considered detections. J-qualified data are considered detections.

4 years of operation of the RHLLW Disposal Facility to establish baseline conditions for future compliance monitoring of aquifer wells and performance monitoring of vadose-zone lysimeters. Based on this the project plans to move from the baseline data collection phase (originally planned for 3 years, but extended to 4 years), as outlined in the monitoring plan. INL (2023b) also made the following recommendations that will be added to the monitoring plan in FY 2024 (see Section 7 for additional details).

- The lysimeter action level for gross alpha will be increased from 10 to 20 pCi/L. An action level of 20 pCi/L, is slightly greater than the 99% upper confidence level (UCL) for all baseline lysimeter samples, is protective of the aquifer, and would reduce unnecessary sampling. As a result, groundwater sampling will revert back to annual sampling, as specified in the monitoring plan, until the action level for gross alpha or gross beta action is exceeded.
- Tritium will be added to the lysimeter-analyte list for post-baseline period monitoring. After the baseline period, the monitoring plan calls for analysis of indicator analytes gross alpha and gross beta only. However, tritium is not likely to show up in a gross-beta analysis, and while not a dose concern, tritium is a good tracer that can provide valuable information on water flow in and around the RHLLW Disposal Facility and requires a minimal sample volume.

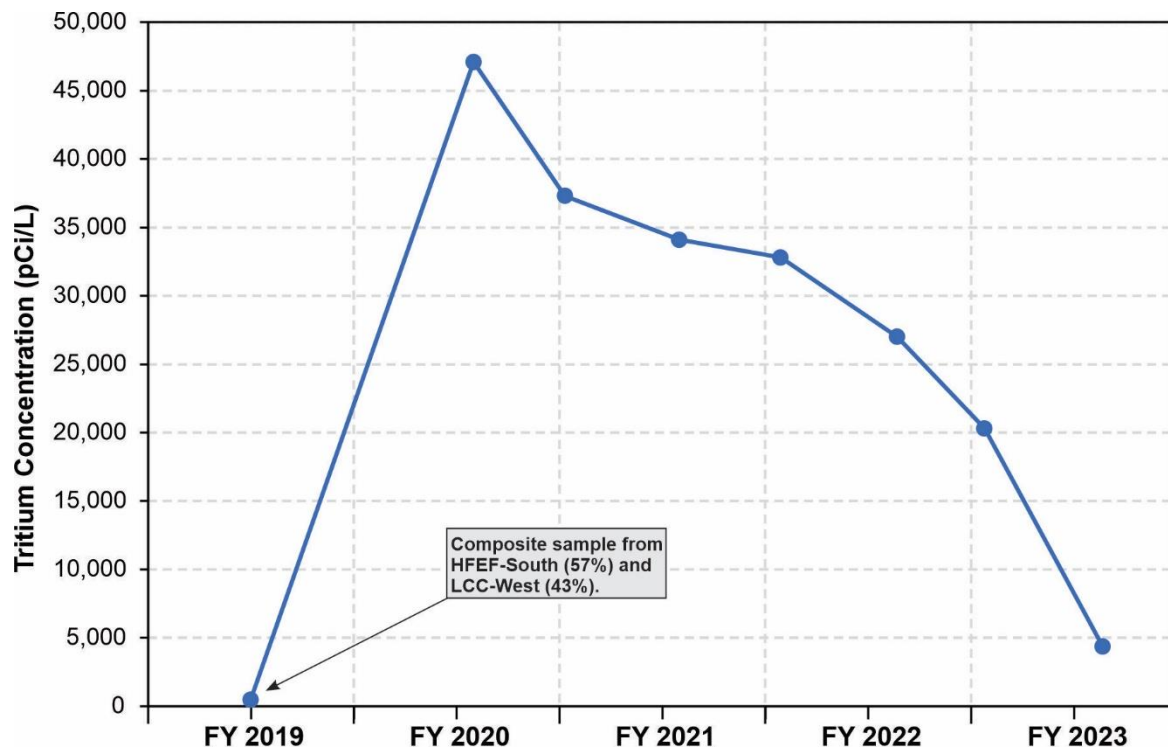


Figure 7. Tritium concentration time history in lysimeter HFEF-South.

Table 9. Compliance monitoring summary for the RHLLW Disposal Facility in FY 2023.

Monitoring Location	Monitoring Type	Monitoring Results	Performance Objective Measure or Other Regulatory Limit	Action Level	Action(s) Taken	PA/CA Impacts
RHLLW Disposal Facility Vicinity (Aquifer wells USGS-136, USGS-140, and USGS-141)	Groundwater (indicator analytes gross alpha, and gross beta; and target analytes C-14, H-3, I-129 and Tc-99)	Tritium (H-3) was detected in all three aquifer wells and continues to show a decreasing trend. Gross beta was positively detected in all three wells. Gross alpha was detected in wells USGS-136 and USGS-141. C-14, I-129 and Tc-99 were not detected in any samples. Results are all significantly less than regulatory limits and consistent with historical measurements (INL 2017).	State of Idaho Groundwater Quality Rule (IDAPA 58.01.11)	Drinking-water MCLs	Because the gross alpha action level for performance monitoring will increase, there are no exceedances of action levels (see Section 5.2), and thus semi-annual groundwater sampling will revert back to annual sampling.	None. No impacts to the PA or CA.
CA = Composite analysis IDAPA = Idaho Administrative Procedures Act PA = Performance assessment						

Table 10. Performance-monitoring summary for the RHLLW Disposal Facility in FY 2023.

Monitoring Location	Monitoring Purpose	Monitoring Results and Trends	PA Expected Behavior	Action(s) Taken	PA/CA Impacts
Vadose zone lysimeters adjacent to and below the disposal vaults. Moisture-content data are reviewed only to support lysimeter if necessary.	Provide data to indicate potential radionuclide release from source zone and migration toward aquifer.	<p>All 21 of the lysimeters yielded water, and nine yielded sufficient water for the full suite of analytes. All sample concentrations were non-detect or less than action levels with two exceptions. The gross alpha results for the PA-North lysimeter sample and the combined sample from the deep-alluvium lysimeters were 12.9 pCi/L and 14.0 pCi/L respectively. These are greater than the original action level of 10 pCi/L. The action level is being increased to 20 pCi/L based on a recommendation in INL (2023b).</p> <p>High H-3 concentrations in lysimeter HFEF-South continued to decline and the latest result, 4,350 pCi/L (spring 2023), is less than the drinking-water MCL of 20,000 pCi/L. MCLs do not apply to porewater and are not action levels, but are used for comparison purposes only.</p>	<p>FY 2023 is the fifth year of operations. Because very little waste has been emplaced and only in two locations (see Figure 4), the concentrations are considered not to have been impacted by disposals. Therefore, these concentrations are considered reflective of background concentrations with the exception of the elevated tritium result from the HFEF-South lysimeter. The impact of the elevated tritium on the PA predicted groundwater dose is insignificant (see Section 5.2.1 of the FY 2021 ASR, INL 2022a) and monitoring results are consistent with assumptions and results from the PA.</p>	<p>Discontinue semi-annual sampling of selected lysimeters in the fall based on low H-3 concentrations in lysimeter HFEF-South. Update monitoring plan and increase gross alpha action level from 10 to 20 pCi/L based on recommendation in INL (2023b).</p> <p>Begin post-baseline period sampling per the monitoring plan: sample lysimeters near waste and analyze for indicator analytes gross alpha and gross beta.</p> <p>Add H-3 to the post-baseline period analyte list per the recommendation in INL (2023b).</p>	None. No changes to PA/CA results and conclusions.
<p>CA = composite analysis PA = performance assessment</p>					

6. RESEARCH AND DEVELOPMENT

No research and development activities were conducted at the RHLLW Disposal Facility in FY 2023 (see Table 11).

Table 11. Research and development activities.

Document Number	Results	PA/CA Impacts
None	N/A	N/A

7. PLANNED OR CONTEMPLATED CHANGES

Planned or contemplated changes are presented in Table 12. Potential changes to technical-basis documents include revisions or updates to the monitoring plan (PLN-5501), the WAC (PLN-5446), and the change control document (RH-ADM-5214). Updates to the monitoring plan are based on recommendations from the report, “Assessment of Baseline Monitoring Data for the Remote-Handled Low-Level Waste Disposal Facility at Idaho National Laboratory” (INL 2023b). Action levels in the original monitoring plan were established prior to monitoring. The initial gross-alpha action level was not based on regional data, modeling, or protectiveness, but was established as a conservative value that is less than the gross-alpha drinking water standard. INL (2023b) recommended the gross-alpha action level for performance monitoring of lysimeters be increased from 10 to 20 pCi/L. An action level of 20 pCi/L is slightly greater than the 99% UCL, is protective of the aquifer, and would reduce unnecessary sampling.

INL (2023b) also concluded that sufficient data had been collected over the first 4 years of operation of the RHLLW Disposal Facility to establish baseline conditions for future compliance monitoring of aquifer wells and performance monitoring of vadose-zone lysimeters. Based on this the project plans to move from the baseline data-collection phase (originally planned for 3 years, but extended to 4) as outlined in the monitoring plan. However, INL (2023b) recommended that tritium be added to the lysimeter analyte list for post-baseline-period monitoring. Tritium, while not a dose concern, is a good tracer that can provide valuable information on water flow in and around the RHLLW Disposal Facility. These changes to the monitoring plan are planned for FY 2024 and are not expected to impact the conclusions of the PA/CA.

Tables B-6 and B-8 in Appendix B of the WAC will be updated to include radionuclides on NRF SC debris that were not included in the projected inventory of surface contamination on NRF activated metal components for the original PA inventory. NRF Waste Programs provided information that was used to estimate a projected 20-year inventory for SC debris. This inventory was evaluated and determined to be within the bounds of the PA (see INL 2023a: Table 2, UDQE-RHLLW-052). The evaluation recommended the radionuclides be added to the WAC. As the NRF ECF water-pool chemistry will be analyzed every 3 years, any new radionuclides identified will be evaluated using the change-control process. The tables in Appendix B of the WAC are used by RHINO during the waste-canister acceptance process.

Another potential change to the WAC involves radionuclides on resins. NRF is proposing to extend the service life of Radioactive Water Demineralizer System (RWDS) modules in the ECF water pool and the Naval Spent Fuel Handling Facility water pool when it becomes operable. NRF indicated this could impact or change the base-case inventory of radionuclides on NRF resins used for PA dose calculations. As a result, NRF provided RHLLW Disposal Facility personnel with a new revised 20-year estimate of radionuclides on NRF resins assuming the service life of RWDS modules would be extended. This new revised RWDS resin inventory is documented in Nelson (2023) and will be evaluated using the change-control process in FY 2024. If the revised inventory is deemed acceptable, tables in Appendix B of the WAC would require revision. NRF Waste Programs is also developing bounding resin inventories for 55-ton and LCC waste canisters so that it can be determined if the accident analyses in ECAR-1559, “Evaluation of Facility Inventory and Radiological Consequences to Support RHLLW Disposal Facility Safety Basis,” require updating. The current bounding inventories for waste containers with NRF resins are found in Table A-3 of ECAR-1559. If ECAR-1559 requires updating, Tables A-2 and A-4 of the WAC will need to be updated. These changes to the WAC are planned for FY 2024 and are not expected to impact the conclusions of the PA/CA.

The change-control document will be revised to remove FRM-2544 from the list of documents requiring mandatory screening. In FY 2023, FRM-2544 was revised to update the limits for removable surface contamination for NRF waste canisters based on the outcome of UDQE-RHLLW-058 and add NRF as a certified waste generator. UDQE-RHLLW-058 also recommended that FRM-2544 be removed from the list of documents requiring mandatory screening (UDQS) in RH-ADM-5214 because forms do not and will not include new proposed activities, changes in existing activities, facility-configuration changes, or new information that would potentially affect the assumption and/or conclusions of the PA or CA. The revision is planned for FY 2024.

A reevaluation of the radionuclide inventory in legacy and new-generation waste in HFEF-5 waste canisters from MFC that began in FY 2022 was completed in FY 2023. This activity was initiated in response to discrepancies between canister inventories used for the PA, and updated canister inventories estimated prior to shipping to the RHLLW Disposal Facility. The updated inventory estimates are based on dose-rate measurements taken prior to shipping. The results of this evaluation, which have the potential to impact the PA, will be evaluated using the change-control process in FY 2024.

Operational activities associated with shipment and disposal of ATR-5 waste canisters from the ATR are expected to begin in FY 2024. An initial waste-generator certification assessment of ATR Complex Waste Programs was initiated in FY 2023, and approval is anticipated early in FY 2024. Although these are anticipated activities and should not be considered changes, they will increase operations at the facility. ATR-5 canisters will be placed in the HFEF vault array (Array 2).

Only one of the planned changes discussed in the section could potentially impact the PA, CA, ODAS, or the RHLLW Disposal Facility design, operations, closure, research and development, or land use. The full impact of the HFEF-5 inventory reevaluation will be determined and evaluated using the change-control process.

Table 12. Planned or contemplated changes for the RHLLW Disposal Facility.

Planned or Contemplated Change	Change Basis	PA/CA Impact	Schedule
Update monitoring plan (PLN-5501)	An effort to establish and document baseline concentrations of all indicator and target analytes for groundwater and lysimeter samples, based on 4 years of data collection, was completed in FY 2023 (INL 2023b). The report recommended the gross-alpha action level for lysimeter samples be increased, and tritium be added to the lysimeter analyte list for post-baseline-period monitoring. The monitoring plan will be revised to incorporate these recommendations.	None	FY 2024
Update WAC (PLN-5446)	Tables B-6 and B-8 in Appendix B of the WAC will be updated to include new radionuclides identified on NRF SC debris (see INL 2023a: Table 2, UDQE-RHLLW-052).	None	FY 2024
Update WAC (PLN-5446)	Table B-7 in Appendix B of the WAC could potentially be revised to include new radionuclides identified on NRF resins. This will be evaluated using the change-control process in FY 2024. Additionally, Tables A-2 and A-4 in Appendix A of the WAC may also require revision after evaluation of the accident analyses in ECAR-1559.	None expected	FY 2024
Revise change-control document RH-ADM-5214	UDQE-RHLLW-058 recommended RH-ADM-5214 be revised to remove FRM-2544 from the list of documents requiring mandatory screening (UDQS) because forms do not and will not include new proposed activities, changes in existing activities, facility configuration changes, or new information that would potentially affect the assumption and/or conclusions of the PA or CA.	None	FY 2024
Evaluate potential impacts of reevaluated radionuclide inventories used in the PA for HFEF-5 waste canisters from MFC	Discrepancies between canister inventories used for the PA, and updated canister inventories estimated prior to shipping prompted a reevaluation of the inventories used for the PA. The results of this evaluation documented in ECAR-5959 have the potential to impact the PA. The potential impacts will be evaluated using the change control process.	TBD	FY 2024
Begin operational activities and waste shipments/disposals of ATR-5 waste canisters	Initial waste-generator certification of the ATR Canal Cleanup Project as a generator of ATR-5 waste canisters containing activated metals began in FY 2023 and is expected to be completed in FY 2024. Operational activities and ATR-5 waste-canister shipments from the ATR Complex are expected to begin in FY 2024.	None	FY 2024

8. STATUS OF ODAS CONDITIONS AND KEY AND SECONDARY ISSUES

The PA, CA, and all related technical-basis documentation for the RHLLW Disposal Facility were reviewed and approved by the DOE Low-Level Waste Disposal Facility Federal Review Group (LFRG) in FY 2018. The ODAS for the RHLLW Disposal Facility was approved in May 2018 (ODAS 2018). No conditions, key or secondary issues, or other findings were identified by the LFRG in FY 2023.

No outstanding issues or conditions were placed on disposal operations at the RHLLW Disposal Facility as a result of recent assessments, ODAS conditions, or key and secondary issues identified during LFRG review of the PA and CA (see Table 13).

Table 13. ODAS conditions and key and secondary issues.

Disposal Facility/Unit	Key/Secondary Issue or ODAS Condition Number	Issue Description	Initial Resolution Schedule Date	Projected Resolution Scheduled Date	Disposition Documentation and Date Completed	PA, CA, ODAS Impact
N/A ^a						
a. Not applicable for FY 2023.						

9. DETERMINATION OF CONTINUED ADEQUACY OF THE PA, CA, ODAS, AND RWMB

The primary purpose of the RHLLW Disposal Facility ASR is to review the activities conducted over the past fiscal year to evaluate the adequacy of the assumptions and conclusions of the approved PA (DOE-ID 2018a), CA (DOE-ID 2012), CA Addendum (DOE-ID 2018b), ODAS (ODAS 2018), and RWMB (INL 2020a).

This FY 2023 ASR was reviewed and determined to demonstrate the continued adequacy of the PA, CA, ODAS, ODAS technical-basis documents, and the RWMB to meet the DOE Order 435.1 performance objectives for the RHLLW Disposal Facility. As presented in this report, it is determined that assumptions and conclusions of the PA, CA, and ODAS remain valid:

- No changes in operations or activities that might impact the PA and CA assumptions and conclusions have been identified (Section 2).
- Waste receipts were mostly consistent with the assumptions of the PA. Some differences in projected vs. actual waste receipts have been flagged by RHINO, but the impacts were determined to be within the bounds of the PA. All differences continue to be monitored and evaluated (Section 4).
- Compliance and performance-monitoring results indicate assumptions and conclusions of the PA and CA are appropriate (Section 5).
- The only technical-basis document revised in FY 2023 was the WAC (PLN-5446) (see Section 2.9.2). All changes were evaluated using the change-control process and determined to be within the bounds of the PA. Projected disposal operations indicate continued compliance with the RWMB (Section 2). The most recent RWMB was approved by the field-element manager on December 11, 2020 (FY 2021). A draft of the next revision of the RWMB was completed in FY 2023 and is expected to be approved by DOE-ID in FY 2024.

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Appendix A

Fiscal Year 2023 Unreviewed Disposal Question Screenings and Evaluations for the RHLLW Disposal Facility

This appendix includes copies of UDQs and UDQEs that were completed and approved by the end of FY 2023. Evaluations that were initiated, but not completed, are listed as “in progress” in Table 2 of the ASR and are not included here. Evaluations that were cancelled are also not included here. One special analysis was completed in FY 2023 (“Special Analysis: An Assessment of Potential Dose Impacts from External Contamination on Naval Reactors Facility Waste Canisters,” INL/RPT-22-68668). The following are included herein:

- RHLLW-UDQE-055, Page 47
- RHLLW-UDQE-058, Page 58
- RHLLW-UDQE-063, Page 64
- RHLLW-UDQE-067, Page 71
- RHLLW-UDQE-068, Page 95
- RHLLW-UDQE-069, Page 104
- RHLLW-UDQE-070, Page 114
- RHLLW-UDQE-071, Page 126
- RHLLW-UDQE-074, Page 133
- RHLLW-UDQE-075, Page 143
- RHLLW-UDQE-076, Page 155
- RHLLW-UDQE-077, Page 164
- RHLLW-UDQE-078, Page 174

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

UDQE Tracking No.: UDQE-RHLLW-055

Subject: Review Document, "Five-Year Review of CERCLA Response Actions at the INL Site," for
Potential Impacts to the RHLLW Disposal Facility PA and CA

NOTE: *The objective of this screening is to determine whether further evaluation is required for a proposed change, new information, or discovery to ensure the validity of the existing Performance Assessment (PA; DOE/ID-11421) and Composite Analysis (CA; DOE/ID-11422) are not impacted.*

Describe the Proposed Change in Activity/New Information/Discovery:

The Remote-Handled Low-Level Waste Disposal Facility Performance Assessment/Composite Analysis (PA/CA) Maintenance Plan (PLN-3368) requires several planned maintenance activities be completed annually or as specified. One of the as-specified activities is:

- Evaluate potential impact of published Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA) five-year reviews (FYRs) on RH-LLW PA/CA, including review of upgradient groundwater monitoring data.

CERCLA FYRs are conducted every five years to meet the statutory mandate under CERCLA Section 121(c) and the requirements of the National Contingency Plan. The purpose of FYRs is to evaluate the implementation and performance of an environmental remedy in order to determine if it is or will be protective of human health and the environment. Information in the reports, specifically identification of new contaminated sites (if any) or monitoring data from facilities immediately upgradient and downgradient of the RHLLW Disposal Facility, can be helpful in determining if perched water and aquifer conditions (water levels, radionuclide concentrations, etc.) have changed enough to potentially impact the validity or conclusions of the PA or CA.

The purpose of this activity is not to conduct an in-depth review of the FYR report, but to determine if there is information in the report that could potentially impact the validity or conclusions of the PA or CA. The activity is to be conducted as FYRs are published. The latest report, "Five-Year Review of CERCLA Response Actions at the Idaho National Laboratory Site—Fiscal Years 2015–2019" (DOE/ID-12034, 2021), was completed in FY-2021 and is the fourth site-wide FYR of cleanup actions at the INL Site. This UDQS/UDQE serves as documentation that the review was conducted and summarizes the findings of that review. The result of this review and the findings will determine if an evaluation is necessary to determine the potential impacts to the PA and/or CA.

Summary of Review of Five-Year Review of CERCLA Response Actions at the Idaho National Laboratory Site— Fiscal Years 2015–2019

The FYR report evaluated response actions at 8 operable units (OUs) (1-07B, 2-13, 3-13, 3-14, 4-12/13, 7-13/14, 10-04, and 10-08) at 6 Waste Area Groups (WAGs) at the INL Site. The water quality in the aquifer near the RHLLW Disposal Facility has been adversely impacted due to past facility operations at the upgradient ATR Complex. Downgradient, the aquifer has been impacted by operations at INTEC, CFA and the RWMC. This review focused on the FYR of OUs that are upgradient (WAG 2, ATR Complex), cross-gradient (WAG 3, INTEC and WAG 4, CFA) and downgradient (WAG 7, RWMC) of the RHLLW Disposal Facility with respect to the aquifer flow direction. OUs 10-04 and 10-08 (WAG 10) were also reviewed because they include miscellaneous sites not associated with INL facilities, future sites, and sitewide groundwater. Although the CERCLA FYR considered multiple contaminant types, this review focused on radionuclide contamination.

The FYR concluded that, overall, remedies at the INL Site are—or are expected to be—protective of human health and the environment. The FYR identified no issues or recommendations for the OUs associated with WAG 2, WAG 3, WAG 4, WAG 7, or WAG 10. Only two issues were identified and both are associated with WAG 1 (TAN). Because the WAG 1 remedy is expected to achieve remedial action objectives (RAOs) and is approximately 36 km upgradient of the RHLLW Disposal Facility, there is no impact to the RHLLW Disposal Facility PA or CA.

Upgradient WAG 2 (ATR Complex)

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

The ATR Complex is located approximately ½ km northeast of the RHLLW vault yard. According to the FYR, remediation is complete at the ATR Complex except for groundwater and perched-water monitoring under an OU-specific monitoring plan (DOE-ID 2016a). The FYR of OU 2-13 focused on perched-water and groundwater monitoring activities which indicate OU 2-13 remedies are functioning as intended in decision documents. In general, contaminant concentrations are trending lower in perched water and are below maximum contaminant levels (MCLs) in the aquifer due to natural processes, and decreasing trends are ahead of model predictions.

In general, contaminant concentrations are trending lower in perched water and are below maximum contaminant levels (MCLs) in the aquifer due to natural processes, and decreasing trends are ahead of model predictions. The size of the perched-water zone is approximately the same as it was in FY 2009, and water levels decreased in all perched-water wells except one, with decreases averaging approximately 3.8 ft during the FYR period. Perched-water wells are sampled for Sr-90, tritium and Co-60. Sr-90 and tritium were detected in perched water, but concentrations of both are generally decreasing (see Figures 1 and 2 below). Sr-90 exceeded the MCL in six perched-water wells, while all tritium results are less than the MCL. Co-60 has been detected in the past in perched-water, but was not detected in this FYR period. Six aquifer wells near the ATR Complex are also sampled for Sr-90, tritium and Co-60. Sr-90 and Co-60 were not detected during the FYR period. Tritium was detected in all 6 wells, but concentrations were less than MCLs and declining (see Figures 3 and 4 below).

In summary, perched water and groundwater institutional controls are in place and the boundaries of current institutional control areas adequately encompass contaminated media. The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selections are still valid, and no new information has come to light that would call into question the protectiveness of the remedies.

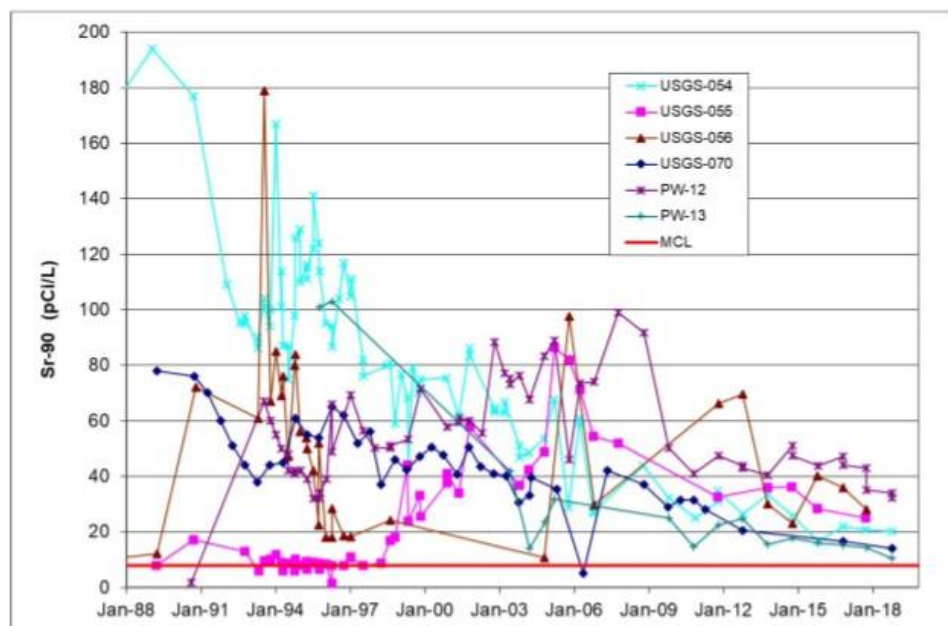


Figure 1. Strontium-90 concentration trends in perched-water wells at the ATR Complex (from DOE/ID-12034).

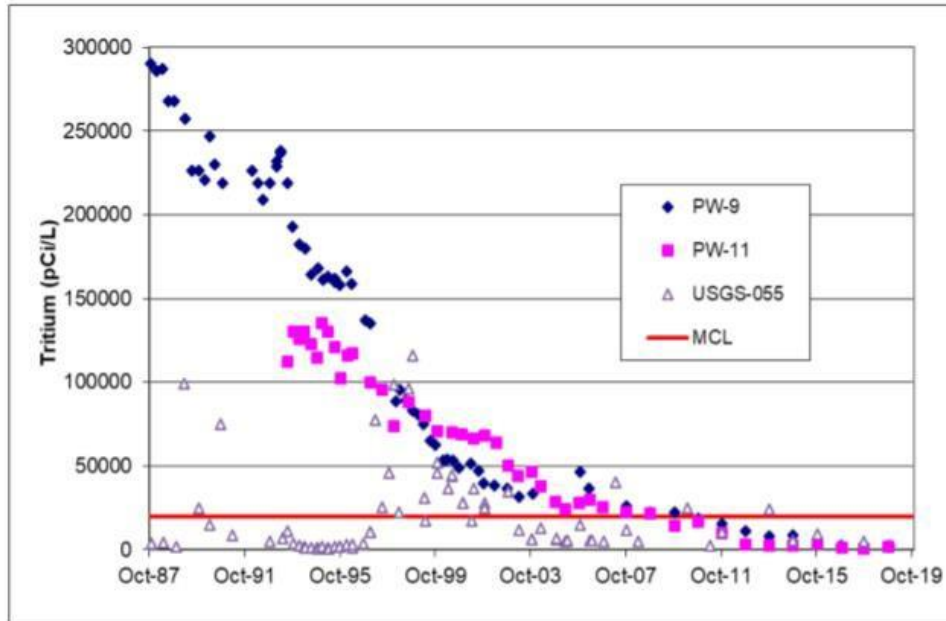


Figure 2. Tritium concentrations in perched water wells at the ATR Complex (from DOE/ID-12034).

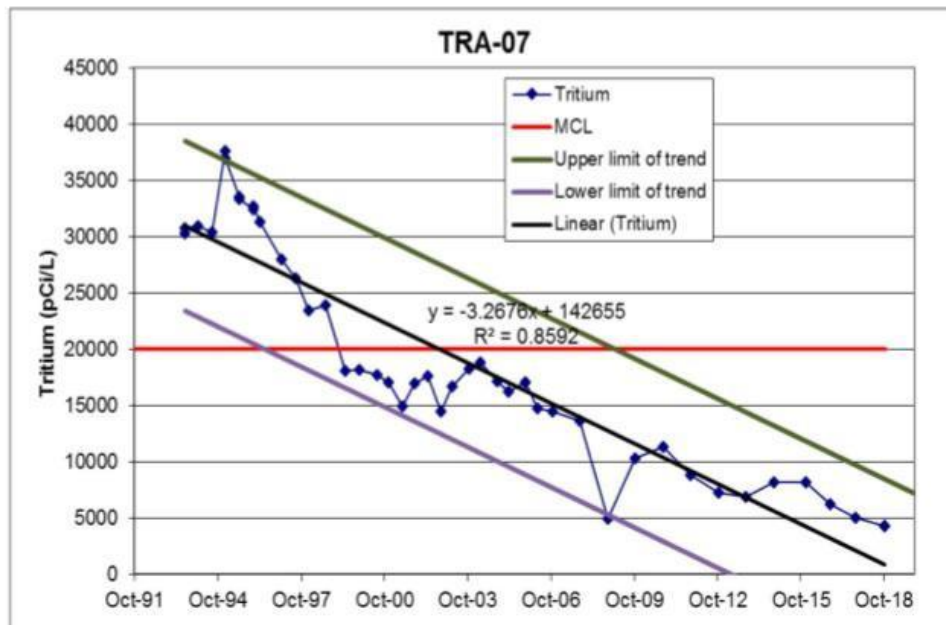


Figure 3. Tritium concentration trend analysis for aquifer Well TRA-07.

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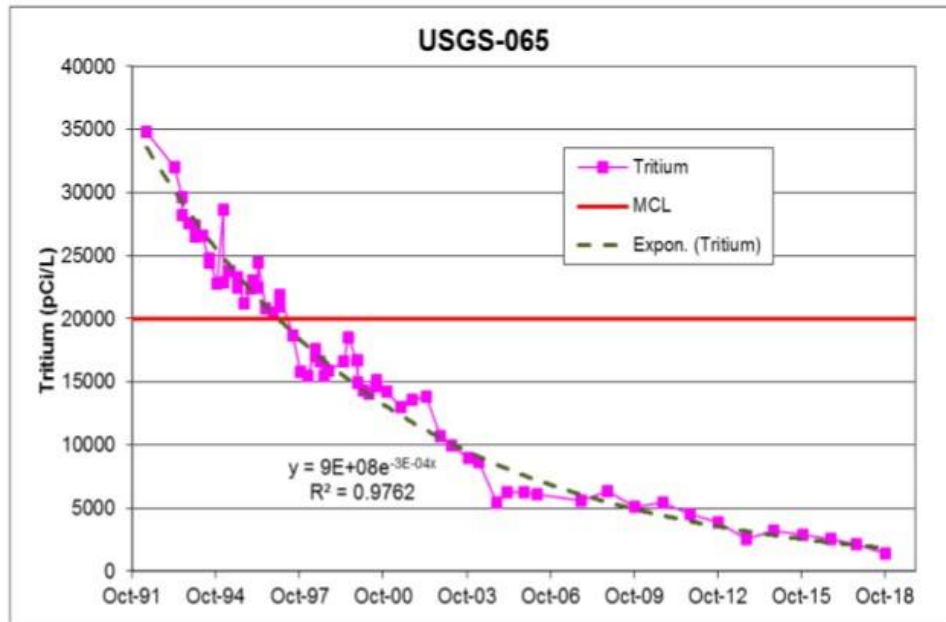


Figure 4. Tritium concentration trend analysis for aquifer Well USGS-065.

Cross-gradient WAG 3 (INTEC) and WAG 4 (CFA)

The RHLLW Disposal Facility CA addendum (INL 2018) concluded the impact of the RH-LLW Disposal Facility on cross-gradient or downgradient facility closure decisions is negligible. The RH-LLW Disposal Facility *de minimis* contribution to the cumulative groundwater dose will not require any downgradient or cross-gradient facilities to consider the presence of the RH-LLW Disposal Facility when closure actions or closure requirements are considered.

According to the FYR, the remedies for OUs 3-13 and 3-14 (WAG 3) are expected to be protective of human health and the environment upon completion, and, in the interim, exposure pathways that could result in unacceptable risks are being controlled. OU 3-13 operations and maintenance (O&M) activities and monitoring data collected to date show the Idaho CERCLA Disposal Facility (ICDF) is operating and functioning as intended by decision documents. Although OU 3-14 remedial actions are only partially complete at this time, the actions to date are functioning as intended in the decision document, and monitoring results indicate that the OU 3-14 remedy will be protective. Actions to reduce recharge are successfully reducing the volume of perched water and slowing migration of Sr-90 and other contaminants toward the aquifer. Declining concentration trends in the aquifer show that groundwater quality is steadily improving and that MCLs will be met in groundwater for all constituents before the year 2095 (see Figure 5 below).

According to the FYR, the remedy for OU 4-12/13 (WAG 4) is protective of human health and the environment, and exposure pathways that could result in unacceptable risks are being controlled. Remediation is complete except for monitoring, O&M of landfill covers, and institutional controls. Radioactivity is not included in CFA monitoring.

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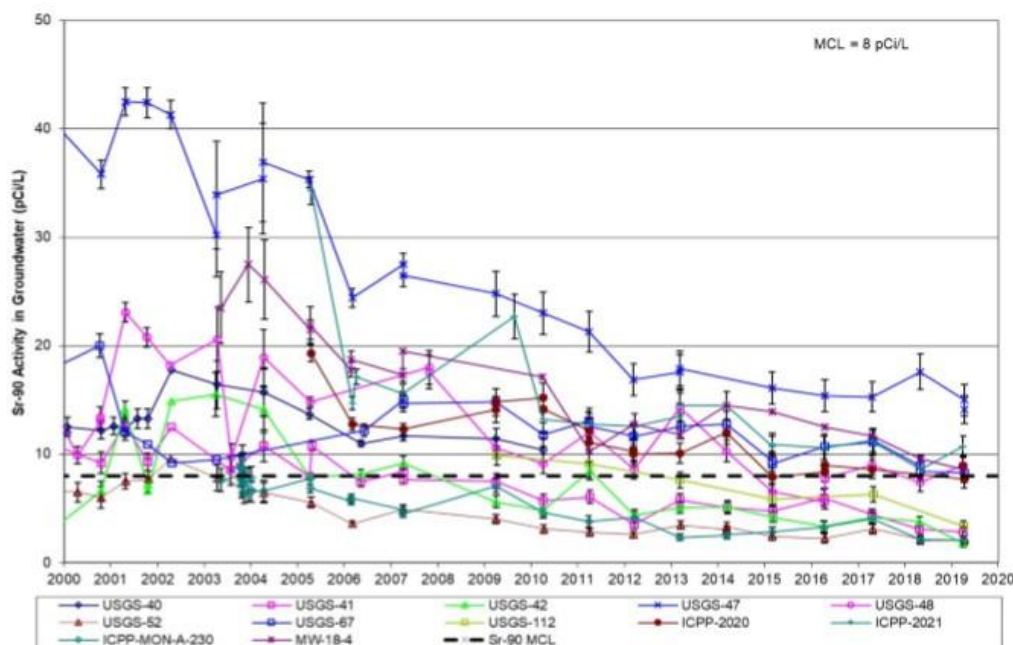


Figure 5. Sr-90 concentration trends for selected aquifer wells near INTEC.

Downgradient WAG 7 (RWMC)

According to the FYR, the OU 7-13/14 (WAG 7) remedy is functioning as intended by the OU 7-13/14 ROD. Targeted waste retrieval and in-situ grouting have reduced the potential impact to the aquifer for radioactive contaminants. Operational data for targeted waste retrieval, and trends in monitoring data support a conclusion that the integrated response action at RWMC will achieve remediation goals and performance objectives as expected. Monitoring shows only a few radionuclides detected above reporting levels, and concentrations are considerably below MCLs. Exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy remain valid, and no other information has come to light that could call the protectiveness of the remedy into question.

WAG 10 (Miscellaneous Sites, Future Sites and Sitewide Groundwater)

The FYR report concluded that the OU 10-04 remedy is protective of human health and the environment, and the OU 10-08 remedy is expected to be protective of human health and the environment upon completion; and, in the interim, exposure pathways that could result in unacceptable risks are being controlled. Overall, institutional controls and O&M are functioning as intended by decision documents.

Fourteen new sites were identified and approved by the Agencies for evaluation using the OU 10-08 new sites process, and 12 of were recommended for designation as new Federal Facility Agreement and Consent Order sites. Of these 12, 4 require no action and are not subject to FYR, 4 require no further action with institutional controls, and 4 are pending with interim institutional controls.

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The remedy for OU10-08 groundwater is functioning as intended based on groundwater monitoring results. All groundwater analytes including radionuclides tritium, I-129, gross alpha, Sr-90 and Tc-99 were below MCLs, and there was no evidence of commingling of groundwater plumes. All analytes from OU 10-08 wells on the southern (downgradient) boundary of the INL Site continue to be nondetect or are well below the MCLs. To demonstrate the absence of unacceptable groundwater threats, OU 10-08 groundwater monitoring will continue until the Agencies determine it is no longer required.

Conclusion

A review of the report, "Five-Year Review of CERCLA Response Actions at the Idaho National Laboratory Site—Fiscal Years 2015–2019" (DOE/ID-12034, 2021), was conducted to determine if the report contained information that could potentially impact the RHLLW Disposal Facility PA and/or CA. The review concluded CERCLA remedies at the INL Site currently are or will be protective of human health. Although two issues related to groundwater were found at OU 1-07B, one related to TCE contamination and the other to Cs-137 and Sr-90, the remedy is expected to be protective upon completion. And because OU-107B is a significant distance (36 km) upgradient of the RHLLW Disposal Facility, the issues have no potential impact on the PA or CA.

A review of the FYR report found no information that could potentially impact the validity or conclusions of the RHLLW Disposal Facility PA or CA. The review found that at each OU, exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the CERCLA remedies remain valid. The review also found the extent of perched water at the ATR Complex is steady and water levels are declining. Radionuclide concentrations in perched water and the aquifer at facilities near the RHLLW Disposal Facility are steady or declining and groundwater quality is steadily improving. Therefore, the impact of upgradient facilities in combination with the RHLLW Disposal Facility on the all-pathways groundwater dose will be negligible as determined in the CA and CA addendum.

Section I, Unreviewed Disposal Question Screening (UDQS)

1. Does the proposed activity/new information/discovery involve a change to the disposal facility from what has been previously or analyzed in the most recent Disposal Authorization Statement (DAS) conditions or limitations, Performance Assessment (PA), approved Special Analyses (SA), or approved UDQE?

Yes ☐ No ☒

Comments:

2. Does the proposed activity/new information/discovery potentially result in an increased effective dose from the disposal facility that would challenge the conclusions of the Composite Analysis (i.e., that the RHLLW Disposal Facility has *de minimus* contribution to the cumulative impacts of surrounding facilities) or otherwise have the potential to impact the CA?

- Change to the site use plan or end state document
- Construction of a new facility near the RHLLW Disposal Facility with the potential to impact perched water
- CA inputs or assumptions
- Change to work outlined in the PA/CA Maintenance Plan (PLN-3368).

Yes ☐ No ☒

Comments:

3. Does the proposed activity/new information/discovery involve a change to the disposal process or procedures from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

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Comments:

4. *Does the proposed activity/new information/discovery involve a change to the Waste Acceptance Criteria (WAC) from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?*

Yes ☐ No ☒

Comments:

5. *Does the proposed activity/new information/discovery involve a change inputs or assumptions of the most recent PA or approved SA?*

Yes ☐ No ☒

Comments:

6. *Does the proposed activity/new information/discovery result in a change the facility preliminary closure approach or criteria from what was previously described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?*

Yes ☐ No ☒

Comments:

7. *Does the proposed activity/new information/discovery involve a test or experiment not described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?*

Yes ☐ No ☒

Comments:

8. *Does the proposed activity/new information/discovery involve any analytical errors, omissions, or deficiencies in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?*

Yes ☐ No ☒

Comments:

9. *Do other considerations warrant development of an evaluation or special analysis?*

Yes ☐ No ☒

Comments:

NOTE: *If all questions above are answered "No," then obtain signatures and implement proposed change. If any of the questions above are answered "Yes," then continue with Form and complete Unreviewed Disposal Questions Evaluation Section.*

Explanation/Additional Comments:

A review of the report, "Five-Year Review of CERCLA Response Actions at the Idaho National Laboratory Site—Fiscal Years 2015–2019" (DOE/ID-12034, 2021), was conducted to determine if the report contained information that could potentially impact the RHLLW Disposal Facility PA and/or CA. The review found that at each OU at the INL Site, exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the CERCLA remedies remain valid. The review also found the extent of perched water at the ATR Complex is steady

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and water levels are declining. Radionuclide concentrations in perched water and the aquifer at facilities near the RHLLW Disposal Facility are steady or declining and groundwater quality is steadily improving. No information was found that could potentially impact the RHLLW Disposal Facility PA or CA or the conclusions therein.

Does the Unreviewed Disposal Question Screening screen negative or positive?

Negative ☒ Positive ☐

Is an Unreviewed Disposal Question Evaluation or Special Analysis needed?

No ☒ UDQE ☐ Special Analysis ☐

Jonathan Jacobson	<i>Jonathan Jacobson</i>	3/30/2023
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
Tim Arsenault	<i>Timothy Arsenault</i>	3/30/2023
Print/Type Name	Signature	Date
Approver/NFM	Approver/NFM	

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLW DISPOSAL FACILITY**

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Section II, Unreviewed Disposal Question Evaluation (UDQE)

Evaluation:

1. *Is the proposed activity/new information/discovery outside the bounds of the approved PA or CA (e.g., does the proposed activity/new information/discovery involve a change to the basic disposal concept as described in the PA/CA such as critical inputs/assumptions or an increase in facility inventory analyzed in the PA or considered in the CA)?*

Yes ☐ No ☐

Comments:

2. *Does the proposed activity/new information/discovery result in the PA performance objective being exceeded?*

Yes ☐ No ☐

Comments:

3. *Would the proposed activity/new information/discovery result in a change to the facility radionuclide disposal limits in the approved PA?*

Yes ☐ No ☐

Comments:

4. *Would the proposed activity/new information/discovery result in a change to DAS conditions or limitations?*

Yes ☐ No ☐

Comments:

5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

Yes ☐ No ☐

If "Yes," Special Analysis and DOE NE-ID notification required. Provide explanation.

If "No," provide an explanation and basis for the determination. Attach supplementary documentation (e.g., TEV), as required

Explanation:

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
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Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Print/Type Name System Engineer/SE	Signature System Engineer/SE	Date
Print/Type Name PA/CA SME	Signature PA/CA SME	Date
Print/Type Name Waste Management/WMP	Signature Waste Management/WMP	Date
Print/Type Name Nuclear Facility Manger/NFM	Signature Nuclear Facility Manger/NFM	Date

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

Section III, Special Analysis, SA (If Required in Section I or II)

PARC Assigned SME: _____

Special Analysis Document Number: _____

Proposed Activity Approved? Yes ☐ No ☐

Comments: _____

_____ Print/Type Name Originator/FDS	_____ Signature Originator/FDS	_____ Date
_____ Print/Type Name System Engineer/SE	_____ Signature System Engineer/SE	_____ Date
_____ Print/Type Name PA/CA SME	_____ Signature PA/CA SME	_____ Date
_____ Print/Type Name Waste Management/WMP	_____ Signature Waste Management/WMP	_____ Date
_____ Print/Type Name Nuclear Facility Manger/NFM	_____ Signature Nuclear Facility Manger/NFM	_____ Date
_____ Print/Type Name DOE/ID Representative	_____ Signature DOE/ID Representative	_____ Date

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UDQE Tracking No.: UDQE-RHLLW-058

Subject: Revision to FRM-2544 to add NRF as a certified waste generator and update surface contamination control section.

NOTE: *The objective of this screening is to determine whether further evaluation is required for a proposed change, new information, or discovery to ensure the validity of the existing Performance Assessment (PA; DOE/ID-11421) and Composite Analysis (CA; DOE/ID-11422) are not impacted.*

Describe the Proposed Change in Activity/New Information/Discovery:

RH-ADM-5214 "DOE Order 435.1 Documentation Change Control Process for the RHLLW Disposal Facility." Section 3.1 requires a mandatory Unreviewed Disposal Question Screening (UDQS) for any proposed changes to DOE 435.1 documentation. FRM-2544 "Remote-Handled Low-Level Waste Canister Acceptance Sheet" is listed as a document that requires a mandatory screening if initiation of document change request (DCR) occurs. RH-ADM-5214 defines a "proposed change" as information resulting from research and development, operation activities, or discoveries or information that have the potential to affect the assumptions and/or conclusions of the facility performance assessment (PA) or composite analysis (CA). UDQE-RHLLW-058 serves as documentation that the proposed changes to FRM-2544 have been reviewed according to RH-ADM-5214.

The Remote-Handled Low-Level Waste Disposal Facility (DF) performed an initial review of the Naval Reactors Facility (NRF) Waste Certification Program (WCP) to ensure NRF WCP is compliant with requirements in PLN-5446, "Waste Acceptance Criteria for the Remote-Handled Low-Level Waste Disposal Facility." As a result of the review, NRF requested an exception to Section 2.6 "Surface Contamination" of PLN-5446 for the exterior surface contamination and proposed revised surface contamination limits that NRF can meet with 97.5% confidence level. A UDQE (UDQE-RHLLW-063) was completed and recommended a Special Analysis (INL/RPT-22-68668) be conducted. The SA was presented to the U.S. Department of Energy, Office of Nuclear Energy, Idaho Operations Office (NE-ID) and approved on November 16, 2022. The increase in canister exterior contamination limits requested were shown to be within the bounds of the current Performance Assessment (PA) and will not violate the performance objectives. Therefore, NRF's requested exterior contamination levels on waste canisters was approved and the revised limits were added to the RHLLW WAC, PLN-5446 Section 2.6 "Surface Contamination."

With the approval of the SA, UDQE and the revision of WAC, the RHLLW generator certification review teams were able to close the NRF initial generator waste certification review (ASMT 2022-0618) and certify NRF as an approved generator allowing NRF to send RHLLW in the 55-Ton Scrap Cask to the RHLLW DF. In addition to revising the WAC, it was necessary to revise FRM-2544 to include adding NRF as an approved waste generator and adding a new section for recording surface contamination control.

The revision to FRM-2544 does not involve a temporary or permanent change in the existing documentation safety analysis nor does it involve a temporary or permanent change in procedures as described in the existing documented safety analysis. These changes do not impact the assumption and/or the conclusion of the PA and CA or impact the validity of the Radioactive Waste Management Basis (RWMB) and Operating Disposal Authorization Statement (ODAS).

Section I, Unreviewed Disposal Question Screening (UDQS)

1. *Does the proposed activity/new information/discovery involve a change to the disposal facility from what has been previously or analyzed in the most recent Disposal Authorization Statement (DAS) conditions or limitations, Performance Assessment (PA), approved Special Analyses (SA), or approved UDQE?*

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Yes ☐ No ☒

Comments: NA

2. Does the proposed activity/new information/discovery potentially result in an increased effective dose from the disposal facility that would challenge the conclusions of the Composite Analysis (i.e., that the RHLLW Disposal Facility has *de minimus* contribution to the cumulative impacts of surrounding facilities) or otherwise have the potential to impact the CA?
- Change to the site use plan or end state document
 - Construction of a new facility near the RHLLW Disposal Facility with the potential to impact perched water
 - CA inputs or assumptions
 - Change to work outlined in the PA/CA Maintenance Plan (PLN-3368).

Yes ☐ No ☒

Comments:

3. Does the proposed activity/new information/discovery involve a change to the disposal process or procedures from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

4. Does the proposed activity/new information/discovery involve a change to the Waste Acceptance Criteria (WAC) from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments:

5. Does the proposed activity/new information/discovery involve a change inputs or assumptions of the most recent PA or approved SA?

Yes ☐ No ☒

Comments:

6. Does the proposed activity/new information/discovery result in a change the facility preliminary closure approach or criteria from what was previously described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

7. Does the proposed activity/new information/discovery involve a test or experiment not described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

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Comments: NA

8. Does the proposed activity/new information/discovery involve any analytical errors, omissions, or deficiencies in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

9. Do other considerations warrant development of an evaluation or special analysis?

Yes ☐ No ☒

Comments:

NOTE: If all questions above are answered "No," then obtain signatures and implement proposed change. If any of the questions above are answered "Yes," then continue with Form and complete Unreviewed Disposal Questions Evaluation Section.

Explanation/Additional Comments:



RHLLW DF waste canister acceptance sheet, FRM-2544, is used to gather canister information. Forms do not and cannot provide direction. Revisions to FRM-2544 do not and will not include new proposed activities, changes in existing activities, facility configuration changes, or new information that would potentially affect the assumption and/or conclusions of the PA or CA. Therefore, it is recommended that FRM-2544 be removed from the list of documents requiring mandatory screening (UDQS) in RH-ADM-5214 for every initiation of a document change request (DCR).

Does the Unreviewed Disposal Question Screening screen negative or positive?

Negative ☒ Positive ☐

Is an Unreviewed Disposal Question Evaluation or Special Analysis needed?

No ☒ UDQE ☐ Special Analysis ☐

Jonathan Jacobson		2/27/2023
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
Tim Arsenault		2/27/2023
Print/Type Name	Signature	Date
Approver/NFM	Approver/NFM	

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

Section II, Unreviewed Disposal Question Evaluation (UDQE)

Evaluation:

1. *Is the proposed activity/new information/discovery outside the bounds of the approved PA or CA (e.g., does the proposed activity/new information/discovery involve a change to the basic disposal concept as described in the PA/CA such as critical inputs/assumptions or an increase in facility inventory analyzed in the PA or considered in the CA)?*

Yes ☐ No ☒

Comments: See Explanation below

2. *Does the proposed activity/new information/discovery result in the PA performance objective being exceeded?*

Yes ☐ No ☒

Comments: See Explanation below

3. *Would the proposed activity/new information/discovery result in a change to the facility radionuclide disposal limits in the approved PA?*

Yes ☐ No ☒

Comments: See Explanation below

4. *Would the proposed activity/new information/discovery result in a change to DAS conditions or limitations?*

Yes ☐ No ☒

Comments: See Explanation below

5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

Yes ☐ No ☒

If "Yes," Special Analysis and DOE NE-ID notification required. Provide explanation.

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EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Print/Type Name System Engineer/SE	Signature System Engineer/SE	Date
Print/Type Name PA/CA SME	Signature PA/CA SME	Date
Print/Type Name Waste Management/WMP	Signature Waste Management/WMP	Date
Print/Type Name Nuclear Facility Manger/NFM	Signature Nuclear Facility Manger/NFM	Date

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Section III, Special Analysis, SA (If Required in Section I or II)

PARC Assigned SME: _____

Special Analysis Document Number: _____

Proposed Activity Approved? Yes ☐ No ☐

Comments:

Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Print/Type Name System Engineer/SE	Signature System Engineer/SE	Date
Print/Type Name PA/CA SME	Signature PA/CA SME	Date
Print/Type Name Waste Management/WMP	Signature Waste Management/WMP	Date
Print/Type Name Nuclear Facility Manger/NFM	Signature Nuclear Facility Manger/NFM	Date
Print/Type Name DOE/ID Representative	Signature DOE/ID Representative	Date

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UDQE Tracking No.: UDQE-RHLLW-063

Subject: NRF request exception to the RHLLW WAC Section 2.6 Surface contamination requirement for waste canisters shipped to RHLLW DF

NOTE: *The objective of this screening is to determine whether further evaluation is required for a proposed change, new information, or discovery to ensure the validity of the existing Performance Assessment (PA; DOE/ID-11421) and Composite Analysis (CA; DOE/ID-11422) are not impacted.*

Describe the Proposed Change in Activity/New Information/Discovery:

Naval Reactors Facility (NRF) Waste Programs is requesting a permanent exception to limits of removable surface contamination on the exterior of waste canisters shipped to the current Remote-Handled Low-Level Waste (RHLLW) Disposal Facility as specified in the waste acceptance criteria (WAC), PLN-5446. Section 2.6 of the WAC states:

“Waste canisters accessible for radiological contamination surveys shall be free of removable surface contamination on the outside of the disposal canister. Waste canisters not accessible for swiping shall utilize process controls to minimize loose contamination on canister surfaces as much as practical. All canisters and packaging received at the RHLLW Disposal Facility shall comply with contamination control limits of 10 CFR 835, Appendix D, “Surface Contamination Values.”

NRF waste canisters are loaded underwater in the Expended Core Facility (ECF) water pool with irradiated metal components and surface contaminated waste, or depleted Radioactive Water Demineralizer System (RWDS) modules. The high radiation levels of the irradiated metal waste prohibit raising the loaded waste canisters out of the water pool to verify removable surface contamination levels. The loaded waste canister are raised from the ECF pool directly into the shielded 55-ton cask through doors on the bottom of the cask while seated on a loading stand. Once the waste canister is loaded inside the 55-ton cask, NRF Waste Programs contend there is no practical way to access the waste canister to conduct contamination surveys using 10 CFR 835 Appendix D methods.

While NRF Waste Programs is not able to measure the surface contamination on the loaded waste canister above the water, they do take action to minimize the amount of contamination on the outside of the waste canister. The first mitigation action that reduces surface contamination on waste canister is placing RWDS modules underwater in each zone where waste canisters are loaded and prepared for shipment. The second mitigation requires NRF technicians perform an underwater high-pressure wash (hydroblitz) of all accessible external surfaces of each waste canister prior to loading in the 55-ton cask. The third mitigation involves rinsing each waste canister as they are loaded into the 55-ton cask. This rinse is done using a circular ring with 33 nozzles that direct low pressure water to all surface of the waste canister lid and shell.

NRF Waste Programs was able to obtain underwater swipes to measure the removable surface contamination on waste canisters that had been in the water pool from approximately 10 months to nearly 3 years, which covers the period of time most canisters will be in the pool prior to removal and shipment. The swipes were performed on 5 canisters with 5 smears on each lid and 10 smears on each shell before and after hydroblitzing. The swipes were removed from the water pool and gamma counted by NRF Chemistry. The swipe data was used to estimate the average activity by radionuclide on each waste canister before and after hydroblitzing (see NRF-ENF-FE-00670 2022). The average activities after hydroblitzing were then compared against the 10 CFR 835 Appendix D limits. One waste canister exceeded the transuranic limit and four exceeded the beta-gamma emitter limit as identified in 10 CFR 835 Appendix D. Although the waste canisters were not swiped after being rinsed by the loading spray system, NRF Waste Programs has determined that the WAC surface contamination requirement cannot consistently be met for the transuranic and the beta-gamma emitters group.

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EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

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Based on an evaluation of the underwater swipe data from five 55-ton waste canisters, NRF Waste Programs is requesting a permanent exception to the current RHLLW WAC, Section 2.6 Surface Contamination, requirements for all waste canisters shipped to the RHLLW Disposal Facility and provided proposed surface contamination limits

Section I, Unreviewed Disposal Question Screening (UDQS)

1. Does the proposed activity/new information/discovery involve a change to the disposal facility from what has been previously or analyzed in the most recent Disposal Authorization Statement (DAS) conditions or limitations, Performance Assessment (PA), approved Special Analyses (SA), or approved UDQE?

Yes ☐ No ☒

Comments: NA

2. Does the proposed activity/new information/discovery potentially result in an increased effective dose from the disposal facility that would challenge the conclusions of the Composite Analysis (i.e., that the RHLLW Disposal Facility has **de minimus** contribution to the cumulative impacts of surrounding facilities) or otherwise have the potential to impact the CA?

- Change to the site use plan or end state document
- Construction of a new facility near the RHLLW Disposal Facility with the potential to impact perched water
- CA inputs or assumptions
- Change to work outlined in the PA/CA Maintenance Plan (PLN-3368).

Yes ☒ No ☐

Comments: Surface contamination on the exterior of waste canisters above current WAC limits could potentially increase the all-pathways dose. The potential increase should be evaluated to determine if it is within the bounds of the current PA and does not violate the conclusions of the CA. If the dose is within the bounds of the PA, then there is no impact to the conclusions of the CA.

3. Does the proposed activity/new information/discovery involve a change to the disposal process or procedures from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

4. Does the proposed activity/new information/discovery involve a change to the Waste Acceptance Criteria (WAC) from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☒ No ☐

Comments: NRF Waste Programs is requesting a permanent exception to the current RHLLW WAC, Section 2.6 Surface Contamination, requirements for all waste canisters shipped to the RHLLW Disposal Facility and provided proposed surface contamination limits that NRF can meet with at least a 97.5% confidence level. The increased limits, if allowed, could potentially increase the all-pathways dose. The potential increase should be evaluated to determine if it is within the bounds of the current PA.

5. Does the proposed activity/new information/discovery involve a change inputs or assumptions of the most recent PA or approved SA?

Yes ☐ No ☒

Comments:

6. Does the proposed activity/new information/discovery result in a change the facility preliminary closure approach or criteria from what was previously described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

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Yes ☐ No ☒

Comments: NA

7. Does the proposed activity/new information/discovery involve a test or experiment not described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

8. Does the proposed activity/new information/discovery involve any analytical errors, omissions, or deficiencies in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

9. Do other considerations warrant development of an evaluation or special analysis?

Yes ☐ No ☒

Comments:

NOTE: If all questions above are answered "No," then obtain signatures and implement proposed change. If any of the questions above are answered "Yes," then continue with Form and complete Unreviewed Disposal Questions Evaluation Section.

Explanation/Additional Comments:

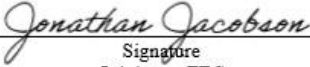

A Special Analysis is recommended to address the potential impacts of the NRF-requested limits.

Does the Unreviewed Disposal Question Screening screen negative or positive?

Negative ☐ Positive ☒

Is an Unreviewed Disposal Question Evaluation or Special Analysis needed?

No ☐ UDQE ☐ Special Analysis ☒

Jonathan Jacobson		10/04/2022
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Timothy Arsenualt		10/04/2022
Print/Type Name Approver/NFM	Signature Approver/NFM	Date

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Section II, Unreviewed Disposal Question Evaluation (UDQE)

Evaluation:

1. *Is the proposed activity/new information/discovery outside the bounds of the approved PA or CA (e.g., does the proposed activity/new information/discovery involve a change to the basic disposal concept as described in the PA/CA such as critical inputs/assumptions or an increase in facility inventory analyzed in the PA or considered in the CA)?*

Yes ☐ No ☒

Comments: See Explanation below

2. *Does the proposed activity/new information/discovery result in the PA performance objective being exceeded?*

Yes ☐ No ☒

Comments: See Explanation below

3. *Would the proposed activity/new information/discovery result in a change to the facility radionuclide disposal limits in the approved PA?*

Yes ☐ No ☒

Comments: See Explanation below

4. *Would the proposed activity/new information/discovery result in a change to DAS conditions or limitations?*

Yes ☐ No ☒

Comments: See Explanation below

5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

Yes ☐ No ☒

If "Yes," Special Analysis and DOE NE-ID notification required. Provide explanation.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

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Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Print/Type Name System Engineer/SE	Signature System Engineer/SE	Date
Print/Type Name PA/CA SME	Signature PA/CA SME	Date
Print/Type Name Waste Management/WMP	Signature Waste Management/WMP	Date
Print/Type Name Nuclear Facility Manger/NFM	Signature Nuclear Facility Manger/NFM	Date

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Section III, Special Analysis, SA (If Required in Section I or II)

PARC Assigned SME: A. Jeffrey Sondrup

Special Analysis Document Number: INL/RPT-22-68668

Proposed Activity Approved? Yes ☒ No ☐

Comments:

A Special Analysis (INL/RPT-22-68668) was performed to address a request by Naval Reactors Facility (NRF) Waste Programs for a permanent exception to limits of removable surface contamination on the exterior of waste canisters shipped to the Remote-Handled Low-Level Waste (RHLLW) Disposal Facility as specified in the waste acceptance criteria (WAC) (PLN-5446). This UDQE (UDQE-RHLLW-063) documents the need for a Special Analysis.

The purpose of the Special Analysis was to determine if the NRF-requested levels for removable surface contamination on the exterior of all NRF waste canisters is within the bounds of the current performance assessment (PA). This was done by calculating the groundwater all-pathways dose contribution from surface contamination on the exterior of NRF canisters for the following cases: (1) the exteriors of all NRF waste canisters are contaminated to the 10 CFR 835 Appendix D allowable limits in the current WAC, and (2) the exteriors of all NRF waste canisters are contaminated to the limits requested by NRF Waste Programs.

Dose impacts for each case were compared to each other and to the all-pathways dose for the PA base case. Dose impacts were also compared to the all-pathways dose limit specified in DOE O 435.1.

A simple assessment of the potential impacts of the increase in surface contamination using the NRF-requested limits on the biotic, air, and inadvertent intruder pathways was also performed.

Based on the results of the SA, the increase in canister exterior contamination limits requested by NRF are well within the bounds of the current PA and will not result in a violation of performance objectives. The results also show the increased limits do not reflect or necessitate a fundamental change to the PA conceptual model, nor a change to the way exterior contamination is not included in PA dose calculations.

Therefore, it is recommended the NRF request for an exception to the current limits for external surface contamination be accepted and the revised limits for NRF-generated waste canisters be added to the WAC. The monitoring plan will also be revised to identify external canister contamination as a potential mobile source term that may be detected by monitoring earlier than potential releases from waste.

The PA, composite analysis (CA), closure plan, and PA/CA maintenance plan do not require revision. The Special Analysis recommends the waste generator certification process includes NRF procedures used to limit water pool radionuclide variability (and thus canister surface contamination variability).

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Jonathan Jacobson _____ Print/Type Name Originator/FDS	<i>Jonathan Jacobson</i> _____ Signature Originator/FDS	10/04/2022 _____ Date
A. R. Prather _____ Print/Type Name System Engineer/SE	<i>A. R. Prather</i> _____ Signature System Engineer/SE	10/12/22 _____ Date
A. Jeff Sondrup _____ Print/Type Name PA/CA SME	<i>A. Jeff Sondrup</i> _____ Signature PA/CA SME	10/12/2022 _____ Date
Paul A. Velasquez _____ Print/Type Name Waste Management/WMP	<i>Paul Velasquez</i> _____ Signature Waste Management/WMP	10/12/2022 _____ Date
Tim Arsenault _____ Print/Type Name Nuclear Facility Manger/NFM	<i>Timothy Arsenault</i> _____ Signature Nuclear Facility Manger/NFM	10/12/2022 _____ Date
Gerardo Islas Rivera _____ Print/Type Name DOE/ID Representative	Gerardo j. Islas-Rivera _____ Signature DOE/ID Representative	11/15/2022 _____ Date

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

UDQE Tracking No.: UDQE-RHLLW-067

Subject: Evaluation of 3 HFEF-5 Waste Canisters from RSWF (SN-181, OWC-090-H5, and OWC-300-H5) Flagged for PA and WAC Checks during RHINO Acceptance Testing

NOTE: *The objective of this screening is to determine whether further evaluation is required for a proposed change, new information, or discovery to ensure the validity of the existing Performance Assessment (PA; DOE/ID-11421) and Composite Analysis (CA; DOE/ID-11422) are not impacted.*

Describe the Proposed Change in Activity/New Information/Discovery:

Prior to shipment, details of each waste canister are entered into the Remote-Handled Low-Level Waste (RHLLW) Inventory Online (RHINO¹) software which performs several checks to evaluate the canister for acceptance. Three legacy HFEF-5 waste canisters with unique identifiers (IDs) were submitted to RHINO for acceptance testing. These canisters have been stored at the Radioactive Scrap and Waste Facility (RSWF) and are designated legacy canisters because the waste was generated prior to 4/22/2015. Each of the canisters were flagged (did not pass) by RHINO for PA Checks 9 and 10. Canisters OWC-090-H5 and OWC-300-H5 were also flagged for PA Checks 11 and 13. All three canisters were identified as containing non-system radionuclides. Canisters OWC-090-H5 and OWC-300-H5 were also flagged by RHINO for having radionuclide inventories that exceed WAC check limits based on nuclear safety considerations. Table 1 contains a summary of the canister checks that were flagged by RHINO. Each check is explained below.

Table 1. Summary of canister checks flagged by RHINO that require evaluation.

Canister ID	Generation Date	Waste Content ^a	PA Checks 9 and 10 ^b	PA Check 11 ^b	PA Check 12 ^b	PA Check 13 ^b	Contains Non-System Radionuclides ^c	WAC Check
SN-181	2/24/2014	Combined	X				Yes	
OWC-090-H5	10/13/2010	AM	X	X		X	Yes	X
OWC-300-H5	4/21/2015	Combined	X	X		X	Yes	X

a. Content can be AM = activated metal, SC = surface contaminated debris, or Combined = AM and SC. AM waste can have surface contamination, but is not identified as surface contaminated debris.

b. "X" indicates the canister inventory did not pass the check. A blank cell indicates it passed.

c. "Yes" indicates the container contains one or more non-system radionuclides that must be evaluated.

PA Check 9: PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)**PA Check 10: PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides Only)**

These checks are flagged if the cumulative inventory exceeds the PA 20-year base-case inventory for the specific generator, canister type, and waste form. The cumulative inventory includes the inventory of all placed canisters plus the proposed canister(s). The exceedance may be the result of the proposed canister inventory or it may be a result of previously placed canisters. PA Check 9 performs the check for all radionuclides in the PA base case inventory (see ECAR-3940, Table 8), and PA Check 10 performs the check for key radionuclides only. Key radionuclides are those that failed the PA screening and were fully evaluated in the PA (see INL 2018, Table 18, column 7). Thus, any canister that is flagged by PA Check 10 will also be flagged by PA Check 9. The cumulative inventory of non-key radionuclides should be evaluated to determine if the increased inventory (above the PA base case) could have resulted in the radionuclide not being screened out. The cumulative inventory of key radionuclides should be evaluated to determine if the inventory and accompanying dose is within the bounds of the PA. This is checked by examining the increase in performance measures (see RHINO PA Check tab, Checks 1 through 8) if the canisters were to be placed at the facility. All three of the proposed canisters were flagged by both these checks.

¹ RHINO is an NQA-1 software application for accepting, managing, and tracking the receipt of waste and its disposal location. The technical and functional requirements for RHINO are found in TFR-981, "Remote Handle-LLW Inventory Online Database."

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
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This check is flagged if the key radionuclide inventory in the a proposed canister exceeds 10% of the PA 20-year base-case inventory for the particular generator, canister type and waste form (see INL 2018, Table 18, column 8). According to INL (2018), the inventory of any canister that causes or contributes to an exceedance of these threshold values must be reviewed according to RH-ADM-5214, "DOE Order 435.1 Documentation Change Control Process for the RHLLW Disposal Facility" to determine if the estimated inventory/activity is an anomalous occurrence or indicative of a change in waste generation rates, and is within the bounds of the approved PA. Canisters OWC-090-H5 and OWC-300-H5 were flagged by this check.

PA Check 12: Unanalyzed/Non-Exempt Nuclides Check

This flag is checked if a proposed canister contains an unanalyzed radionuclide that is not on the exempt list. Unanalyzed radionuclides are radionuclides that were not considered during preparation of the PA. According to the WAC (PLN-5446), containers with reportable radionuclides not analyzed in the PA (see WAC, Tables B-1 through B-8), or not listed as an exempt radionuclide (see WAC, Table 1) will not be accepted for disposal at the RHLLW Disposal Facility without additional evaluation per RH-ADM-5214 (2021). All three of the proposed canisters passed this check, but the description is included for completeness.

PA Check 13: Canister Action Levels Check

This check is flagged if a proposed canister contains a key radionuclide whose inventory exceeds canister action levels based on the chronic intruder pathway dose standard (see INL 2018, Table 19). The canister action levels are the array action levels (INL 2018, Table 20) divided by the total number of canisters that may be placed in the array. The canister action levels represent average canister inventories that could potentially cause an exceedance of an intruder dose standard if they were representative of all canisters. According to PLN-5446 Section 2.3, action levels were established based on the chronic intruder² pathway scenario analyzed in the facility PA. If the radionuclide activity in a specific canister exceeds an action level, an evaluation must be conducted in accordance with RH-ADM-5214 (2021). Canisters OWC-090-H5 and OWC-300-H5 were flagged by this check.

Identification of Non-System Radionuclide

Non-System radionuclides are radionuclides that are not in the RHINO database and are similar to unanalyzed/non-exempt radionuclides (PA Check 12) in that they were not considered during preparation of the PA. According to the WAC (PLN-5446), containers with reportable radionuclides not analyzed in the PA (see WAC, Tables B-1 through B-8), or not listed as an exempt radionuclide (see WAC, Table 1) will not be accepted for disposal at the RHLLW Disposal Facility without additional evaluation per RH-ADM-5214 (2021). Non-system radionuclides are currently identified on the "Nuclides" tab under the "Canister Details" page in RHINO. A future update of RHINO will include a check for non-system radionuclides on the "PA Check" tab. Non-system radionuclides were identified in each of the three proposed canisters.

WAC Check: WAC Nuclear Safety Limits

This flag is checked if a proposed canister contains a radionuclide whose inventory exceeds nuclear-safety threshold levels derived in ECAR-1559 and presented in the WAC (PLN-5446). According to ECAR-1559, the radionuclide content of each proposed waste canister must be screened against the threshold levels adopted as waste acceptance criteria. If the canister inventory for one or more radionuclides exceeds threshold levels, a full dose consequence calculation must be completed to verify the total dose consequence for the proposed waste canister is within the bounding total dose consequence values for that waste stream/canister combination. Canisters OWC-090-H5 and OWC-300-H5 were flagged by this check.

² The chronic intruder scenario is the more limiting of the two intruder scenarios (acute, chronic) evaluated in the PA.

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Exceedance of a threshold value or action level that is flagged by RHINO does not indicate a proposed canister is unacceptable for disposal but the flagged inventory levels must be reviewed. If after review, it is determined the inventory levels (both canister and cumulative) are within the bounds of the approved PA, the proposed canister may be approved for disposal.

Section I, Unreviewed Disposal Question Screening (UDQS)

1. Does the proposed activity/new information/discovery involve a change to the disposal facility from what has been previously or analyzed in the most recent Disposal Authorization Statement (DAS) conditions or limitations, Performance Assessment (PA), approved Special Analyses (SA), or approved UDQE?

Yes ☐ No ☒

Comments: NA

2. Does the proposed activity/new information/discovery potentially result in an increased effective dose from the disposal facility that would challenge the conclusions of the Composite Analysis (i.e., that the RHLLW Disposal Facility has *de minimus* contribution to the cumulative impacts of surrounding facilities) or otherwise have the potential to impact the CA?
- Change to the site use plan or end state document
 - Construction of a new facility near the RHLLW Disposal Facility with the potential to impact perched water
 - CA inputs or assumptions
 - Change to work outlined in the PA/CA Maintenance Plan (PLN-3368).

Yes ☐ No ☒

Comments: NA

3. Does the proposed activity/new information/discovery involve a change to the disposal process or procedures from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

4. Does the proposed activity/new information/discovery involve a change to the Waste Acceptance Criteria (WAC) from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

5. Does the proposed activity/new information/discovery involve a change inputs or assumptions of the most recent PA or approved SA?

Yes ☒ No ☐

Comments: Each canister was flagged by RHINO for one or more exceedances of a threshold value or action level. This does not indicate the canisters are unacceptable for disposal but the canister inventory levels must be reviewed. If after review, it is determined the inventory levels (both canister and cumulative) are within the bounds of the approved PA, the canisters may be approved for disposal. A UDQE (see Section II) is recommended to address these issues.

6. Does the proposed activity/new information/discovery result in a change the facility preliminary closure approach or criteria from what was previously described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

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7. Does the proposed activity/new information/discovery involve a test or experiment not described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

8. Does the proposed activity/new information/discovery involve any analytical errors, omissions, or deficiencies in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

9. Do other considerations warrant development of an evaluation or special analysis?

Yes ☐ No ☒

Comments: NA

NOTE: If all questions above are answered "No," then obtain signatures and implement proposed change. If any of the questions above are answered "Yes," then continue with Form and complete Unreviewed Disposal Questions Evaluation Section.



Explanation/Additional Comments:

Does the Unreviewed Disposal Question Screening screen negative or positive?

Negative ☐ Positive ☒

Is an Unreviewed Disposal Question Evaluation or Special Analysis needed?

No ☐ UDQE ☒ Special Analysis ☐

Jonathan Jacobson		11/9/2022
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
Timothy Arsenault		11/9/2022
Print/Type Name	Signature	Date
Approver/NFM	Approver/NFM	

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
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Section II, Unreviewed Disposal Question Evaluation (UDQE)

Evaluation:

1. *Is the proposed activity/new information/discovery outside the bounds of the approved PA or CA (e.g., does the proposed activity/new information/discovery involve a change to the basic disposal concept as described in the PA/CA such as critical inputs/assumptions or an increase in facility inventory analyzed in the PA or considered in the CA)?*

Yes ☐ No ☒

Comments: See Explanation below

2. *Does the proposed activity/new information/discovery result in the PA performance objective being exceeded?*

Yes ☐ No ☒

Comments: See Explanation below

3. *Would the proposed activity/new information/discovery result in a change to the facility radionuclide disposal limits in the approved PA?*

Yes ☐ No ☒

Comments: See Explanation below

4. *Would the proposed activity/new information/discovery result in a change to DAS conditions or limitations?*

Yes ☐ No ☒

Comments: See Explanation below

5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

Yes ☐ No ☒

If "Yes," Special Analysis and DOE NE-ID notification required. Provide explanation.

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
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If "No," provide an explanation and basis for the determination. Attach supplementary documentation (e.g., TEV), as required

Explanation

An evaluation of checks flagged by RHINO was performed for three legacy HFEF-5 waste canisters with specific identifiers SN-181, OWC-090-H5, and OWC-300-H5. Each of the canisters were flagged (did not pass) by RHINO for PA Checks 9 and 10. Canisters OWC-090-H5 and OWC-300-H5 were also flagged for PA Checks 11 and 13. All three canisters were identified as containing non-system radionuclides. Canisters OWC-090-H5 and OWC-300-H5 were also flagged by RHINO for having radionuclide inventories that exceed WAC check limits based on nuclear safety considerations. Table 1 contains a summary of the canister checks that were flagged by RHINO. Each check is evaluated in order.

Table 1. Summary of canister checks flagged by RHINO that require evaluation.

Canister ID	Generation Date	Waste Form ^a	PA Checks 9 and 10 ^b	PA Check 11 ^b	PA Check 12 ^b	PA Check 13 ^b	Contains Non-System Radionuclides ^c	WAC Check
SN-181	2/24/2014	Combined	X				Yes	
OWC-090-H5	10/13/2010	AM	X	X		X	Yes	X
OWC-300-H5	4/21/2015	Combined	X	X		X	Yes	X

a. Waste Form can be AM = activated metal, SC = surface contaminated debris, or Combined = AM and SC. AM waste can have surface contamination, but is not identified as surface contaminated debris.

b. "X" indicates the canister inventory did not pass the check. A blank cell indicates it passed.

c. "Yes" indicates the container contains one or more non-system radionuclides that must be evaluated.

Exceedance of a threshold value or action level that is flagged by RHINO does not indicate a proposed canister is unacceptable for disposal but the flagged inventory levels must be reviewed in accordance with RH-ADM-5214, "DOE Order 435.1 Documentation Change Control Process for the RHLLW Disposal Facility." If after review, it is determined the inventory levels (both canister and cumulative) are within the bounds of the approved PA, the proposed canister may be approved for disposal.

Figure 1 contains RHINO output showing the PA performance measures for all placed canisters as of 9/28/2022³, prior to placement of the three canisters evaluated in this UDQE. Figures 2 through 4 show the PA Check output screens from RHINO for the three proposed waste canisters identified as SN-181, OWC-090-H5, and OWC-300-H5. The performance measure values and cumulative inventories in Figures 2 through 4 reflect all containers placed as of 9/28/2022 plus each proposed canister by itself. Thus the impact of each individual proposed canister on performance measures can be determined by comparing the values in Figures 2 through 4 to the values in Figure 1.

³ HFEF-5 canister SN-128 was placed into the RHLLW Disposal Facility on 9/28/22. No other canisters have been placed between that date and preparation of this UDQE.

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PA Results						
No.	Acceptance	Performance Measure	Value	Limit	Units	Type
1	Yes	All Pathways Dose	9.4471E-005	1	mrem/yr	Compliance
	Yes	All Pathways Dose	5.5013E-002	12.5	mrem/yr	Post Compliance
2	Yes	Beta-Gamma DE	6.7096E-005	0.16	mrem/yr	Compliance
	Yes	Beta-Gamma DE	3.9053E-002	2.4	mrem/yr	Post Compliance
3	Yes	Ra-226/228	9.0372E-033	0.2	pCi/L	Compliance
	Yes	Ra-226/228	8.4423E-007	2.5	pCi/L	Post Compliance
4	Yes	Gross Alpha	1.9557E-030	0.6	pCi/L	Compliance
	Yes	Gross Alpha	3.9704E-008	7.5	pCi/L	Post Compliance
5	Yes	Beta-Gamma ED	3.6711E-005	0.16	mrem/yr	Compliance
	Yes	Beta-Gamma ED	2.1367E-002	2	mrem/yr	Post Compliance
6	Yes	Uranium	5.9287E-028	1.2	ug/L	Compliance
	Yes	Uranium	1.1330E-005	15	ug/L	Post Compliance
7	Yes	Intruder	5.1287E-002	20	mrem/yr	Compliance
8	Yes	Air Pathway	6.6648E-007	0.4	mrem/yr	Compliance
9	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	-			Compliance
10	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-			Compliance
9. & 10. PA Base Case Inventory Check by Generator/Canister/Waste Form						
Nuclide	Form	Vault	Generator	Array	East/West	Amount (Ci)
Ba-137m [Details]	S	HFEF-5 Can	MFC	2	East	8.3590E+000
Co-60 [Details]	S	HFEF-5 Can	MFC	2	East	1.5534E+000
Cs-137 [Details]	S	HFEF-5 Can	MFC	2	East	8.8295E+000
Eu-154 [Details]	S	HFEF-5 Can	MFC	2	East	1.0323E-002
I-129 [Details]	S	HFEF-5 Can	MFC	2	East	3.9951E+008
Np-237 [Details]	S	HFEF-5 Can	MFC	2	East	1.8004E-006
Po-210 [Details]	S	HFEF-5 Can	MFC	2	East	2.0930E-006
Pb-210 [Details]	S	HFEF-5 Can	MFC	2	East	6.8840E-013
Pm-147 [Details]	S	HFEF-5 Can	MFC	2	East	5.8559E-004
Pu-238 [Details]	S	HFEF-5 Can	MFC	2	East	9.9406E-007
Pu-239 [Details]	S	HFEF-5 Can	MFC	2	East	5.5179E-004
Pu-240 [Details]	S	HFEF-5 Can	MFC	2	East	5.8076E-004
Pu-241 [Details]	S	HFEF-5 Can	MFC	2	East	4.5874E-004
Pu-242 [Details]	S	HFEF-5 Can	MFC	2	East	5.8063E-008
Ra-226 [Details]	S	HFEF-5 Can	MFC	2	East	4.0022E-012
Sm-151 [Details]	S	HFEF-5 Can	MFC	2	East	3.7328E-003
Sr-90 [Details]	S	HFEF-5 Can	MFC	2	East	1.8010E+001
Th-229 [Details]	S	HFEF-5 Can	MFC	2	East	6.5215E-008
Th-230 [Details]	S	HFEF-5 Can	MFC	2	East	1.0434E-009
Th-231 [Details]	S	HFEF-5 Can	MFC	2	East	2.4776E-006
U-232 [Details]	S	HFEF-5 Can	MFC	2	East	1.0918E-005
U-233 [Details]	S	HFEF-5 Can	MFC	2	East	3.0667E-005
U-235 [Details]	S	HFEF-5 Can	MFC	2	East	2.4776E-006
U-236 [Details]	S	HFEF-5 Can	MFC	2	East	2.3698E-006
U-238 [Details]	S	HFEF-5 Can	MFC	2	East	1.2870E-006
Y-90 [Details]	S	HFEF-5 Can	MFC	2	East	1.7982E+001
						1.6513E+000

Figure 1. RHINO PA performance measures output screen for all placed canisters as of 9/28/2022. Radionuclides listed at the bottom under PA checks 9 & 10 exceed the PA base case inventory for this generator/canister/waste form prior to acceptance testing of the three proposed canisters evaluated in this UDQE.

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

Canister Details SN-181

Tasks: Add New Canister

Canister Details
Nuclides
Rad Readings
PA Check
WAC Check
References
Attachments
Images

PA Status: Fail | Placement Vault: HFEF-5 Can

Clear/Cancel PA Result

PA Results							
No.	Pass	Performance Measure	Value	Limit	Units	Type	Run Date
1	Yes	All Pathways Dose	9.4573E-005	1	mrem/yr	Compliance	10/18/2022
	Yes	All Pathways Dose	5.5073E-002	12.5	mrem/yr	Post Compliance	10/18/2022
2	Yes	Beta-Gamma DE	6.7172E-005	0.16	mrem/yr	Compliance	10/18/2022
	Yes	Beta-Gamma DE	3.9096E-002	2.4	mrem/yr	Post Compliance	10/18/2022
3	Yes	Ra-226/228	9.0372E-033	0.2	pCi/L	Compliance	10/18/2022
	Yes	Ra-226/228	8.4423E-007	2.5	pCi/L	Post Compliance	10/18/2022
4	Yes	Gross Alpha	1.9557E-030	0.6	pCi/L	Compliance	10/18/2022
	Yes	Gross Alpha	3.9704E-006	7.5	pCi/L	Post Compliance	10/18/2022
5	Yes	Beta-Gamma ED	3.6751E-005	0.16	mrem/yr	Compliance	10/18/2022
	Yes	Beta-Gamma ED	2.1390E-002	2	mrem/yr	Post Compliance	10/18/2022
6	Yes	Uranium	5.9287E-028	1.2	ug/L	Compliance	10/18/2022
	Yes	Uranium	1.1330E-005	15	ug/L	Post Compliance	10/18/2022
7	Yes	Intruder	5.1209E-002	20	mrem/yr	Compliance	10/18/2022
8	Yes	Air Pathway	6.6684E-007	0.4	mrem/yr	Compliance	10/18/2022
9	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	-	-	-	Compliance	10/18/2022
10	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-	-	-	Compliance	10/18/2022
11	Yes	Administrative 10% Canister Inventory Check (Key Radionuclides)	-	-	-	Compliance	10/18/2022
12	Yes	Unanalyzed/Not Exempt Nuclides Check	-	-	-	Compliance	10/18/2022
13	Yes	Canister Action Levels Check	-	-	-	Compliance	10/18/2022

9. & 10. PA Base Case Inventory Check by Generator/Canister/Waste Form
 Note: Nuclides of interest are in bold.

Nuclide	Form	Vault	Generator	Array	East/West	Cumulative PA Amount (Ci)	Limit Inv (Ci)	Canister Contribution (Ci)
Ba-137m [Details]	S	HFEF-5 Can	MFC	2	East	8.3500E+000	1.3503E-002	4.9030E-005
Co-60 [Details]	S	HFEF-5 Can	MFC	2	East	1.5534E+000	7.9139E-001	4.2056E-006
Cs-137 [Details]	S	HFEF-5 Can	MFC	2	East	8.6295E+000	3.3072E+000	5.1940E-005
Eu-154 [Details]	S	HFEF-5 Can	MFC	2	East	1.0323E-002	8.7567E-003	
I-129 [Details]	S	HFEF-5 Can	MFC	2	East	3.9951E-006	4.4004E-009	2.0990E-014
Np-237 [Details]	S	HFEF-5 Can	MFC	2	East	1.8004E-006	6.8565E-008	1.4164E-018
Pa-233 [Details]	S	HFEF-5 Can	MFC	2	East	2.0930E-006	2.0675E-017	1.9695E-018
Pb-210 [Details]	S	HFEF-5 Can	MFC	2	East	6.8940E-013	4.6793E-017	1.0792E-018
Pm-147 [Details]	S	HFEF-5 Can	MFC	2	East	5.8559E-004	1.0061E-004	6.8394E-010
Pu-236 [Details]	S	HFEF-5 Can	MFC	2	East	9.9496E-007	1.7684E-007	
Pu-238 [Details]	S	HFEF-5 Can	MFC	2	East	5.5179E-004	1.6411E-004	1.2245E-010
Pu-240 [Details]	S	HFEF-5 Can	MFC	2	East	5.8076E-004	6.1053E-005	7.7730E-012
Pu-241 [Details]	S	HFEF-5 Can	MFC	2	East	4.5874E-004	3.0447E-004	7.4610E-012
Pu-242 [Details]	S	HFEF-5 Can	MFC	2	East	5.8003E-000	1.7066E-008	
Ra-226 [Details]	S	HFEF-5 Can	MFC	2	East	4.0022E-012	4.1935E-016	1.3019E-017
Sm-151 [Details]	S	HFEF-5 Can	MFC	2	East	3.7320E-003	4.1756E-004	8.3822E-009
Sr-90 [Details]	S	HFEF-5 Can	MFC	2	East	1.8010E+001	6.7841E+000	1.3702E-004
Th-229 [Details]	S	HFEF-5 Can	MFC	2	East	6.5215E-008	1.8644E-015	9.7000E-027
Th-230 [Details]	S	HFEF-5 Can	MFC	2	East	1.0434E-009	2.1520E-013	7.0424E-015
Th-231 [Details]	S	HFEF-5 Can	MFC	2	East	2.4778E-006	4.7750E-011	2.6910E-012
U-232 [Details]	S	HFEF-5 Can	MFC	2	East	1.0915E-005	3.4376E-007	
U-233 [Details]	S	HFEF-5 Can	MFC	2	East	3.0687E-005	3.3797E-006	3.5764E-023
U-235 [Details]	S	HFEF-5 Can	MFC	2	East	2.4778E-006	1.8102E-006	2.6915E-012
U-236 [Details]	S	HFEF-5 Can	MFC	2	East	2.3698E-006	2.3053E-006	2.0717E-012
U-238 [Details]	S	HFEF-5 Can	MFC	2	East	1.2870E-006	9.1146E-007	2.7622E-016
Y-90 [Details]	S	HFEF-5 Can	MFC	2	East	1.7962E+001	1.6513E+000	1.3705E-004

Figure 2. PA Check output screen from RHINO for waste canister SN-181

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Canister Details OWC-090-H5

Tasks: Add New Canister

Canister Details
Nuclides
Rad Readings
PA Check
WAC Check
References
Attachments
Images

PA Status: Fail | Placement Vault: HFEF-5 Can

Clear/Cancel PA Result

PA Results

No.	Pass	Performance Measure	Value	Limit	Units	Type	Run Date
1	Yes	All Pathways Close	1.2740E-004	1	intensity	Compliance	10/10/2022
2	Yes	Beta-Gamma DE	7.4104E-003	12.5	intensity	Post Compliance	10/10/2022
3	Yes	Beta-Gamma DE	9.9404E-005	0.10	intensity	Compliance	10/10/2022
4	Yes	Beta-Gamma DE	5.2603E-002	2.4	intensity	Post Compliance	10/10/2022
5	Yes	Ra-226/228	2.1740E-030	0.2	pCi/L	Compliance	10/10/2022
6	Yes	Ra-226/228	2.9304E-006	2.5	pCi/L	Post Compliance	10/10/2022
7	Yes	Gross Alpha	4.5100E-030	0.0	pCi/L	Compliance	10/10/2022
8	Yes	Gross Alpha	6.3342E-006	7.5	pCi/L	Post Compliance	10/10/2022
9	Yes	Beta-Gamma ED	4.9505E-005	0.10	intensity	Compliance	10/10/2022
10	Yes	Beta-Gamma ED	2.8813E-002	2	intensity	Post Compliance	10/10/2022
11	Yes	Uranium	0.7790E-020	1.2	ug/L	Compliance	10/10/2022
12	Yes	Uranium	1.8714E-005	15	ug/L	Post Compliance	10/10/2022
13	Yes	Intruder	0.0443E-002	20	intensity	Compliance	10/10/2022
14	Yes	All Pathways	6.9170E-007	0.4	intensity	Compliance	10/10/2022
15	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (all Radionuclides)	-	-	-	Compliance	10/10/2022
16	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-	-	-	Compliance	10/10/2022
17	No	Administrative 10% Canister Inventory Check (Key Radionuclides)	-	-	-	Compliance	10/10/2022
18	Yes	Unanalyzed/Not Examined Nucleides Check	-	-	-	Compliance	10/10/2022
19	No	Canister Action Levels Check	-	-	-	Compliance	10/10/2022

6. & 10. PA Base Case Inventory Check by Generator/Canister/Waste Form

Note: Nuclides of interest are in bold

Nuclide	Form	Vault	Generator	Array	East/West	Cumulative PA Amount (Ci)	Limit (Ci)	Canister Contribution (Ci)
Ba-137m	Details	S	HFEF-5 Can	MFC	2	East	0.7900E+000	1.3503E-002
Co-60	Details	S	HFEF-5 Can	MFC	2	East	1.5534E+000	7.9139E-001
Co-137	Details	S	HFEF-5 Can	MFC	2	East	9.2901E+000	3.3072E+000
Eu-154	Details	S	HFEF-5 Can	MFC	2	East	1.1233E-002	8.7567E-003
Eu-155	Details	S	HFEF-5 Can	MFC	2	East	1.2932E-002	8.1631E-003
I-129	Details	S	HFEF-5 Can	MFC	2	East	3.9951E-000	4.4004E-000
Np-237	Details	S	HFEF-5 Can	MFC	2	East	1.8004E-006	6.0545E-008
Pa-233	Details	S	HFEF-5 Can	MFC	2	East	2.0031E-006	2.0675E-017
Pb-210	Details	S	HFEF-5 Can	MFC	2	East	4.0543E-012	4.6793E-017
Pm-147	Details	S	HFEF-5 Can	MFC	2	East	5.0550E-004	1.0881E-004
Pu-238	Details	S	HFEF-5 Can	MFC	2	East	9.9404E-007	1.7044E-007
Pu-239	Details	S	HFEF-5 Can	MFC	2	East	6.7289E-004	1.8411E-004
Pu-240	Details	S	HFEF-5 Can	MFC	2	East	6.3306E-004	6.1053E-005
Pu-241	Details	S	HFEF-5 Can	MFC	2	East	2.1759E-003	3.8447E-004
Pu-242	Details	S	HFEF-5 Can	MFC	2	East	7.0103E-000	1.7966E-000
Ra-226	Details	S	HFEF-5 Can	MFC	2	East	4.1940E-011	4.1936E-016
Sm-151	Details	S	HFEF-5 Can	MFC	2	East	3.7200E-003	4.1750E-004
Sr-90	Details	S	HFEF-5 Can	MFC	2	East	1.8521E+001	6.7941E+000
Th-229	Details	S	HFEF-5 Can	MFC	2	East	6.5215E-000	1.6644E-015
Th-230	Details	S	HFEF-5 Can	MFC	2	East	1.5400E-000	2.1520E-013
Th-231	Details	S	HFEF-5 Can	MFC	2	East	2.9500E-000	4.7750E-011
U-232	Details	S	HFEF-5 Can	MFC	2	East	1.0910E-005	3.4370E-007
U-233	Details	S	HFEF-5 Can	MFC	2	East	3.0607E-005	3.3797E-006
U-234	Details	S	HFEF-5 Can	MFC	2	East	2.2604E-004	1.1720E-004
U-235	Details	S	HFEF-5 Can	MFC	2	East	2.9500E-000	1.0102E-000
U-236	Details	S	HFEF-5 Can	MFC	2	East	4.0010E-006	2.3933E-006
U-238	Details	S	HFEF-5 Can	MFC	2	East	2.0124E-000	9.1140E-007
V-90	Details	S	HFEF-5 Can	MFC	2	East	1.0403E+001	1.6513E+000

Canister Specific Test Details

Note: Tests 11-13 are canister specific.

11. Administrative 10% Canister Inventory Check (Canister Specific)

Nuclide	Form	Generator	Vault	Array	Amount (Ci)	PA (Ci)	Threshold (Ci)
Co-137	S	MFC	HFEF-5 Can	2	4.6090E-001	3.3072E+000	3.3072E-001
Co-60	A	MFC	HFEF-5 Can	2	2.4790E-001	1.1007E+000	1.1007E-001
Pu-240	S	MFC	HFEF-5 Can	2	5.2340E-005	6.1053E-005	6.1053E-006
U-234	S	MFC	HFEF-5 Can	2	1.3247E-004	1.1720E-004	1.1720E-005
U-235	S	MFC	HFEF-5 Can	2	4.7041E-007	1.0102E-006	1.0102E-007
U-238	S	MFC	HFEF-5 Can	2	7.2544E-007	9.1140E-007	9.1140E-008

13. Canister Action Levels (Canister Specific)

Nuclide	Vault	Amount (Ci)	Limit
Co-137	HFEF-5 Can	4.6090E-001	3.4000E-001

Figure 3. PA Check output screen from RHINO for waste canister OWC-090-H5.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Wells: Jonathan Jacobson | Logout | Site Map
RHINO Home > Search Canister > Canister Details

Canister Details OWC-300-H5

Tasks: Add New Canister

Canister Details | Nuclides | Rad Readings | **PA Check** | WAC Check | References | Attachments | Images

PA Status: Fail | Placement Vault: HFEF-5 Can

Clear/Cancel PA Result

No.	Pass	Performance Measure	Value	Limit	Units	Type	Run Date
1	Yes	All Pathways Close	9.4471E-005	1	mm/yr	Compliance	10/10/2022
2	Yes	Beta-Gamma DE	5.9813E-002	12.5	mm/yr	Post Compliance	10/10/2022
3	Yes	Beta-Gamma DE	6.7099E-005	0.16	mm/yr	Compliance	10/10/2022
4	Yes	Beta-Gamma DE	3.9163E-002	2.4	mm/yr	Post Compliance	10/10/2022
5	Yes	Ra-226/228	9.9372E-033	0.2	pCi/L	Compliance	10/10/2022
6	Yes	Ra-226/228	8.4423E-007	2.5	pCi/L	Post Compliance	10/10/2022
7	Yes	Gross Alpha	1.9557E-030	0.6	pCi/L	Compliance	10/10/2022
8	Yes	Gross Alpha	3.9704E-006	7.5	pCi/L	Post Compliance	10/10/2022
9	Yes	Beta-Gamma ED	3.6711E-005	0.16	mm/yr	Compliance	10/10/2022
10	Yes	Beta-Gamma ED	2.1367E-002	2	mm/yr	Post Compliance	10/10/2022
11	Yes	Uranium	5.9287E-030	1.2	ug/L	Compliance	10/10/2022
12	Yes	Uranium	1.1336E-005	15	ug/L	Post Compliance	10/10/2022
13	Yes	Intruder	1.0976E-001	20	mm/yr	Compliance	10/10/2022
14	Yes	So Pathway	8.6648E-007	0.4	mm/yr	Compliance	10/10/2022
15	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	-	-	-	Compliance	10/10/2022
16	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-	-	-	Compliance	10/10/2022
17	No	Administrative 10% Canister Inventory Check (Key Radionuclides)	-	-	-	Compliance	10/10/2022
18	Yes	Unanalyzed/Not Exampl Nuclides Check	-	-	-	Compliance	10/10/2022
19	No	Canister Action Levels Check	-	-	-	Compliance	10/10/2022

9. & 10. PA Base Case Inventory Check by Generator/Canister/Waste Form

Note: Nuclides of interest are in bold.

Nuclide	Form	Vault	Generator	Array	East/West	Cumulative PA Amount (Ci)	Limit Inv (Ci)	Canister Contribution (Ci)
Ba-137m (Details)	S	HFEF-5 Can	MFC	2	East	8.3631E+000	1.3503E+002	5.0780E+003
Co-60 (Details)	S	HFEF-5 Can	MFC	2	East	1.5539E+000	7.9130E+001	4.9871E+004
Cs-137 (Details)	S	HFEF-5 Can	MFC	2	East	6.0349E+000	3.3072E+000	5.3793E+003
Eu-154 (Details)	S	HFEF-5 Can	MFC	2	East	1.0323E+002	6.7867E+003	
I-129 (Details)	S	HFEF-5 Can	MFC	2	East	3.9851E+000	4.4004E+009	
Ni-63 (Details)	A	HFEF-5 Can	MFC	2	East	6.6108E+003	9.3298E+002	8.4743E+003
Np-237 (Details)	S	HFEF-5 Can	MFC	2	East	1.8004E+000	6.0505E+008	
Pa-233 (Details)	S	HFEF-5 Can	MFC	2	East	2.0809E+000	2.0875E+017	
Pb-210 (Details)	S	HFEF-5 Can	MFC	2	East	6.8940E+013	4.6703E+017	
Pb-147 (Details)	S	HFEF-5 Can	MFC	2	East	5.8859E+004	1.0861E+004	
Po-210 (Details)	S	HFEF-5 Can	MFC	2	East	9.9498E+007	1.7604E+007	
Po-210 (Details)	S	HFEF-5 Can	MFC	2	East	5.5179E+004	1.6411E+004	
Po-240 (Details)	S	HFEF-5 Can	MFC	2	East	5.8076E+004	6.1053E+005	
Po-241 (Details)	S	HFEF-5 Can	MFC	2	East	4.5874E+004	3.0447E+004	
Po-242 (Details)	S	HFEF-5 Can	MFC	2	East	5.8003E+000	1.7966E+008	
Ra-226 (Details)	S	HFEF-5 Can	MFC	2	East	4.9022E+012	4.1935E+016	
Sm-151 (Details)	S	HFEF-5 Can	MFC	2	East	3.7320E+003	4.1756E+004	
Si-36 (Details)	S	HFEF-5 Can	MFC	2	East	1.8024E+001	6.7841E+000	1.4254E+002
Th-229 (Details)	S	HFEF-5 Can	MFC	2	East	6.5215E+000	1.6644E+015	
Th-230 (Details)	S	HFEF-5 Can	MFC	2	East	1.0434E+009	2.1520E+013	
Th-231 (Details)	S	HFEF-5 Can	MFC	2	East	2.4776E+006	4.7756E+011	
U-232 (Details)	S	HFEF-5 Can	MFC	2	East	1.0810E+005	3.4376E+007	
U-233 (Details)	S	HFEF-5 Can	MFC	2	East	3.0607E+005	3.3797E+006	
U-235 (Details)	S	HFEF-5 Can	MFC	2	East	2.4776E+006	1.8102E+006	
U-236 (Details)	S	HFEF-5 Can	MFC	2	East	2.3690E+006	2.3953E+006	
U-238 (Details)	S	HFEF-5 Can	MFC	2	East	1.2870E+006	9.1140E+007	
U-80 (Details)	S	HFEF-5 Can	MFC	2	East	1.7997E+001	1.6513E+000	1.4258E+002

Canister Specific Test Details

Note: Tests 15-17 are canister specific.

11. Administrative 10% Canister Inventory Check (Canister Specific)

Nuclide	Form	Generator	Vault	Array	Amount (Ci)	PA Inv (Ci)	Threshold (Ci)
Ni-63	A	MFC	HFEF-5 Can	2	8.4743E+003	9.3298E+002	9.3298E+001

13. Canister Action Levels (Canister Specific)

Nuclide	Vault	Amount (Ci)	Limit
Ni-63	HFEF-5 Can	8.4743E+003	2.8010E+003

Figure 4. PA Check output screen from RHINO for waste canister OWC-300-H5.

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLW DISPOSAL FACILITY****Evaluation of PA Checks 9 and 10**

PA Checks 9 and 10 were flagged because the cumulative inventory of some radionuclides for the specific generator (MFC), canister type (HFEF-5), and waste form (AM, SC or Combined AM/SC) exceeds the PA 20-year base-case inventory of those radionuclides. The cumulative inventory includes the inventory of all placed canisters plus each proposed canister. PA Check 9 performs the check for all radionuclides in the PA base case inventory (see ECAR-3940, Tables 8 and 9), and PA Check 10 performs the check for key radionuclides only. Key radionuclides are those that failed a PA pathway screening and were fully evaluated in the PA for the groundwater, air⁴ and intruder pathways (see INL 2018, Table 18, column 7). Thus, any canister that is flagged by PA Check 10 will also be flagged by PA Check 9. The cumulative inventory of radionuclides that were screened from the groundwater pathway should be evaluated to determine if the increased inventory (above the PA base case) could have resulted in the radionuclide not being screened out during preparation of the PA (DOE-ID 2018). The cumulative inventory of key radionuclides should be evaluated to determine if the inventory and accompanying dose and concentration performance measures are within the bounds of the PA. This is checked by examining the increase in performance measures above those calculated and shown in Figure 1 (see Checks 1 through 8) assuming each proposed canister is placed at the facility.

In general, the exceedances flagged by PA Checks 9 and 10 may be the result of the inventory in previously placed canisters, or it may be due to the inventory of one or more proposed canisters. The details for PA Checks 9 and 10 in Figure 1 shows the inventories of 26 radionuclides (including 8 key radionuclides) already exceed the PA 20-year base-case inventories for surface contamination in HFEF-5 canisters even before the three proposed canisters are considered. Therefore, it is important to understand how much additional inventory of these radionuclides is added to the cumulative facility inventory by the addition of the three proposed canisters, and if the three canisters contain other radionuclides that result in additional exceedances.

Percent Increase in Facility Inventory for Radionuclides Flagged by PA Checks 9 and 10

For evaluation of PA Checks 9 and 10, the inventory of the three proposed canisters was considered together. Table 3 contains a summary of the radionuclide inventories flagged by RHINO for PA Checks 9 and 10. The cumulative inventory of these radionuclides for this generator/canister/waste form already placed at the facility is shown in column 3. Column 4 contains the combined inventory in the three proposed canisters. Column 5 is the sum of columns 3 and 4 and represents the cumulative inventory in all HFEF-5 canisters if the three canisters were placed at the facility. The final column (6) shows the percent increase in the cumulative inventory of each radionuclide for this generator/canister/waste form if the three proposed canisters were placed.

Radionuclides highlighted light blue in Table 3 (Ba-137m, Pa-233, Th-231 and Y-90, see footnote a) were screened out during phase I of a three-phase screening process for the PA groundwater and intruder pathways because their half-lives are less than one year. According to the PA (DOE-ID 2018), the inventory of these radionuclides will have no impact on the PA all-pathway dose and therefore, require no further evaluation.

Radionuclides shaded green in Table 3 (Pu-236, and U-232, see footnote b of Table 3) were not listed in the inventory of any of the three proposed canisters. The cumulative inventory of these radionuclides for this generator/canister/waste form were evaluated in a previous UDQE and because the three proposed canisters do not add additional inventory of these radionuclides, they also require no further evaluation.

The inventory of the 11 radionuclides shaded pink (Co-60, Cs-137, Eu-154, I-129, Np-237, Pm-147, Pu-240, Sm-151, Sr-90, Th-229, and U-233) for this generator/canister/waste form exceed the PA base case inventories before the inventory from the three proposed canisters is added. If the inventory from the three proposed canisters is

⁴ Although the air pathway was screened from the all-pathways analysis in the PA, the Phase III air pathway screening analysis is used by RHINO to calculate potential air pathway doses.

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added to the cumulative facility inventory, the percent increase in the cumulative inventory from addition of the three canisters is less than 10% for each radionuclide (Table 3, column 5). It is very unlikely that increases this small will impact the PA results and the inventory in the three canisters is acceptable. Nevertheless, this was confirmed by checking the increase in performance measures which is discussed in the Section, "**Performance Measure Evaluation for PA Checks 9 and 10.**" Co-60, Cs-137 and Sr-90 are also key radionuclides for the intruder pathway and were evaluated under PA check 13 (see Section "**Evaluation of PA Check 13**")

The cumulative inventory increases for the 12 radionuclides not shaded in Table 3 (Eu-155, Ni-63, Pb-210, Pu-238, Pu-241, Pu-242, Ra-226, Th-230, U-234, U-235, U-236, and U-238) are more significant and range from 21% (Pu-242) to 1384% (Th-230). Three of these radionuclides (U-234, U-235 and U-238) are key groundwater pathway radionuclides and their inventory was evaluated by checking the increase in performance measures which is discussed in the Section, "**Performance Measure Evaluation for PA Checks 9 and 10.**" The other nine non-shaded radionuclides were screened from the groundwater pathway and they were evaluated to determine if the increase would still result in the radionuclides being screened. This is discussed in Section, "**Evaluation of Screened Groundwater Pathway Radionuclides for PA Checks 9 and 10.**" Ni-63 is also a key radionuclide for the intruder pathway and was evaluated under PA check 13 (see Section "**Evaluation of PA Check 13**").

It is worth mentioning that three of the non-shaded radionuclides in Table 3 (Eu-155, Ni-63 and U-234) were the only radionuclides flagged by PA check 9 that were not previously flagged by RHINO prior to consideration of the three proposed canisters. This means the cumulative inventory prior to consideration of the three proposed canisters is less than the PA base case inventory for this generator/canister/waste form, and it is the inventory in one, two or all three canisters that caused the cumulative inventory to exceed the PA base case inventory. Eu-155 and U-234 were only reported in canister OWC-090-H5 and Ni-63 was only reported in canister OWC-300-H5 so the inventory in SN-181 did not contribute to these radionuclides being flagged by RHINO for PA check 9.

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Table 3. Summary of radionuclide inventories flagged by RHINO for PA Checks 9 and 10.

1	2	3	4	5	6
Nuclide	Waste Form ^a	Cumulative Inventory of Placed Canisters in HFEF Vault Array (Ci)	Total Inventory of 3 Proposed Canisters (Ci)	Cumulative Inventory of Placed + 3 Proposed Canisters in HFEF Vault Array (Ci)	Percent Inventory Increase if 3 Proposed Canisters were Placed in HFEF Vault Array
Ba-137m ^a	SC	8.3580E+00	4.4594E-01	8.8039E+00	5%
Co-60 ^c	SC	1.5534E+00	5.3644E-04	1.5539E+00	0.03%
Cs-137 ^c	SC	8.8295E+00	4.7239E-01	9.3019E+00	5%
Eu-154 ^c	SC	1.0323E-02	9.1059E-04	1.1233E-02	9%
Eu-155	SC	6.6604E-03	6.2717E-03	1.2932E-02	94%
I-129 ^c	SC	3.9951E-08	2.0998E-14	3.9951E-08	0.00005%
Ni-63	AM	1.3652E+02	8.4743E+03	8.6108E+03	6207%
Np-237 ^c	SC	1.8004E-06	1.0926E-11	1.8004E-06	0.0006%
Pa-233 ^a	SC	2.0930E-06	9.0671E-11	2.0931E-06	0%
Pb-210	SC	6.8940E-13	4.1649E-12	4.8543E-12	604%
Pm-147 ^c	SC	5.8559E-04	6.8394E-10	5.8559E-04	0.0001%
Pu-236 ^b	SC	9.9496E-07	0	9.9496E-07	0
Pu-238	SC	5.5179E-04	1.2110E-04	6.7289E-04	22%
Pu-240 ^c	SC	5.8076E-04	5.2334E-05	6.3309E-04	9%
Pu-241	SC	4.5874E-04	1.7172E-03	2.1759E-03	374%
Pu-242	SC	5.8083E-08	1.2100E-08	7.0183E-08	21%
Ra-226	SC	4.0022E-12	3.7044E-11	4.1046E-11	926%
Sm-151 ^c	SC	3.7328E-03	8.3922E-09	3.7328E-03	0.0002%
Sr-90 ^c	SC	1.8010E+01	5.2540E-01	1.8535E+01	3%
Th-229 ^c	SC	6.5215E-08	4.6341E-19	6.5215E-08	0.000000007%
Th-230	SC	1.0434E-09	1.4445E-08	1.5488E-08	1384%
Th-231 ^a	SC	2.4776E-06	4.7841E-07	2.9560E-06	19%
U-232 ^b	SC	1.0918E-05	0	1.0918E-05	0
U-233 ^c	SC	3.0687E-05	1.6223E-15	3.0687E-05	0.000000005%
U-234	SC	9.4174E-05	1.3247E-04	2.2664E-04	141%
U-235	SC	2.4776E-06	4.7841E-07	2.9560E-06	19%
U-236	SC	2.3698E-06	2.3283E-06	4.6981E-06	98%
U-238	SC	1.2870E-06	7.2544E-07	2.0124E-06	56%
Y-90 ^a	SC	1.7982E+01	5.2553E-01	1.8508E+01	3%

- a. Blue-shaded radionuclides half-life is less than 1 year. Inventory has no impact on the PA all-pathway dose and requires no evaluation.
- b. Green-shaded radionuclides are not listed in the inventory of the three proposed canisters. This radionuclide was flagged due to inventory in prior canister placements which has already been evaluated in a previous UDQE.
- c. Pink-shaded and non-shaded radionuclides indicate radionuclides whose inventory prior to placement of the three canisters exceeds the PA base case inventory. The inventory contribution from the three canisters adds to the exceedance of the PA base case inventory. The percent inventory increase of pink-shaded radionuclides is < 10% while the percent increase of non-shaded radionuclides is > 10%.
- d. Waste Form can be AM = activated metal, SC = surface contaminated debris, or Combined = AM and SC
- Radionuclides shown in **BOLD** text are key radionuclides meaning they were not screened and were fully evaluated in the PA in at least one of the three pathways (groundwater, air, or intruder). Other radionuclides (non-key) were screened from all pathways during preparation of the PA (DOE-ID 2018).

Performance Measure Evaluation for PA Checks 9 and 10

Increases in performance measures were checked to ensure they are within the bounds of the PA. Figures 2 through 4 show the increase in each performance measure for each of the three proposed canisters. The performance measures are based on the cumulative inventory of key radionuclides. Key radionuclides in Table 3

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include I-129, Np-237, Pu-240, U-235, and U-238 for the groundwater pathway and Co-60, Cs-137, Ni-63, and Sr-90 for the intruder pathway. Table 4 contains a summary of the increases in performance measures if all three of the proposed canisters are placed in the facility. The percent increase in each performance measure if the three proposed canisters are placed at the facility ranges from 3.8% to 141% (see Table 4, column 7). With the exception of the air pathway increase (3.8%), these increases seem uncharacteristically high for three canisters. However, by comparing Figures 2 through 4, it is evident that the increases are primarily the result of canister OWC-090-H5 with the exception of the intruder dose increase. 86.5% of the intruder dose increase is from Ni-63 in canister OWC-300-H5 with 13.5% from Sr-90 in canister OWC-090-H5 (see Section "Evaluation of PA Check 11").

Although the percent increases in performance measure totals after addition of the three proposed canisters are uncharacteristically high (Table 4, column 7), they remain a relatively small percent of the limits in RHINO (Table 4, column 3) which for most measures are 1/25th the regulatory limit for the 1000-year compliance period and 1/2 the regulatory limit for the post-compliance period (see Table 4, column 8). This is evidence that the canisters are acceptable for disposal. However, the all-pathways dose for the compliance period (1.275E-04 mrem/yr) would be 30% of the dose predicted in the PA for the entire facility (4.38E-04 mrem/yr). This suggests the current cumulative inventory of some key radionuclides in the placed plus proposed canisters is greater than the estimated inventory used for the PA base case. This is discussed in the **Summary** section and will be monitored as additional canisters (from MFC and other generators) are evaluated for acceptance.

Table 4. Summary of performance measures for the three proposed canisters.

1	2	3	4	5	6	7	8
Performance Measure (PM)	Period	Limit ^a	Units	PM Before Addition of 3 Proposed Canisters	PM After Addition of 3 Proposed Canisters	Percent Increase in PM from All 3 Proposed Canisters	PM as Percent of Limit After Addition of 3 Proposed Canisters ^a
All Pathways Dose	Compliance	1	mrem/yr	9.4471E-05	1.2750E-04	35%	0.013%
All Pathways Dose	Post Compliance	12.5	mrem/yr	5.5013E-02	7.4244E-02	35%	0.6%
Beta-Gamma DE	Compliance	0.16	mrem/yr	6.7099E-05	9.0557E-05	35%	0.06%
Beta-Gamma DE	Post Compliance	2.4	mrem/yr	3.9053E-02	5.2706E-02	35%	2.2%
Ra-226/228	Compliance	0.2	pCi/L	9.0372E-33	2.1749E-32	141%	<1E-25%
Ra-226/228	Post Compliance	2.5	pCi/L	8.4423E-07	2.0304E-06	141%	0.00008%
Gross Alpha	Compliance	0.6	pCi/L	1.9557E-30	4.5198E-30	131%	<1E-25%
Gross Alpha	Post Compliance	7.5	pCi/L	3.9704E-06	6.3342E-06	60%	0.00008%
Beta-Gamma ED	Compliance	0.16	mrem/yr	3.6711E-05	4.9545E-05	35%	0.031%
Beta-Gamma ED	Post Compliance	2	mrem/yr	2.1367E-02	2.8836E-02	35%	1.44%
Uranium	Compliance	1.2	ug/L	5.9287E-28	8.7798E-28	48%	<1E-25%
Uranium	Post Compliance	15	ug/L	1.1330E-05	1.6714E-05	48%	0.00011%
Intruder	Compliance	20	mrem/yr	5.1287E-02	1.1892E-01	132%	0.595%
Air Pathway	Compliance	0.4	mrem/yr	6.6648E-07	6.9211E-07	3.8%	0.00017%

a. Conservative limit in RHINO set to less than regulatory limit. In most cases the administrative limits are 1/25th the regulatory limits for the compliance period and one-half the regulatory limits for the post-compliance period.

Evaluation of Screened Groundwater Pathway Radionuclides for PA Checks 9 and 10

For pink-shaded and non-shaded radionuclides in Table 3 that were screened from the groundwater pathway in the PA, it is important to show that the cumulative inventory of each radionuclide in the placed plus three proposed canisters would still be screened from the groundwater pathway as it was during the PA. This was done by calculating the cumulative inventory of each radionuclide after placement of the three canisters as a percent of the maximum allowable inventory allowed by the phase II and III screening steps from the PA. For this calculation the inventory of the placed plus three proposed canisters was added to the total PA base case inventory. This is conservative because the PA base case inventories include some of the inventory in the placed plus three proposed canisters. The phase II and III screenings were done on the total facility inventory and are independent of generator, canister type and waste form. It should be noted that Co-60, Cs-137, Ni-63, and Sr-90 are key

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radionuclides in the PA, but only for the intruder pathway. Because the three-phase PA screening was performed for the groundwater pathway, these four radionuclides were evaluated with the other non-key radionuclides eliminated during the phase II or III screening steps in the PA.

The maximum allowable inventory allowed by the phase II screening ($I_{max_{II_i}}$) was calculated using the following equation:

$$I_{max_{II_i}} \left(\frac{Ci}{yr} \right) = \frac{0.4 \left(\frac{mrem}{yr} \right)}{NCRP \text{ Screening Dose}_i \left(\frac{mrem}{Ci} \right)} \quad (\text{Equation 1})$$

where:

0.4 mrem/yr = PA phase II screening dose standard (1/10th the allowable 40 CFR 141 drinking water dose for beta-gamma emitters). This assumes the entire inventory is leached from the source in one year.

NCRP Screening Factor (mrem/Ci) (see DOE-ID 2018, Table 2-26).

The maximum allowable inventory allowed by the phase III screening ($I_{max_{III_i}}$) was calculated using the following equation:

$$I_{max_{III_i}}(Ci) = 0.4 \left(\frac{mrem}{yr} \right) \times \frac{I_{PA_i}(Ci)}{D_{III_i} \left(\frac{mrem}{yr} \right)} \quad (\text{Equation 2})$$

here:

0.4 mrem/yr = PA phase III screening dose standard (1/10th the allowable 40 CFR 141 drinking water dose for beta-gamma emitters)

I_{PA_i} = total PA base case inventory of radionuclide i (see DOE-ID 2018, Table 2-29)

D_{III_i} = PA phase III screening dose for radionuclide i based on total PA base case inventory of radionuclide i.

Table 5 shows that even when the projected cumulative inventory after placement of three proposed canisters (column 3) and the total PA base case inventory (column 4) are conservatively summed together for each radionuclide, the totals (column 5) when compared to the maximum allowable phase II and phase III screening inventories (column 7) are small fractions (column 8) and would still be screened out. Therefore, the inventories of the radionuclides in the three proposed canisters are consistent with the assumptions and screening process/results of the PA, and within the bounds of the PA.

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Table 5. Comparison of non-key radionuclide inventories to maximum allowable screening inventories.

1	2	3	4	5	6	7	8
Radionuclides Screened During PA Phase II Screening							
Non-Key Radionuclide	Total Inventory of 3 Proposed HFEF-5 Canisters (Ci) ^a	Projected Cumulative Inventory (Placed + 3 Proposed Cans) (Ci) ^a	Total PA Base Case Inventory (All Generators, Canisters, Waste Forms) (Ci) ^b	Projected Cumulative Inventory after Placement of 3 Proposed Cans + Total PA Base Case Inventory (Col3+Col4) (Ci)	PA Phase II NCRP Screening Factor (mrem/Ci) ^c	Max Allowable Phase II Screening Inventory (Ci/yr) ^d	PA Base Case + Projected Cumulative Inventory after Placement of 3 Proposed Cans as % of Max Allowable Phase II Screening Inventory (Col5/Col7)
Pb-210	6.89E-13	4.85E-12	2.89E-12	7.74E-12	7.77E+04	5.15E-06	0.0002%
Ra-226	4.00E-12	4.10E-11	3.14E-11	7.24E-11	2.96E+05	1.35E-06	0.005%
Th-229	6.52E-08	6.52E-08	5.35E-08	1.19E-07	1.18E+05	3.39E-06	3.5%
Th-230	1.04E-09	1.55E-08	4.93E-08	6.48E-08	1.59E+05	2.52E-06	2.6%
Radionuclides Screened During PA Phase III Screening							
Non-Key Radionuclide	Total Inventory of 3 Proposed HFEF-5 Canisters (Ci) ^a	Projected Cumulative Inventory (Placed + 3 Proposed Cans) (Ci) ^a	Total PA Base Case Inventory (All Generators, Canisters, Waste Forms) (Ci) ^b	Projected Cumulative Inventory after Placement of 3 Proposed Cans + Total PA Base Case Inventory (Col3+Col4) (Ci)	PA Phase III Dose (mrem/yr) ^e	Max Allowable Phase III Screening Inventory (Eqn 2) (Ci/yr) ^f	PA Base Case + Projected Cumulative Inventory after Placement of 3 Proposed Cans as % of Max Allowable Phase III Screening Inventory (Col5/Col7)
Co-60 ^g	5.36E-04	1.55E+00	3.09E+05	3.09E+05	< 1E-40	1.24E+45	< 1E-40%
Cs-137 ^g	4.72E-01	9.30E+00	9.45E+02	9.54E+02	< 1E-40	3.78E+42	< 1E-40%
Eu-154	9.11E-04	1.12E-02	1.56E+01	1.56E+01	< 1E-40	6.24E+40	< 1E-40%
Eu-155	6.27E-03	1.29E-02	1.65E+00	1.66E+00	< 1E-40	6.60E+39	< 1E-40%
Ni-63 ^g	8.47E+03	8.61E+03	2.18E+05	2.27E+05	< 1E-40	8.72E+44	< 1E-40%
Pm-147	6.84E-10	5.86E-04	5.23E+01	5.23E+01	< 1E-40	2.09E+41	< 1E-40%
Pu-238	1.21E-04	6.73E-04	3.68E-01	3.69E-01	2.57E-02	5.73E+00	6.4%
Pu-241	1.72E-03	2.18E-03	1.97E+01	1.97E+01	4.32E-02	1.82E+02	11%
Pu-242	1.21E-08	7.02E-08	2.27E-04	2.27E-04	1.50E-02	6.05E-03	3.8%
Sm-151	8.39E-09	3.73E-03	5.27E+01	5.27E+01	< 1E-40	2.11E+41	< 1E-40%
Sr-90 ^g	5.25E-01	1.85E+01	6.73E+02	6.92E+02	< 1E-40	2.69E+42	< 1E-40%
U-233	1.62E-15	3.07E-05	8.38E-05	1.14E-04	2.54E-02	1.32E-03	8.7%
U-236	2.33E-06	4.70E-06	5.88E-05	6.35E-05	1.04E-02	2.26E-03	2.8%

- Inventory of surface contaminated debris except for Ni-63 which is activated metal.
- Table 2-14, RHLLW Performance Assessment (DOE-ID 2018).
- Table 2-26, RHLLW Performance Assessment (DOE-ID 2018).
- I_{max} from Equation 1 above.
- Table 2-29, RHLLW Performance Assessment (DOE-ID 2018). Phase III screening doses < 1E-40 mrem/yr were assumed = 1E-40 mrem/yr for calculating Maximum Allowable Phase III Screening Inventory (column 7).
- I_{max} from Equation 2 above.
- Co-60, Cs-137, Ni-63, and Sr-90 are key radionuclides in the PA, but only for the intruder pathway. Because the three-phase PA screening was performed for the groundwater pathway, these radionuclides were evaluated with the other non-key radionuclides eliminated during the phase II or III screening steps in the PA.

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Evaluation of PA Check 11

This check is flagged by RHINO if the inventory of a key radionuclide in a proposed canister exceeds 10% of the PA 20-year base-case inventory for the particular generator, canister type and waste form (see INL 2018, Table 18, column 8). When this occurs, the inventories greater than 10% must be reviewed to determine if: 1) they are anomalous or indicative of a change in waste generation rates, and 2) they are within the bounds of the approved PA.

Table 6 shows the canisters and radionuclides by waste form that were flagged during PA Check 11. Column 7 confirms the canister inventories of each radionuclide are greater than 10% of the PA 20-yr base case inventories for the specific generator/canister/waste form. Ni-63 in canister OWC-300-H5 and U-234 in canister OWC-090-H5 are the largest at 908% and 113% respectively. A percentage greater than 100% indicates these canisters contain more of these radionuclides in the respective waste forms than the projected inventory in all HFEF-5 canisters from MFC (legacy and projected future generation waste). This indicates the canister inventories of these two radionuclides are not reflective of the original projected inventories for these canisters. This is confirmed by the information in Table 7 which shows the current radionuclide inventory estimates in canister OWC-090-H5 are 8 times the original projected inventory estimates for all radionuclides shown in Table 6 except Pu-240. Table 7 also shows the current estimate of 8470 Ci of Ni-63 as activated metal in canister OWC-300-H5 is 114 times greater than the original projected estimate of 74.3 Ci.

Table 6. Summary of radionuclide inventories flagged by RHINO for PA Check 11.

1	2	3	4	5	6	7	8	9
Can	Nuclide	Waste Form ^a	Canister Inventory (Ci)	PA 20-yr Base Case Inventory for MFC Legacy and Future Generation Waste in HFEF-5 Canisters for each Waste Form (Ci) ^b	10% Canister Threshold Inventory (Ci) ^c	Canister Inventory as % of PA 20-yr Base Case Inventory for MFC Legacy and Future Generation Waste in HFEF-5 Canisters for each Waste Form	PA 20-yr Base Case Inventory for RHLLW Facility and each Waste Form (Ci) ^b	Can Inventory as % of PA 20-yr Base Case Inventory for RHLLW Facility and each Waste Form
OWC-090-H5	Cs-137	SC	4.67E-01	3.31E+00	3.31E-01	14%	9.18E+02	0.05%
	Nb-94	AM	2.48E-01	1.11E+00	1.11E-01	22%	5.60E+01	0.44%
	Pu-240	SC	5.23E-05	6.11E-05	6.11E-06	86%	2.28E-03	2.3%
	U-234	SC	1.32E-04	1.17E-04	1.17E-05	113%	1.20E-04	110%
	U-235	SC	4.78E-07	1.81E-06	1.81E-07	26%	3.70E-03	0.01%
	U-238	SC	7.25E-07	9.11E-07	9.11E-08	80%	7.41E-04	0.10%
OWC-300-H5	Ni-63	AM	8.47E+03	9.33E+02	9.33E+01	908%	2.17E+05	3.9%

a. Waste Form can be AM = activated metal, SC = surface contaminated debris, or Combined = AM and SC.

b. From ECAR-3940, Table 16. Also see Figures 2, 3 and 4 for numbers in column 5.

c. From INL 2018, Table 18, column 8.

Table 7. Comparison of current inventory estimates to original inventory estimates for radionuclides, waste forms and canisters flagged by RHINO for PA Check 11.

1	2	3	4	5	6
Canister	Nuclide	Waste Form ^a	Current Estimated Canister Inventory (Ci)	Original Estimated Inventory of Canister (Ci)	Current to Original Inventory Ratio
OWC-090-H5	Cs-137	SC	4.67E-01	5.84E-02	8
	Nb-94	AM	2.48E-01	2.94E-02	8
	Pu-240	SC	5.23E-05	5.23E-05	1
	U-234	SC	1.32E-04	1.57E-05	8
	U-235	SC	4.78E-07	5.67E-08	8
	U-238	SC	7.25E-07	8.6E-08	8

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OWC-300-H5	Ni-63	AM	8.47E+03	7.43E+01	114
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Other evaluations performed in this UDQE provide evidence that the radionuclide inventories flagged by RHINO during PA Check 11 are within the bound of the PA (see **Evaluation of PA Checks 9 and 10: Performance Measure Evaluation for PA Checks 9 and 10**, and **Evaluation of Screened Groundwater Pathway Radionuclides for PA Checks 9 and 10**, and **Evaluation of PA Check 13**). To provide additional assurance, the estimated canister inventories in Table 6 (column 4) were compared to the PA 20-yr base case inventories by waste form for the RHLLW Disposal Facility (column 8). Column 9 shows the canister inventories are small fractions for each radionuclide except U-234 in canister OWC-090-H5 (110%). However, U-234 is a key radionuclide and the dose contribution to the groundwater pathway dose is included in RHINO dose calculations. The inventory of U-234 in canister OWC-090-H5, above the original estimated inventory in the PA base case, is the likely reason for the increase in the all-pathways dose from 9.447E-05 mrem/yr to 1.275E-04 mrem/yr as shown in Table 4. Nevertheless, the dose is within the bounds of the PA. So although the inventories of several radionuclides in canisters OWC-090-H5 and OWC-300-H5 are significantly greater than originally estimated, the canisters are acceptable for disposal.

Evaluation of PA Check 13

This check is flagged by RHINO if a proposed canister contains a key radionuclide whose inventory exceeds canister action levels based on the chronic intruder pathway dose standard (see INL 2018, Table 19). The canister action levels represent average canister inventories that could potentially cause an exceedance of an intruder dose standard if they were representative of all canisters. According to the RHLLW WAC (PLN-5446 Section 2.3), action levels were established based on the chronic intruder⁵ pathway scenario analyzed in the facility PA. If a radionuclide inventory of a specific canister exceeds an action level, an evaluation must be conducted to ensure the total inventory is likely to remain within the bounds of the PA.

Cs-137 in canister OWC-090-H5 and Ni-63 in canister OWC-300-H5 were the only radionuclide inventories flagged by PA check 13. Table 8 shows the canister inventories are 137% (Cs-137) and 326% (Ni-63) of the canister action levels (see Table 8, column 5), but both are less than 2% of the vault array action levels (see Table 8, column 7). Although the levels of Cs-137 and Ni-63 in the two canisters were flagged by RHINO, the levels are not indicative of other HFEF-5 canisters. For example, the total inventory of Cs-137 and Ni-63 in all 60 HFEF-5 canisters placed in the HFEF vault array at the time this evaluation was being prepared is 8.83 Ci and 136.5 Ci respectively. For Cs-137, this is 14.4% of the 61.2 Ci action level for the HFEF vault array (see Table 8, column 5), and for Ni-63, this is 0.03% of the 468,000 Ci action level for the HFEF vault array (see Table 8, column 5). Given the HFEF vault array is filled to 33% of capacity at the time of this evaluation (60 canisters placed out of 180), the amount of Cs-137 and Ni-63 in all placed plus the three proposed canisters remains within the bounds of the PA. So although the Cs-137 and Ni-63 in these two canisters is much greater than other HFEF-5 canisters, the total inventory remains within the bounds of the PA intruder analysis.

Table 8. Summary details of inventory evaluation for PA check 13.

1	2	3	4	5	6	7
Canister ID	Nuclide	Canister Inventory (Ci)	Canister Action Level for HFEF Vault Array (Ci)	Canister Inventory as % of Canister Action Level for HFEF Vault Array	Vault Array Action Level for HFEF Vault Array (Ci)	Canister Inventory as % of Vault Array Action Level for HFEF Vault Array
OWC-090-H5	Cs-137	0.467	0.34	137%	61.2	0.8%
OWC-300-H5	Ni-63	8474.3	2600	326%	468000	1.8%

⁵ The chronic intruder scenario is the more limiting of the two intruder scenarios (acute and chronic) evaluated in the PA.

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Identification of Non-System Radionuclides

Non-System radionuclides are radionuclides that are not in the RHINO database and are similar to unanalyzed/non-exempt radionuclides (PA Check 12) in that they were not considered during preparation of the PA. According to the WAC (PLN-5446), containers with reportable radionuclides not analyzed in the PA (see WAC, Tables B-1 through B-8), or not listed as an exempt radionuclide (see WAC, Table 1) will not be accepted for disposal at the RHLLW Disposal Facility without additional evaluation per RH-ADM-5214 (2021). These radionuclides are identified on the "Nuclides" tab under the "Canister Details" page in RHINO. A future update of RHINO will include a check for non-system radionuclides on the "PA Check" tab.

Table 9 shows the non-system radionuclides identified by RHINO in the three proposed canisters. Typically non-system radionuclides have very short half-lives or are essentially stable with very long half-lives. This is true of the radionuclides in Table 9. Radionuclides shaded pink have half-lives less than 5E-05 years (26 minutes). Radionuclides shaded green have very long half-lives and are considered essentially stable. In the PA, radionuclides with half-lives less than 1 year were screened out during phase I of a three-phase screening process for the PA groundwater and intruder pathways because they have essentially no impact on the PA all-pathway dose and intruder dose. Radionuclides with very long half-lives were also not considered in the PA. Therefore, the non-system radionuclides identified by RHINO in the three proposed canisters will have no impact on the PA.

Table 9. Non-system radionuclides identified by RHINO in the proposed canisters.

Canister	Nuclide	Waste Form	Half-Life ^a (yr)	Inventory (Ci)
SN-181	At-218	S	4.8E-08	2.59E-21
	At-219	S	1.8E-06	5.02E-23
	Bi-215	S	1.4E-05	4.87E-23
	Hg-206	S	1.5E-05	2.05E-26
	Nd-144	S	2.3E+15	4.89E-21
	Rn-218	S	1.1E-09	2.59E-24
	Tl-210	S	2.5E-06	2.72E-21
	U-235m	S	4.9E-05	4.46E-10
OWC-090-H5	At-218	S	4.8E-08	7.39E-15
	At-219	S	1.8E-06	1.66E-17
	Bi-215	S	1.4E-05	1.61E-17
	Hg-206	S	1.5E-05	7.91E-20
	Nd-144	S	2.3E+15	5.43E-17
	Rn-218	S	1.1E-09	7.39E-18
	Tl-210	S	2.5E-06	7.76E-15
	U-235m	S	4.9E-05	1.05E-02
OWC-300-H5	Nd-144	S	2.3E+15	4.94E-19

a. Half-lives taken from Federal Guidance Report (FGR)15 (2019). Radionuclides shaded pink have a half-life less than 5E-05 yr (26 minutes). Radionuclides shaded green have very long half-lives and are considered essentially stable.

Evaluation of Flagged WAC Check: Nuclear Safety Limits

Two of the three proposed waste canisters were flagged by RHINO during the WAC check. Radionuclide inventories for Cs-137 and Sr-90 in canister OWC-090-H5 (see Figure 5), and Fe-55 in canister OWC-300-H5 (see Figure 6) were flagged as "fail" because the inventories exceed the bounding material-at-risk (MAR) threshold levels evaluated in ECAR-1559 and identified as waste acceptance criteria in the WAC (PLN-5446,

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Table A-9). According to ECAR-1559, the radionuclide content of each proposed waste canister must be screened against the bounding MAR threshold levels. If the canister inventory for one or more radionuclides exceeds the threshold levels, a full dose consequence calculation must be completed to verify the total dose consequence for the proposed waste canister is within the bounding total dose consequence values evaluated for that waste stream/canister combination. In addition, the cause of each high radionuclide outlier should be investigated to determine if (1) the corresponding waste stream processes have been changed such that the characterization as provided in ECAR-1559 and supporting ECARs is no longer valid and needs updating, or (2) the outlier is attributable to an anomalous condition that is unique to a specific proposed canister.

Canister Details OWC-090-H5

Tasks: Add New Canister

Canister Details	Nuclides	Rad Readings	WAC Check	References	Attachments	Images																																																																								
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="background-color: #4a7ebb; color: white;">TRU Amount (nCig)</th> <th style="background-color: #4a7ebb; color: white;">TRU?</th> <th style="background-color: #4a7ebb; color: white;">WAC Result</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">2.0820E+001</td> <td style="text-align: center;">No</td> <td style="text-align: center;">Pass</td> </tr> </tbody> </table>							TRU Amount (nCig)	TRU?	WAC Result	2.0820E+001	No	Pass																																																																		
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Figure 5. WAC Check output screen from RHINO for waste canister OWC-090-H5.

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Canister Details OWC-300-H5

Canister Details
Nuclides
Rad Readings
PA Check
WAC Check
References
Attachments
Images

Insufficient Data to Calculate TRU Ratio

Task: Export Limits for this Canister Type

WAC Limits						
Type: A = Activated Metals R = Resins S = Surface Contamination T = Total (A + R + S)						
Nuclide	Name	Type	Amount (Ci)	Limit (Ci)	Result	
Co-58	Cobalt	T	2.125E-008	1.920E+003	Pass	
Co-60	Cobalt	T	4.940E+002	5.000E+003	Pass	
Cs-137	Cesium	T	5.379E-003	6.510E+001	Pass	
Fe-55	Iron	T	3.934E+004	6.180E+003	Fail	
Fe-59	Iron	T	1.524E-016	2.190E+002	Pass	
Mn-54	Manganese	T	9.137E+001	2.900E+003	Pass	
Sb-125	Antimony	T	4.055E-005	1.180E+000	Pass	
Sr-90	Strontium	T	1.425E-002	1.390E+000	Pass	
Y-90	Yttrium	T	1.426E-002	1.390E+000	Pass	

TRU Ratio Values

No Results Found

Figure 6. WAC Check output screen from RHINO for waste canister OWC-300-H5.

An evaluation of canisters OWC-090-H5 and OWC-300-H5 was performed to verify potential dose consequences from fire and drop accidents involving these canisters are less than the maximum hypothetical dose evaluated in SAR-419, upon which facility safety controls were evaluated. Because the safety basis bounds the potential accident doses (see Table 10), the canisters are deemed acceptable for disposal from a safety basis perspective.

Table 10. Dose consequences from postulated accidents for canisters OWC-090-H5 and OWC-300-H5 compared to the maximum hypothetical dose evaluated in SAR-419.

Canister	Receptor	Potential Dose from Canister Fire (MFC Activated Metal Waste) (rem)	Potential Dose from Canister Drop (MFC Activated Metal Waste) (rem)	Bounding Hypothetical Dose from SAR-419 Section 3.4.2.2.4 (rem)*
OWC-090-H5	Collocated worker (100m)	3.39E-05	1.61E-03	<2.0
	Public (10,900 m)	3.45E-07	1.35E-05	<0.02
Canister	Receptor	Potential Dose from Canister Fire (MFC Combined Waste) (rem)	Potential Dose from Canister Drop (MFC Combined Waste) (rem)	Bounding Hypothetical Dose from SAR-419 Section 3.4.2.2.4 (rem)*
OWD-300-H5	Collocated worker (100m)	1.45E-03	1.45E-01	<2.0
	Public (10,900 m)	6.46E-06	6.44E-04	<0.02

a. Values bound the maximum dose consequences for canisters and waste streams considered.

The inventories of Cs-137 (0.47 Ci) and Sr-90 (0.51 Ci) in canister OWC-090-H5 are within the range of HFEF-5 legacy waste canisters previously placed at the facility but elevated compared to most canisters. The average Cs-137 inventory in the 60 HFEF-5 canisters currently placed at the facility is 0.15 Ci and the average Sr-90 inventory is 0.30 Ci. The amount of Fe-55 in canister OWC-300-H5 is unusually high compared to the 60 HFEF-5 canisters currently placed in the facility. In fact, the total inventory of Fe-55 in the 60 placed canisters is 22.4 Ci

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which is significantly less than the 39,340 Ci of Fe-55 in canister OWC-300-H5. Because this is one of the few remaining legacy HFEF-5 canisters at RSWF, the canister appears to be one-of-a-kind when it comes to Fe-55 and there is no reason to suspect a change in waste generation rates that would indicate that this is a trend that is likely to impact future canisters sent for disposal, nor is it a reason to indicate that characterization of canisters needs updating.

Summary

This evaluation determined that current estimated inventories of some radionuclides for this generator, canister type, and waste form are greater than the base case inventory projections used for the PA. This trend has been documented in UDQEs performed for other canister inventories that were flagged by RHINO. The current inventory estimates are considered more accurate and representative of the waste in each canister primarily because the current dose rate surveys are more accurate and thorough. Prior to shipping a canister, dose rate surveys are conducted to update the characterization information. The original surveys performed in 2014 were done with an uncalibrated (Ludlum RO-7) instrument, and it is unknown if the canisters were rotated during the measurement, the hot spot was identified, or if the dose rate was an "on-contact" measurement. The current surveys are performed using a calibrated AMP-200 instrument and a 20-point on-contact survey. Measurements are obtained in multiple vertical locations at 90-degree intervals on 4 "sides" of the container and averaged to determine the scaled radionuclide inventory.

Despite inventories for some radionuclides being higher than originally projected, radionuclide inventories in canisters with unique identifiers SN-181, OWC-090-H5, and OWC-300-H5 that were flagged by RHINO during PA and WAC checks have been evaluated with respect to potential impacts on the PA. Based on the evaluation, impacts are within the bounds of the PA. Therefore, the three proposed canisters are deemed acceptable for disposal.

References

- DOE-ID, 2018, "Performance Assessment for the INL Remote-Handled Low-Level Waste Disposal Facility," DOE/ID-11421, Revision 2, U.S. Department of Energy Idaho Operations Office.
- ECAR-1559, "Evaluation of Facility Inventory and Radiological Consequences to Support RHLLW Disposal Facility Safety Basis," Rev. 6, June 2020.
- ECAR-3940, 2018, "Baseline Radionuclide Inventory for the Remote-Handled Low-Level Waste Disposal Facility for Use in the Facility Performance Assessment," Idaho National Laboratory, January 2018.
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- PLN-3368, 2021, "Maintenance Plan for the Remote-Handled Low-Level Waste Disposal Facility Performance Assessment and Composite Analysis," Revision 3, Idaho National Laboratory, October 2021.
- PLN-5446, 2017, "Waste Acceptance Criteria for the Remote-Handled Low-Level Waste Disposal Facility," Revision 1, Idaho National Laboratory, March 2018.
- PLN-5501, 2020, "Monitoring Plan for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility," Revision 2, Idaho National Laboratory, July 2020.


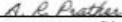



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TFR-981, 2018, "Technical and Functional Requirements: Remote Handled-LLW Inventory Online Database," Revision 2, Idaho National Laboratory, June 2018.

Jonathan Jacobson Print/Type Name Originator/FDS	 Signature Originator/FDS	11/14/2022 Date
A. R. Prather Print/Type Name System Engineer/SE	 Signature System Engineer/SE	11/10/22 Date
A. Jeff Sondrup Print/Type Name PA/CA SME	 Signature PA/CA SME	11/10/2022 Date
Paul Velasquez Print/Type Name Waste Management/WMP	 Signature Waste Management/WMP	11/14/2022 Date
Tim Arsenault Print/Type Name Nuclear Facility Manger/NFM	 Signature Nuclear Facility Manger/NFM	11/14/2022 Date

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Section III, Special Analysis, SA (If Required in Section I or II)

PARC Assigned SME: _____

Special Analysis Document Number: _____

Proposed Activity Approved? Yes ☐ No ☐

Comments: _____

_____ Print/Type Name Originator/FDS	_____ Signature Originator/FDS	_____ Date
_____ Print/Type Name System Engineer/SE	_____ Signature System Engineer/SE	_____ Date
_____ Print/Type Name PA/CA SME	_____ Signature PA/CA SME	_____ Date
_____ Print/Type Name Waste Management/WMP	_____ Signature Waste Management/WMP	_____ Date
_____ Print/Type Name Nuclear Facility Manager/NFM	_____ Signature Nuclear Facility Manager/NFM	_____ Date
_____ Print/Type Name DOE/ID Representative	_____ Signature DOE/ID Representative	_____ Date

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UDQE Tracking No.: UDQE-RHLLW-068

Subject: Canister ECF-05-18-121 from NRF flagged by RHINO during PA checks

NOTE: *The objective of this screening is to determine whether further evaluation is required for a proposed change, new information, or discovery to ensure the validity of the existing Performance Assessment (PA; DOE/ID-11421) and Composite Analysis (CA; DOE/ID-11422) are not impacted.*

Describe the Proposed Change in Activity/New Information/Discovery:

Prior to shipment, waste canisters details are entered into the RHLLW Inventory Online (RHINO) software, whereupon several checks are performed by RHINO to evaluate the canister for acceptance. Waste canister ECF-05-18-121, a 55-Ton canister from Naval Reactors Facility (NRF) containing activated metals and surface contaminated debris was flagged by RHINO for the following:

- **PA Checks 9 and 10:** The inventories of several radionuclides were flagged by RHINO because they exceed the performance assessment (PA) (DOE-ID 2018) base case inventories for a specific generator, canister type, and waste form. However, these radionuclides are associated with another waste generator (MFC), canister type (HFEF-5) and vault array (HFEF), and this information is not relevant to the acceptance process for canister ECF-05-18-121. Therefore, this is not a check that needs further evaluation. This situation has not occurred previously because up to this time, there had been only one canister type (HFEF-5) from one generator (MFC) accepted at the facility. In a future revision to the RHINO software, PA Checks 9 and 10 will be limited to the generator and canister type being considered for acceptance.
- **PA Check 11:** The inventory of Mo-93 as activated metal in the waste canister was flagged by RHINO because it exceeds 10% of the total Mo-93 inventory evaluated in the PA as activated metal in 55-Ton waste canisters from NRF. Mo-93 is a key radionuclide in the PA for the groundwater pathway. If a key radionuclide activity in a waste canister exceeds the 10% threshold activity level for that generator, canister type, and waste stream, the canister is flagged for further review according to the change control process to determine if the container being evaluated is an anomalous occurrence or indicative of a change in waste generation rates. A threshold of 10% was selected by considering the total number of waste disposal vaults, the variance in expected container radionuclide activity levels, and other pathway-specific considerations presented in INL/EXT-18-45184 (INL 2018). Exceedance of the 10% threshold does not indicate the canister is unacceptable but dictates the activity levels be reviewed.

In addition to the PA checks discussed above, non-system and unanalyzed radionuclides were identified by RHINO in waste canister ECF-05-18-121, but they were not flagged by RHINO for evaluation. Non-system radionuclides are currently not flagged by RHINO but are identified on the "Nuclides" tab under the "Canister Details" page in RHINO. A future update of RHINO will include a check for non-system radionuclides on the "PA Check" tab. Nevertheless, non-system radionuclides must be evaluated to confirm the inventories are within the bounds of the PA.

Unanalyzed radionuclides are flagged by RHINO if the half-life is greater than 1 year and the inventory is above minimum reporting criteria from the WAC (PLN-5446). All of the unanalyzed radionuclides identified have inventories less than the minimum reporting criteria with the exception of H-3 as surface contamination. H-3 is a key radionuclide with a minimum reporting criteria of 1E-12 Ci. This should have been flagged by RHINO, but was not because H-3 was not listed in the PA as a surface contamination radionuclide for 55-Ton waste canisters. UDQE-RHLLW-053 (2021) identified H-3 and several other radionuclides as needing to be added to the list of surface contamination radionuclides for 55-Ton waste canisters. This is in the process of being corrected. Until then, and because this is the first 55-Ton canister from NRF to go through the acceptance process, unanalyzed radionuclides with half-lives greater than one year regardless of their activity were identified manually for evaluation as a precaution to ensure the activities are within PA limits.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Section I, Unreviewed Disposal Question Screening (UDQS)

1. Does the proposed activity/new information/discovery involve a change to the disposal facility from what has been previously or analyzed in the most recent Disposal Authorization Statement (DAS) conditions or limitations, Performance Assessment (PA), approved Special Analyses (SA), or approved UDQE?

Yes ☒ No ☐

Comments: Canister ECF-05-18-121 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214 (2021), the canister activities must be evaluated to confirm they are within the bounds of the approved PA.

2. Does the proposed activity/new information/discovery potentially result in an increased effective dose from the disposal facility that would challenge the conclusions of the Composite Analysis (i.e., that the RHLLW Disposal Facility has *de minimus* contribution to the cumulative impacts of surrounding facilities) or otherwise have the potential to impact the CA?

- Change to the site use plan or end state document
- Construction of a new facility near the RHLLW Disposal Facility with the potential to impact perched water
- CA inputs or assumptions
- Change to work outlined in the PA/CA Maintenance Plan (PLN-3368).

Yes ☐ No ☒

Comments: NA

3. Does the proposed activity/new information/discovery involve a change to the disposal process or procedures from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

4. Does the proposed activity/new information/discovery involve a change to the Waste Acceptance Criteria (WAC) from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

5. Does the proposed activity/new information/discovery involve a change inputs or assumptions of the most recent PA or approved SA?

Yes ☒ No ☐

Comments: Canister ECF-05-18-121 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214 (2021), the canister activities must be evaluated to confirm they are within the bounds of the approved PA.

6. Does the proposed activity/new information/discovery result in a change the facility preliminary closure approach or criteria from what was previously described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

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7. Does the proposed activity/new information/discovery involve a test or experiment not described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

8. Does the proposed activity/new information/discovery involve any analytical errors, omissions, or deficiencies in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

9. Do other considerations warrant development of an evaluation or special analysis?

Yes ☐ No ☒

Comments: NA

NOTE: If all questions above are answered "No," then obtain signatures and implement proposed change. If any of the questions above are answered "Yes," then continue with Form and complete Unreviewed Disposal Questions Evaluation Section.

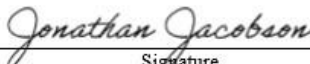

Explanation/Additional Comments:

Does the Unreviewed Disposal Question Screening screen negative or positive?

Negative ☐ Positive ☒

Is an Unreviewed Disposal Question Evaluation or Special Analysis needed?

No ☐ UDQE ☒ Special Analysis ☐

Jonathan Jacobson		2/9/2023
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
Tim Arsenault		2/9/23
Print/Type Name	Signature	Date
Approver/NFM	Approver/NFM	

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY****Section II, Unreviewed Disposal Question Evaluation (UDQE)****Evaluation:**

1. *Is the proposed activity/new information/discovery outside the bounds of the approved PA or CA (e.g., does the proposed activity/new information/discovery involve a change to the basic disposal concept as described in the PA/CA such as critical inputs/assumptions or an increase in facility inventory analyzed in the PA or considered in the CA)?*

Yes ☐ No ☒

Comments:

2. *Does the proposed activity/new information/discovery result in the PA performance objective being exceeded?*

Yes ☐ No ☒

Comments:

3. *Would the proposed activity/new information/discovery result in a change to the facility radionuclide disposal limits in the approved PA?*

Yes ☐ No ☒

Comments:

4. *Would the proposed activity/new information/discovery result in a change to DAS conditions or limitations?*

Yes ☐ No ☒

Comments:

5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

Yes ☐ No ☒

If "Yes," Special Analysis and DOE NE-ID notification required. Provide explanation.

If "No," provide an explanation and basis for the determination. Attach supplementary documentation (e.g., TEV), as required

Explanation:

This explanation contains an evaluation of failed PA Check 11 that was flagged by RHINO, and an evaluation of the unanalyzed and non-system radionuclides identified in the inventory of waste canister ECF-05-18-121. As described in the UDQS (screen) section, PA Checks 9 and 10 should not have been flagged and require no evaluation.

PA Check 11

Figure 1 shows that PA Check 11 was flagged by RHINO because the inventory of Mo-93 as activated metal in the waste canister exceeds 10% of the total Mo-93 inventory evaluated in the PA as activated metal in 55-Ton

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waste canisters from NRF. Mo-93 is a key radionuclide in the PA for the groundwater pathway. If a key radionuclide activity in a waste canister exceeds a 10% threshold activity level for that generator, canister type, and waste stream, the canister is flagged for further review according to the change control process to determine if the container being evaluated is an anomalous occurrence or indicative of a change in waste generation rates.

Waste canister ECF-05-18-121 contains 0.0235 Ci Mo-93 as activated metal, which is only slightly more than the 10% threshold (0.0211) for NRF 55-Ton waste canisters. Because this is the first 55-Ton waste canister to be disposed of at the facility, it is not known if the Mo-93 inventory in the canister is anomalous or indicative of a change in the inventory evaluated in the PA (DOE-ID 2018). The total PA base case inventory of Mo-93 as activated metal for all generators is 25.5 Ci. Because the canister inventory of 0.0235 Ci (as activated metal) is a very small fraction (0.092%) of the total PA base case inventory for all generators (25.5 Ci), the Mo-93 inventory is well within the bounds of the PA.

RHINO Home > Search Canister > Canister Details						
Canister Details ECF-05-18-121						
Canister Details	Nuclides	Rad Readings	PA Check	WAC Check	References	Attachments Images
PA Status: Fail Placement Vault: 55-Ton Cask						
PA Results						
No.	Pass	Performance Measure	Value	Limit	Units	Type
1	Yes	All Pathways Dose	9.4573E-005	1	mrem/yr	Compliance
	Yes	All Pathways Dose	5.5073E-002	12.5	mrem/yr	Post Compliance
2	Yes	Beta-Gamma DE	6.7172E-005	0.16	mrem/yr	Compliance
	Yes	Beta-Gamma DE	3.9066E-002	2.4	mrem/yr	Post Compliance
3	Yes	Ra-226/228	9.0372E-033	0.2	pCi/L	Compliance
	Yes	Ra-226/228	8.4423E-007	2.5	pCi/L	Post Compliance
4	Yes	Gross Alpha	1.9557E-030	0.6	pCi/L	Compliance
	Yes	Gross Alpha	3.9704E-006	7.5	pCi/L	Post Compliance
5	Yes	Beta-Gamma ED	3.6751E-005	0.16	mrem/yr	Compliance
	Yes	Beta-Gamma ED	2.1390E-002	2	mrem/yr	Post Compliance
6	Yes	Uranium	5.9287E-028	1.2	ug/L	Compliance
	Yes	Uranium	1.1330E-005	15	ug/L	Post Compliance
7	Yes	Intruder	1.1301E-001	20	mrem/yr	Compliance
8	Yes	Air Pathway	1.4828E-005	0.4	mrem/yr	Compliance
9	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	-	-	-	Compliance
10	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-	-	-	Compliance
11	No	Administrative 10% Canister Inventory Check (Key Radionuclides)	-	-	-	Compliance
12	Yes	Unanalyzed/Not Exempt Nuclides Check	-	-	-	Compliance
13	Yes	Canister Action Levels Check	-	-	-	Compliance
Canister Specific Test Details						
Note: Tests 11-13 are canister specific.						
11. Administrative 10% Canister Inventory Check (Canister Specific)						
Nuclide	Form	Generator	Vault	Array	Amount (Ci)	PA Inv (Ci)
Mo-93	A	NRF	55-Ton Cask	3	2.3461E-002	2.1131E-001
						2.1131E-002

Figure 1. RHINO Canister Details PA Check output screen for NRF waste canister ECF-05-18-121 showing Mo-93 as activated metal (waste form A) flagged during PA Check 11 (Administrative 10% Canister Inventory Check). Details for PA Checks 9 & 10 are not shown (see explanation in screening section).

Non-system Radionuclides

Table 1 shows waste canister ECF-05-18-121 contains four non-system radionuclides. Radionuclide Nd-144 is listed as both an activated metal waste form (A) and surface contamination waste form (S). Non-system radionuclides are currently identified on the "Nuclides" tab under the "Canister Details" page in RHINO. Many radionuclides are non-system radionuclides because they have very short or very long half-lives (nearly stable). Nb-91m has a half-life less than one year. According to the PA (DOE-ID 2018), radionuclides with half-lives less than one year will have no impact on the PA all-pathway dose and therefore, they require no further evaluation.

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Two other radionuclides, Nd-144 and Sm-148 have half-lives greater than $1\text{E}+15$ years and may be considered observationally stable. The long half-lives coupled with the very small inventories indicate these radionuclides will have an insignificant impact on the PA.

The remaining radionuclide, Nb-91, was identified previously as a non-system radionuclide in HFEF-5 waste canister MFC210277. In UDQE-RHLLW-053 (2021), the Nb-91 inventory in canister MFC210277 was analyzed using the Phase III screening methodology from the PA. As documented in UDQE-RHLLW-053 (2021), the RHLLW Disposal Facility could conservatively accept up to $9\text{E}+16$ Ci of Nb-91 and not exceed the Phase III dose limit criteria of 0.4 mrem/yr. Therefore, the amount of Nb-91 in waste canister ECF-05-18-121 is inconsequential with respect to potential impacts on the PA.

Table 1. Non-system radionuclides in waste canister ECF-05-18-121.

Radionuclide	Canister Inventory (Ci)	Waste Form	Half-Life (yr)
Nb-91	1.74E-05	A	6.80E+02
Nb-91m	2.35E-12	A	1.67E-01
Nd-144	5.14E-23	A	2.29E+15
Sm-148	3.59E-23	A	7.00E+15
Nd-144	8.82E-28	S	2.29E+15

Unanalyzed Radionuclides

Waste canister ECF-05-18-121 contains several radionuclides that were not analyzed in the PA for this generator, canister type and waste form. Table 2 shows the inventory of unanalyzed radionuclides with half-lives greater than one year. The inventories are quite small ($2.5\text{E}-05$ Ci or less) and they were not flagged by RHINO because the inventories are all less than 1% of the total canister activity. In fact, the last column of Table 2 shows the percentages are all less than 0.000011%. Therefore, these radionuclides will have very little impact on the all-pathway dose and are within the bounds of the PA.

All of the unanalyzed radionuclides have inventories less than the minimum reporting criteria with the exception of H-3 as surface contamination. H-3 is a key radionuclide with a minimum reporting criteria of $1\text{E}-12$ Ci. This should have been flagged by RHINO, but was not because H-3 was not listed in the PA as a surface contamination radionuclide for 55-Ton waste canisters. UDQE-RHLLW-052 (2022) identified H-3 and several other radionuclides as needing to be added to the list of surface contamination radionuclides for 55-Ton waste canisters. This is in the process of being corrected. Nevertheless, because H-3 is a key radionuclide, the impact to PA performance measures is included by RHINO. The all-pathway and air pathway doses in Figure 1 are evidence that the impact is small and within the bounds of the PA.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Table 2. Unanalyzed radionuclides in waste canister ECF-05-18-121 with half-lives greater than one year.

Radionuclide	Canister Inventory (Ci)	Waste Form	Half-Life (yr)	Radionuclide Activity as % of Total Canister Activity ^b
Al-26	2.54E-09	A	7.16E+05	1.11E-09
Cd-113	3.38E-23	A	7.70E+15	1.48E-23
Gd-152	2.85E-20	A	1.08E+14	1.25E-20
Lu-173	6.78E-06	A	1.37E+00	2.97E-06
Lu-174	9.94E-07	A	3.30E+00	4.35E-07
Mn-53	1.46E-09	A	3.74E+06	6.41E-10
Pb-210 ^a	7.12E-15	A	2.22E+01	3.12E-15
Re-186m	3.00E-09	A	2.00E+05	1.32E-09
Ta-179	2.48E-05	A	1.82E+00	1.09E-05
Eu-152 ^a	1.04E-06	S	1.35E+01	4.57E-07
Eu-154 ^a	1.24E-06	S	8.59E+00	5.44E-07
H-3 ^a	1.37E-06	S	1.23E+01	5.99E-07
Ra-228 ^a	3.83E-13	S	5.74E+00	1.68E-13
Sm-147 ^a	1.15E-16	S	1.06E+11	5.04E-17
Th-228 ^a	1.70E-08	S	1.91E+00	7.42E-09
Th-229 ^a	1.04E-12	S	7.89E+03	4.56E-13
Th-230 ^a	1.13E-13	S	7.54E+04	4.96E-14

a. Radionuclide included in PA base case inventory, but not necessarily the same waste form.

b. Based on a total canister inventory of 228 Ci.

Summary

The radionuclide inventory of waste canister ECF-05-18-121 has been evaluated with respect to potential impacts on the PA. Based on the evaluation, impacts to the PA are small and within the bounds of the PA. Therefore, the proposed canister is deemed acceptable for disposal.




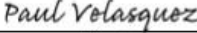
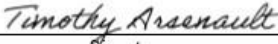
References

- DOE-ID, 2018, "Performance Assessment for the INL Remote-Handled Low-Level Waste Disposal Facility," DOE/ID-11421, Revision 2, U.S. Department of Energy Idaho Operations Office.
- INL, 2018, "Methods, Implementation, and Testing to Support Determination of Performance Assessment Compliance for the RHLLW Disposal Facility WAC," INL/EXT-18-45184, Idaho National Laboratory, June 2018.
- PLN-5446, 2022, "Waste Acceptance Criteria for the Remote-Handled Low-Level Waste Disposal Facility," Revision 2, Idaho National Laboratory, December 2022.
- RH-ADM-5214, 2021, "DOE Order 435.1 Documentation Change Control Process for the RHLLW Disposal Facility," Idaho National Laboratory, October 2021.
- UDQE-RHLLW-052, 2022, "Disposal of Surface Contaminated Debris with NRFs Waste Streams (Activated Metals and Resins)," August 2022.

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UDQE-RHLLW-053, 2021, "RHINO Acceptance Check of Canister MFC210277, Flagged PA and WAC Checks
and Identification of Non-System Radionuclide," December 2021.

Jonathan Jacobson		2/9/23
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
A. R. Prather		2/9/23
Print/Type Name	Signature	Date
System Engineer/SE	System Engineer/SE	
A. Jeff Sondrup		2/9/2023
Print/Type Name	Signature	Date
PA/CA SME	PA/CA SME	
Paul Velasquez		02/09/2023
Print/Type Name	Signature	Date
Waste Management/WMP	Waste Management/WMP	
Tim Arsenault		2/9/23
Print/Type Name	Signature	Date
Nuclear Facility Manger/NFM	Nuclear Facility Manger/NFM	

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
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Section III, Special Analysis, SA (If Required in Section I or II)

PARC Assigned SME: _____

Special Analysis Document Number: _____

Proposed Activity Approved? Yes ☐ No ☐

Comments: _____

Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Print/Type Name System Engineer/SE	Signature System Engineer/SE	Date
Print/Type Name PA/CA SME	Signature PA/CA SME	Date
Print/Type Name Waste Management/WMP	Signature Waste Management/WMP	Date
Print/Type Name Nuclear Facility Manger/NFM	<i>Paul Volasquez</i> Signature Nuclear Facility Manger/NFM	<i>02/09/2023</i> Date
Print/Type Name DOE/ID Representative	Signature DOE/ID Representative	Date

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UDQE Tracking No.: UDQE-RHLLW-069

Subject: Canister ECF-05-18-102 from NRF flagged by RHINO during PA checks

NOTE: *The objective of this screening is to determine whether further evaluation is required for a proposed change, new information, or discovery to ensure the validity of the existing Performance Assessment (PA; DOE/ID-11421) and Composite Analysis (CA; DOE/ID-11422) are not impacted.*

Describe the Proposed Change in Activity/New Information/Discovery:

Waste canister ECF-05-18-102 is a 55-Ton waste canister containing activated metals and surface contaminated debris from Naval Reactors Facility (NRF). Prior to shipment, waste canisters details are entered into the RHLLW Inventory Online (RHINO) software which performs several checks to evaluate the canister for acceptance. Canister ECF-05-18-102 was flagged by RHINO based on the following inventory checks:

PA Check 9: PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)

PA Check 10: PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides Only)

PA checks 9 and 10 were flagged by RHINO because the cumulative inventories of 40 radionuclides exceed the PA base case inventories for a specific generator, waste form and canister type. Twenty-seven of the 40 (including 9 key radionuclides) are from another waste generator (MFC), canister type (HFEF-5) and vault array (HFEF) and this information is not relevant to the acceptance process for canister ECF-05-18-102. However, 13 non-key radionuclides (At-217, Bi-203, Fr-221, Fr-223, Ir-192m, La-137, Pb-209, Po-211, Po-213, Ra-225, Ra-226, Th-229 and Tl-209) were flagged by RHINO due to the cumulative inventories exceeding the PA base-case inventories for this generator (NRF), canister type (55-Ton) and waste form (activated metals). The cumulative inventory includes the inventory of previously emplaced canister (ECF-05-18-121, see UDQE-RHLLW-068) plus the proposed canister. These non-key radionuclides will need to be evaluated to determine if the increased inventory (above the PA base case) would have resulted in the radionuclide not being screened out.

PA Check 11: Administrative 10% Canister Inventory Check (Key Radionuclides Only)

This flag was checked by RHINO because the canisters inventory of Cl-36 exceed the 10% threshold levels of the base-case inventory analyzed in the PA for this generator, canister type and waste form (see INL/EXT-18-45184, Table 18). A threshold of 10% was selected by considering the total number of waste disposal vaults, the variance in expected container radionuclide inventory levels, and other pathway-specific considerations presented in INL/EXT-18-45184 (2018). According to INL/EXT-18-45184 (2018), if a single container exceeds 10% of the generator, waste form, and radionuclide-specific base-case inventory modeled in the PA, the container will be flagged for further review to determine if the canister inventory is an anomalous occurrence or indicative of a change in waste generation rates.

In addition to the PA checks discussed above, non-system radionuclides were identified by RHINO in waste canister ECF-05-18-102, but they were not flagged by RHINO for evaluation. Non-system radionuclides are currently not flagged by RHINO but are identified on the "Nuclides" tab under the "Canister Details" page in RHINO. A future update of RHINO will include a check for non-system radionuclides on the "PA Check" tab. Nevertheless, they are evaluated to confirm the inventories are within the bounds of the PA.

Exceedance of a threshold value flagged by RHINO does not indicate the proposed canister is unacceptable for disposal but the flagged inventory levels must be reviewed. If after review, it is determined the inventory levels (both canister and cumulative) are within the bounds of the approved PA, the proposed canister may be approved for disposal.

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Section I, Unreviewed Disposal Question Screening (UDQS)

1. Does the proposed activity/new information/discovery involve a change to the disposal facility from what has been previously or analyzed in the most recent Disposal Authorization Statement (DAS) conditions or limitations, Performance Assessment (PA), approved Special Analyses (SA), or approved UDQE?

Yes ☒ No ☐

Comments: Canister ECF-05-18-102 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214, the canister activities must be evaluated to confirm they are within the bounds of the approved PA

2. Does the proposed activity/new information/discovery potentially result in an increased effective dose from the disposal facility that would challenge the conclusions of the Composite Analysis (i.e., that the RHLLW Disposal Facility has *de minimus* contribution to the cumulative impacts of surrounding facilities) or otherwise have the potential to impact the CA?

- Change to the site use plan or end state document
- Construction of a new facility near the RHLLW Disposal Facility with the potential to impact perched water
- CA inputs or assumptions
- Change to work outlined in the PA/CA Maintenance Plan (PLN-3368).

Yes ☐ No ☒

Comments: NA

3. Does the proposed activity/new information/discovery involve a change to the disposal process or procedures from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

4. Does the proposed activity/new information/discovery involve a change to the Waste Acceptance Criteria (WAC) from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

5. Does the proposed activity/new information/discovery involve a change inputs or assumptions of the most recent PA or approved SA?

Yes ☒ No ☐

Comments: Canister ECF-05-18-102 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214, the canister activities must be evaluated to confirm they are within the bounds of the approved PA

6. Does the proposed activity/new information/discovery result in a change the facility preliminary closure approach or criteria from what was previously described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
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7. Does the proposed activity/new information/discovery involve a test or experiment not described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

8. Does the proposed activity/new information/discovery involve any analytical errors, omissions, or deficiencies in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

9. Do other considerations warrant development of an evaluation or special analysis?

Yes ☐ No ☒

Comments: NA

NOTE: If all questions above are answered "No," then obtain signatures and implement proposed change. If any of the questions above are answered "Yes," then continue with Form and complete Unreviewed Disposal Questions Evaluation Section.


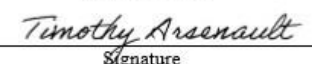
Explanation/Additional Comments:

Does the Unreviewed Disposal Question Screening screen negative or positive?

Negative ☐ Positive ☒

Is an Unreviewed Disposal Question Evaluation or Special Analysis needed?

No ☐ UDQE ☒ Special Analysis ☐

Jonathan Jacobson		4/11/2023
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
Timothy Arsenault		4/12/2023
Print/Type Name	Signature	Date
Approver/NFM	Approver/NFM	

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

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Section II, Unreviewed Disposal Question Evaluation (UDQE)

Evaluation:

1. *Is the proposed activity/new information/discovery outside the bounds of the approved PA or CA (e.g., does the proposed activity/new information/discovery involve a change to the basic disposal concept as described in the PA/CA such as critical inputs/assumptions or an increase in facility inventory analyzed in the PA or considered in the CA)?*

Yes ☐ No ☒

Comments:

2. *Does the proposed activity/new information/discovery result in the PA performance objective being exceeded?*

Yes ☐ No ☒

Comments:

3. *Would the proposed activity/new information/discovery result in a change to the facility radionuclide disposal limits in the approved PA?*

Yes ☐ No ☒

Comments:

4. *Would the proposed activity/new information/discovery result in a change to DAS conditions or limitations?*

Yes ☐ No ☒

Comments:

5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

Yes ☐ No ☒

If "Yes," Special Analysis and DOE NE-ID notification required. Provide explanation.

If "No," provide an explanation and basis for the determination. Attach supplementary documentation (e.g., TEV), as required

This explanation contains an evaluation of flagged PA Checks 9, 10, and 11 by RHINO, and non-system radionuclides identified in the inventory of waste canister ECF-05-18-102. Canister ECF-05-18-102 is the second 55-Ton waste canister from NRF submitted for disposal. The first 55-Ton canister from NRF, ECF-05-18-121, was placed in the disposal facility March 7, 2023.

PA Check 9 and 10

This check was flagged by RHINO because the cumulative inventories of 13 non-key radionuclides (At-217, Bi-203, Fr-221, Fr-223, Ir-192m, La-137, Pb-209, Po-211, Po-213, Ra-225, Ra-226, Th-229 and Tl-209) exceed the PA base-case inventories for this generator/canister/waste form (DOE/ID-11421) (see Figure 1).

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Canister Details ECF-05-18-102

Tasks: Add New Canister

Canister Details | Metrics | Rad Readings | **PA Check** | WAC Check | References | Attachments | Images

PA Status: **Fail** | Placement Vault: **55-Ton Cask**

Clear/Cancel PA Result

No.	Pass	Performance Measure	Value	Limit	Units	Type	Run Date
1	Yes	All Pathways Closed	0.4573E-005	1	mm/yr	Compliance	4/5/2023
2	Yes	Beta-Gamma Dose	5.5073E-002	12.5	mm/yr	Post Compliance	4/5/2023
3	Yes	Beta-Gamma DE	6.7172E-005	0.10	mm/yr	Compliance	4/5/2023
4	Yes	Beta-Gamma DE	3.0006E-002	2.4	mm/yr	Post Compliance	4/5/2023
5	Yes	Ra-226/228	0.0372E-003	0.2	pCi/L	Compliance	4/5/2023
6	Yes	Ra-226/228	8.4032E-007	2.5	pCi/L	Post Compliance	4/5/2023
7	Yes	Gross Alpha	1.9507E-006	0.6	pCi/L	Compliance	4/5/2023
8	Yes	Gross Alpha	3.0746E-006	7.5	pCi/L	Post Compliance	4/5/2023
9	Yes	Beta-Gamma ED	3.0751E-005	0.10	mm/yr	Compliance	4/5/2023
10	Yes	Beta-Gamma ED	2.1300E-002	2	mm/yr	Post Compliance	4/5/2023
11	Yes	Uranium	0.0017E-028	1.2	ug/L	Compliance	4/5/2023
12	Yes	Uranium	1.1330E-005	15	ug/L	Post Compliance	4/5/2023
13	Yes	Intruder	1.1704E-001	20	mm/yr	Compliance	4/5/2023
14	Yes	All Pathways	2.4000E-005	0.4	mm/yr	Compliance	4/5/2023
15	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	-	-	-	Compliance	4/5/2023
16	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-	-	-	Compliance	4/5/2023
17	No	Administrative 10% Canister Inventory Check (Key Radionuclides)	-	-	-	Compliance	4/5/2023
18	Yes	Uranium/Thorium Exempt Radionuclides Check	-	-	-	Compliance	4/5/2023
19	Yes	Canister Action Level Check	-	-	-	Compliance	4/5/2023

5 & 10. PA Base Case Inventory Check by Generator/Canister/Waste Form

Note: Quotient of interest are in bold

Nuclide	Form	Vault	Generator	Array	Pass/Fail	Canister PA Amount (Ci)	Limit (Ci)	Canister Contribution (Ci)
At-217 (Details)	A	55-Ton Cask	HWP	3	Fail	5.0803E-009	2.5003E-009	5.0803E-009
Ba-137m (Details)	S	HPEF-5 Can	WPC	2	Fail	8.3831E-003	1.3500E-002	8.3831E-003
Bk-213 (Details)	A	55-Ton Cask	HWP	3	Fail	5.0803E-009	2.5003E-009	5.0803E-009
Ce-60 (Details)	S	HPEF-5 Can	WPC	2	Fail	1.5538E-003	7.8138E-001	1.5538E-003
Ce-137 (Details)	S	HPEF-5 Can	WPC	2	Fail	8.8349E-003	3.3072E-003	8.8349E-003
Cr-54 (Details)	S	HPEF-5 Can	WPC	2	Fail	1.8329E-002	9.7507E-003	1.8329E-002
Fr-221 (Details)	A	55-Ton Cask	HWP	3	Fail	5.0803E-009	2.5003E-009	5.0803E-009
Fr-223 (Details)	A	55-Ton Cask	HWP	3	Fail	1.2580E-008	4.7100E-010	1.2580E-008
I-129 (Details)	S	HPEF-5 Can	WPC	2	Fail	3.0051E-003	4.4004E-009	3.0051E-003
I-130m (Details)	A	55-Ton Cask	HWP	3	Fail	7.8510E-007	7.8510E-007	7.8510E-007
La-137 (Details)	A	55-Ton Cask	HWP	3	Fail	2.0770E-007	1.5400E-007	2.0770E-007
Li-63 (Details)	A	HPEF-5 Can	WPC	2	Fail	8.8100E-003	9.3200E-002	8.8100E-003
Mn-237 (Details)	S	HPEF-5 Can	WPC	2	Fail	1.8004E-006	8.5602E-008	1.8004E-006
Na-235 (Details)	S	HPEF-5 Can	WPC	2	Fail	2.0890E-006	2.8670E-017	2.0890E-006
Pb-210 (Details)	A	55-Ton Cask	HWP	3	Fail	5.8070E-009	2.5003E-009	5.8070E-009
Pb-210 (Details)	S	HPEF-5 Can	WPC	2	Fail	8.8940E-013	8.8700E-017	8.8940E-013
Pr-147 (Details)	S	HPEF-5 Can	WPC	2	Fail	5.5500E-004	1.0061E-004	5.5500E-004
Pu-211 (Details)	A	55-Ton Cask	HWP	3	Fail	2.4300E-010	9.2410E-011	2.4300E-010
Pu-213 (Details)	A	55-Ton Cask	HWP	3	Fail	5.8101E-009	2.4000E-009	5.8101E-009
Pu-236 (Details)	S	HPEF-5 Can	WPC	2	Fail	8.9400E-007	1.7800E-007	8.9400E-007
Pu-238 (Details)	S	HPEF-5 Can	WPC	2	Fail	5.5170E-004	1.8415E-004	5.5170E-004
Pu-240 (Details)	S	HPEF-5 Can	WPC	2	Fail	3.3070E-004	8.1050E-005	3.3070E-004
Pu-241 (Details)	S	HPEF-5 Can	WPC	2	Fail	4.5074E-004	3.8447E-004	4.5074E-004
Pu-242 (Details)	S	HPEF-5 Can	WPC	2	Fail	5.0003E-008	1.7100E-008	5.0003E-008
Ra-226 (Details)	A	55-Ton Cask	HWP	3	Fail	1.4003E-008	2.5000E-009	1.4003E-008
Ra-226 (Details)	A	55-Ton Cask	HWP	3	Fail	2.7987E-011	3.8840E-012	2.7987E-011
Ra-228 (Details)	S	HPEF-5 Can	WPC	2	Fail	4.0022E-012	4.1990E-016	4.0022E-012
Sm-151 (Details)	S	HPEF-5 Can	WPC	2	Fail	3.7300E-003	4.1700E-004	3.7300E-003
Sm-90 (Details)	S	HPEF-5 Can	WPC	2	Fail	1.8034E-001	6.7041E-003	1.8034E-001
Th-229 (Details)	A	55-Ton Cask	HWP	3	Fail	1.4003E-008	2.5000E-009	1.4003E-008
Th-229 (Details)	S	HPEF-5 Can	WPC	2	Fail	8.5210E-003	1.8844E-015	8.5210E-003
Th-230 (Details)	S	HPEF-5 Can	WPC	2	Fail	1.0434E-008	2.1520E-013	1.0434E-008
Th-231 (Details)	S	HPEF-5 Can	WPC	2	Fail	2.4770E-008	4.7750E-011	2.4770E-008
Th-230 (Details)	A	55-Ton Cask	HWP	3	Fail	7.8030E-011	2.0047E-011	7.8030E-011
U-232 (Details)	S	HPEF-5 Can	WPC	2	Fail	1.0010E-005	5.4370E-007	1.0010E-005
U-233 (Details)	S	HPEF-5 Can	WPC	2	Fail	3.0607E-003	3.3770E-006	3.0607E-003
U-235 (Details)	S	HPEF-5 Can	WPC	2	Fail	2.4770E-008	1.8102E-008	2.4770E-008
U-236 (Details)	S	HPEF-5 Can	WPC	2	Fail	2.3880E-008	2.3802E-008	2.3880E-008
U-238 (Details)	S	HPEF-5 Can	WPC	2	Fail	1.2070E-004	9.1146E-007	1.2070E-004
Y-90 (Details)	S	HPEF-5 Can	WPC	2	Fail	1.7907E-001	1.6013E-003	1.7907E-001

Canister Specific Test Details

Note: Tests 11-13 are canister specific

Nuclide	Form	Generator	Vault	Array	Amount (Ci)	PA Rev (Ci)	Threshold (Ci)
At-217	A	HWP	55-Ton Cask	3	6.0001E-003	2.2100E-002	2.2100E-003

Figure 1. PA Check output screen from RHINO for waste canister ECF-05-18-102.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Of the 13 radionuclides flagged by RHINO, nine (At-217, Bi-203, Fr-221, Fr-223, Pb-209, Po-211, Po-213, Ra-225, Tl-209) were screened out during phase I of a three-phase screening process for the PA because their half-lives are less than one year. The inventory of these radionuclides will have no impact on the PA all-pathway dose and they do not require evaluation.

The other four radionuclides flagged by RHINO (Ir-192m, La-137, Ra-226, Th-229) were screened out during the PA phase II and III screening. Table 1 shows that even if the inventory of the only other placed 55-Ton canister (ECF-05-18-121), plus the inventory of the proposed canister (ECF-05-18-102) were added to the PA base-case inventory, it would still have been screened out as it was during the PA. This was done by calculating the cumulative inventory of each radionuclide as a percentage of the maximum allowable inventory allowed by the phase II and III screenings. For this calculation the inventory of the placed canister (ECF-05-18-121) plus the proposed canister (ECF-05-18-102) was added to the total PA base case inventory. This is conservative because the PA base case inventories include some of the inventory in the placed canister plus the proposed canister. The screenings are done on the total facility inventory and are independent of generator, canister type and waste form.

The maximum allowable inventory allowed by the phase II screening ($I_{max_{II_i}}$) was calculated using the following equation:

$$I_{max_{II_i}} \left(\frac{Ci}{yr} \right) = \frac{0.4 \left(\frac{mrem}{yr} \right)}{NCRP \text{ Screening Dose}_i \left(\frac{mrem}{Ci} \right)} \quad (\text{Equation 1})$$

where:

0.4 mrem/yr = PA Phase II screening dose standard (1/10th the allowable 40 CFR 141 drinking water dose for beta-gamma emitters). This assumes the entire inventory is leached from the source in one year.

NCRP Screening Factor (mrem/Ci) (see DOE/ID-11421, Table 2-26).

The maximum allowable inventory allowed by the phase III screening ($I_{max_{III_i}}$) was calculated using the following equation:

$$I_{max_{III_i}} (Ci) = 0.4 \left(\frac{mrem}{yr} \right) \times \frac{I_{PA_i} (Ci)}{D_{III_i} \left(\frac{mrem}{yr} \right)} \quad (\text{Equation 2})$$

where:

0.4 mrem/yr = PA Phase III screening dose standard (1/10th the allowable 40 CFR 141 drinking water dose for beta-gamma emitters)

I_{PA_i} = total PA base case inventory of radionuclide i (see DOE/ID-11421, Table 2-29)

D_{III_i} = PA Phase III screening dose for radionuclide i based on total PA base case inventory of radionuclide i.

Table 1 shows that even when the projected cumulative inventory after placement of ECF-05-18-102 canister (column 3) and the total PA base case inventory (column 4) are conservatively summed together for each radionuclide, the totals (column 5) are fractions of the maximum allowable phase II and phase III screening inventories (column 7) and would still be screened out. Therefore, the inventories of the non-key radionuclides in ECF-05-18-102 are within the bounds of the PA.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Table 1. Comparison of non-key radionuclide inventories to maximum allowable screening inventories.

1	2	3	4	5	6	7	8
Radionuclides Screened During PA Phase II Screening							
Non-Key Radionuclide	Total Inventory of Proposed 55-Ton Canister (Ci) ^a	Projected Cumulative Inventory (Placed + Proposed Can) (Ci) ^a	Total PA Base Case Inventory (All Generators, Canisters, Waste Forms) (Ci) ^b	Projected Cumulative Inventory after Placement of Proposed Can + Total PA Base Case Inventory (Col3+Col4) (Ci)	PA Phase II NCRP Screening Factor (mrem/Ci) ^c	Max Allowable Phase II Screening Inventory (Eqn 1) (Ci/yr) ^d	PA Base Case + Projected Cumulative Inventory after Placement of Proposed Can as % of Max Allowable Phase II Screening Inventory (Col5/Col7)
Th-229	1.40E-08	7.92E-08 ^e	5.35E-08	1.33E-07	1.18E+05	3.39E-06	3.9%
La-137	2.08E-07	2.08E-07	2.38E-06	2.59E-06	9.62E+02	4.16E-04	0.6%
Ra-226	2.79E-11	3.20E-11 ^e	3.14E-11	6.34E-11	2.96E+05	1.35E-06	0.005%
Radionuclides Screened During PA Phase III Screening							
Non-Key Radionuclide	Total Inventory of Proposed 55-Ton Canister (Ci) ^a	Projected Cumulative Inventory (Placed + Proposed Can) (Ci) ^a	Total PA Base Case Inventory (All Generators, Canisters, Waste Forms) (Ci) ^b	Projected Cumulative Inventory after Placement of Proposed Can + Total PA Base Case Inventory (Col3+Col4) (Ci)	PA Phase III Dose (mrem/yr) ^e	Max Allowable Phase III Screening Inventory (Eqn 2) (Ci/yr) ^f	PA Base Case + Projected Cumulative Inventory after Placement of Proposed Can as % of Max Allowable Phase III Screening Inventory (Col5/Col7)
Ir-192m	7.84E-07	7.85E-07	1.07E-05	1.15E-05	1.00E-40	4.28E+34	2.68E-36%

- a. Inventory of activated metal and surface contaminated debris.
b. Table 2-14, RHLLW Performance Assessment (DOE-ID 2018).
c. Table 2-26, RHLLW Performance Assessment (DOE-ID 2018).
d. $I_{max,II}$ from Equation 1 above.
e. Table 2-29, RHLLW Performance Assessment (DOE-ID 2018). Doses < 1E-40 mrem/yr are assumed = 1E-40 mrem/yr.
f. $I_{max,III}$ from Equation 2 above.
g. Inventory of placed plus proposed canister exceeds the total PA base case inventory for all generators and waste forms.

PA Check 11

Figure 1 shows that PA Check 11 was flagged by RHINO because the inventory of Cl-36 as activated metal in the proposed waste canister exceeds 10% of the total Cl-36 inventory evaluated in the PA as activated metal in 55-Ton waste canisters from NRF. Cl-36 is a key radionuclide in the PA for the groundwater pathway. If a key radionuclide activity in a waste canister exceeds a 10% threshold activity level for that generator, canister type, and waste stream, the canister is flagged for further review according to the change control process to determine if the inventory in container being evaluated is an anomalous occurrence or indicative of a change in waste generation rates.

Waste canister ECF-05-18-102 contains 6.00E-03 Ci of Cl-36 as activated metal, which is more than the 10% threshold (0.00221) for NRF 55-Ton waste canisters. Because this is only the second 55-Ton waste canister to be disposed of at the facility, it is not known if the Cl-36 inventory in the canister is anomalous or indicative of a change in the inventory evaluated in the PA. At this point it appears to be anomalous because it exceeded the 10% threshold, but this can only be determined after more 55-Ton canisters are submitted for disposal. The first NRF 55-Ton canister ECF-05-18-121, was placed on 03/07/2023, which contained 9.38E-07 Ci of Cl-36. The total PA base case inventory for activated metals for this generator (NRF), canister type (55-Ton) and waste form (activated metals) is 2.21E-2 Ci Cl-36 (Table 2, Column 5). The total PA base case inventory of Cl-36 as activated metals for all generators is 1.15E-1 Ci (Table 2,

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

Column 8). The Cl-36 inventory in ECF-05-18-102 is 27% of the PA base-case for this generator/waste form/canister type and 5.22% (Table 2, Column 9) of the total PA base case inventory for the facility. Although these percentages are higher than expected based on the original PA base case inventory, the contribution to the PA all-pathway dose was very low. In fact, the all-pathway dose in Figure 1 did not change (compare Figure 1 above with Figure 1 in UDQE-RHLLW-068). Therefore, impacts to the PA from the Cl-36 in canister ECF-05-18-102 are small and within the bounds of the PA.

Table 2. Comparison of non-key radionuclide inventories to maximum allowable screening inventories.

1	2	3	4	5	6	7	8	9
Can	Nuclide	Waste Form ^a	Canister Inventory (Ci)	PA 20-yr Base Case Inventory for NRF 55-Ton Canisters for AM Waste Form (Ci) ^b	10% Threshold Inventory (Ci) ^c	Canister Inventory as % of PA 20-yr Base Case Inventory for AM in NRF 55-Ton Canister	PA 20-yr Base Case Inventory for RHLLW Facility AM Waste Form (Ci) ^d	Can Inventory as % of PA 20-yr Base Case Inventory for RHLLW Facility and AM Waste Form
ECF-05-18-102	Cl-36	AM	6.00E-03	2.21E-02	2.21E-03	27.2%	1.15E-01	5.22%

- a. AM denotes activated metal waste form.
b. From ECAR-3940, Table 10.
c. From INL 2018, Table 18, column 8.
d. Table 2-14, RHLLW Performance Assessment (DOE-ID 2018).

Non-system Radionuclides

Table 3 shows waste canister ECF-05-18-102 contains two non-system radionuclides (Nd-144 and Sm-148). Radionuclide Nd-144 is listed as both an activated metal waste form (A) and surface contamination waste form (S). Non-system radionuclides are currently identified on the "Nuclides" tab under the "Canister Details" page in RHINO. Many radionuclides are non-system radionuclides because they have very short or very long half-lives (nearly stable). Nd-144 and Sm-148 have half-lives greater than 1E+15 years and may be considered observationally stable. The long half-lives coupled with the very small inventories indicate these radionuclides will have an insignificant impact on the PA.

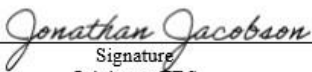
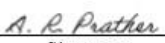

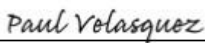

Table 3. Non-system radionuclides in waste canister ECF-05-18-102.

Radionuclide	Canister Inventory (Ci)	Waste Form	Half-Life (yr)
Nd-144	2.26E-22	A	2.29E+15
Sm-148	1.21E-23	A	7.00E+15
Nd-144	2.88E-24	S	2.29E+15

Summary

The radionuclide inventory of waste canister ECF-05-18-102 has been evaluated with respect to potential impacts on the PA. Based on the evaluation, impacts to the PA are small and within the bounds of the PA. Therefore, the proposed canister is deemed acceptable for disposal.

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

Jonathan Jacobson		4/13/2023
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
A. R. Prather		4/13/23
Print/Type Name	Signature	Date
System Engineer/SE	System Engineer/SE	
A. Jeff Sondrup		04/13/2023
Print/Type Name	Signature	Date
PA/CA SME	PA/CA SME	
Paul A. Velasquez		04/13/2023
Print/Type Name	Signature	Date
Waste Management/WMP	Waste Management/WMP	
Tim Arsenault		4/13/2023
Print/Type Name	Signature	Date
Nuclear Facility Manger/NFM	Nuclear Facility Manger/NFM	

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

Section III, Special Analysis, SA (If Required in Section I or II)

PARC Assigned SME: _____

Special Analysis Document Number: _____

Proposed Activity Approved? Yes ☐ No ☐

Comments: _____

_____ Print/Type Name Originator/FDS	_____ Signature Originator/FDS	_____ Date
_____ Print/Type Name System Engineer/SE	_____ Signature System Engineer/SE	_____ Date
_____ Print/Type Name PA/CA SME	_____ Signature PA/CA SME	_____ Date
_____ Print/Type Name Waste Management/WMP	_____ Signature Waste Management/WMP	_____ Date
_____ Print/Type Name Nuclear Facility Manager/NFM	_____ Signature Nuclear Facility Manager/NFM	_____ Date
_____ Print/Type Name DOE/ID Representative	_____ Signature DOE/ID Representative	_____ Date

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UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

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UDQE Tracking No.: UDQE-RHLLW-070

Subject: Canister ECF-05-18-106 from NRF flagged by RHINO during PA checks

NOTE: *The objective of this screening is to determine whether further evaluation is required for a proposed change, new information, or discovery to ensure the validity of the existing Performance Assessment (PA; DOE/ID-11421) and Composite Analysis (CA; DOE/ID-11422) are not impacted.*

Describe the Proposed Change in Activity/New Information/Discovery:

Waste canister ECF-05-18-106 is a 55-Ton waste canister containing activated metals and surface contaminated debris from Naval Reactors Facility (NRF). Prior to shipment, waste canisters details are entered into the RHLLW Inventory Online (RHINO) software which performs several checks to evaluate the canister for acceptance. Canister ECF-05-18-106 was flagged by RHINO based on the following inventory checks:

PA Check 9: PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)

PA Check 10: PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides Only)

PA checks 9 and 10 were flagged by RHINO because the cumulative inventories of 34 radionuclides with half-lives greater than 1 year exceed the PA base case inventories for a specific generator, waste form and canister type. Twenty-five of the 34 (including 10 key radionuclides) are from another waste generator (MFC), canister type (HFEF-5) and vault array (HFEF) and this information is not relevant to the acceptance process for canister ECF-05-18-106. However, nine non-key radionuclides (Ac-227, Ir-192m, La-137, Pt-193, Ra-226, Ra-228, Rb-87, Th-229, and Th-232) were flagged by RHINO due to the cumulative inventories exceeding the PA base-case inventories for this generator (NRF), canister type (55-Ton) and waste form (activated metals). The cumulative inventory includes the inventory of two previously emplaced canisters (ECF-05-18-121 and ECF-05-18-102, see UDQE-RHLLW-068/069) plus the proposed canister. These non-key radionuclides must be evaluated to determine if the increased inventory (above the PA base case) would have resulted in the radionuclide not being screened out during completion of the PA.

PA Check 11: Administrative 10% Canister Inventory Check (Key Radionuclides Only)

This flag was checked by RHINO because the canister inventory of Cl-36 exceed the 10% threshold levels of the base-case inventory analyzed in the PA for this generator, canister type and waste form (see INL/EXT-18-45184, Table 18). A threshold of 10% was selected by considering the total number of waste disposal vaults, the variance in expected container radionuclide inventory levels, and other pathway-specific considerations presented in INL/EXT-18-45184 (2018). According to INL/EXT-18-45184 (2018), if a single container exceeds 10% of the generator, waste form, and radionuclide-specific base-case inventory modeled in the PA, the container will be flagged for further review to determine if the canister inventory is an anomalous occurrence or indicative of a change in waste generation rates.

PA Check 12: Non-system/Unanalyzed/Non-exempt Nuclides Check

This flag was checked by RHINO because unanalyzed radionuclides with half-lives greater than 1 year, and non-system/non-exempt radionuclides were identified by RHINO in waste canister ECF-05-18-106. These should be evaluated to confirm the inventories are within the bounds of the PA.

Exceedance of a threshold value flagged by RHINO does not indicate the proposed canister is unacceptable for disposal but the flagged inventory levels must be reviewed. If after review, it is determined the inventory levels (both canister and cumulative) are within the bounds of the approved PA, the proposed canister may be approved for disposal.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Section I, Unreviewed Disposal Question Screening (UDQS)

1. Does the proposed activity/new information/discovery involve a change to the disposal facility from what has been previously or analyzed in the most recent Disposal Authorization Statement (DAS) conditions or limitations, Performance Assessment (PA), approved Special Analyses (SA), or approved UDQE?

Yes ☒ No ☐

Comments: Canister ECF-05-18-106 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214, the canister activities must be evaluated to confirm they are within the bounds of the approved PA.

2. Does the proposed activity/new information/discovery potentially result in an increased effective dose from the disposal facility that would challenge the conclusions of the Composite Analysis (i.e., that the RHLLW Disposal Facility has *de minimus* contribution to the cumulative impacts of surrounding facilities) or otherwise have the potential to impact the CA?

- Change to the site use plan or end state document
- Construction of a new facility near the RHLLW Disposal Facility with the potential to impact perched water
- CA inputs or assumptions
- Change to work outlined in the PA/CA Maintenance Plan (PLN-3368).

Yes ☐ No ☒

Comments: NA

3. Does the proposed activity/new information/discovery involve a change to the disposal process or procedures from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

4. Does the proposed activity/new information/discovery involve a change to the Waste Acceptance Criteria (WAC) from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

5. Does the proposed activity/new information/discovery involve a change inputs or assumptions of the most recent PA or approved SA?

Yes ☒ No ☐

Comments: Canister ECF-05-18-106 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214, the canister activities must be evaluated to confirm they are within the bounds of the approved PA

6. Does the proposed activity/new information/discovery result in a change the facility preliminary closure approach or criteria from what was previously described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

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**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

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7. Does the proposed activity/new information/discovery involve a test or experiment not described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

8. Does the proposed activity/new information/discovery involve any analytical errors, omissions, or deficiencies in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

9. Do other considerations warrant development of an evaluation or special analysis?

Yes ☐ No ☒

Comments: NA

NOTE: If all questions above are answered "No," then obtain signatures and implement proposed change. If any of the questions above are answered "Yes," then continue with Form and complete Unreviewed Disposal Questions Evaluation Section.

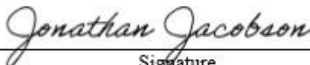

Explanation/Additional Comments:

Does the Unreviewed Disposal Question Screening screen negative or positive?

Negative ☐ Positive ☒

Is an Unreviewed Disposal Question Evaluation or Special Analysis needed?

No ☐ UDQE ☒ Special Analysis ☐

Jonathan Jacobson		6/14/2023
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
Timothy Arsenault		6/14/2023
Print/Type Name	Signature	Date
Approver/NFM	Approver/NFM	

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Section II, Unreviewed Disposal Question Evaluation (UDQE)

Evaluation:

1. *Is the proposed activity/new information/discovery outside the bounds of the approved PA or CA (e.g., does the proposed activity/new information/discovery involve a change to the basic disposal concept as described in the PA/CA such as critical inputs/assumptions or an increase in facility inventory analyzed in the PA or considered in the CA)?*

Yes ☐ No ☒

Comments:

2. *Does the proposed activity/new information/discovery result in the PA performance objective being exceeded?*

Yes ☐ No ☒

Comments:

3. *Would the proposed activity/new information/discovery result in a change to the facility radionuclide disposal limits in the approved PA?*

Yes ☐ No ☒

Comments:

4. *Would the proposed activity/new information/discovery result in a change to DAS conditions or limitations?*

Yes ☐ No ☒

Comments:

5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

Yes ☐ No ☒

If "Yes," Special Analysis and DOE NE-ID notification required. Provide explanation.

If "No," provide an explanation and basis for the determination. Attach supplementary documentation (e.g., TEV), as required

This explanation contains an evaluation of flagged PA Checks 9, 10, 11 and 12 by RHINO, regarding the cumulative inventory of waste canister ECF-05-18-106. Canister ECF-05-18-106 is the third 55-Ton waste canister from NRF submitted for disposal.

PA Check 9 and 10

Canister ECF-05-18-106 contains nine radionuclides (all non-key) whose cumulative inventories (includes placed + proposed canister) exceed the PA base-case inventories for this generator (NRF), canister type (55-Ton) and waste forms (activated metals) (see Figure 1). The cumulative inventories of these radionuclides will be evaluated to determine if the increased inventory (above the PA base case) would have resulted in the radionuclide not being screened out during completion of the PA.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Canister Details ECF-05-18-106

Canister Details

Nuclides

Rad Readings

PA Check

WAC Check

References

Attachments

Images

PA Status: Fail | Placement Vault: 55-Ton Cask

PA Results									
No.	Pass	Performance Measure	Value	Limit	Units	Type	Run Date		
1	Yes	All Pathways Dose	1.2750E-004	1	mrem/yr	Compliance	5/16/2023		
2	Yes	All Pathways Dose	7.4244E-002	12.5	mrem/yr	Post Compliance	5/16/2023		
3	Yes	Beta-Gamma DE	9.0557E-005	0.18	mrem/yr	Compliance	5/16/2023		
4	Yes	Beta-Gamma DE	5.2708E-002	2.4	mrem/yr	Post Compliance	5/16/2023		
5	Yes	Ra-226/228	2.1748E-032	0.2	pCi/L	Compliance	5/16/2023		
6	Yes	Ra-226/228	2.0304E-006	2.5	pCi/L	Post Compliance	5/16/2023		
7	Yes	Gross Alpha	4.5198E-030	0.6	pCi/L	Compliance	5/16/2023		
8	Yes	Gross Alpha	8.5342E-006	7.5	pCi/L	Post Compliance	5/16/2023		
9	Yes	Beta-Gamma ED	4.8545E-005	0.18	mrem/yr	Compliance	5/16/2023		
10	Yes	Beta-Gamma ED	2.8638E-002	2	mrem/yr	Post Compliance	5/16/2023		
11	Yes	Uranium	8.7718E-038	1.2	ug/L	Compliance	5/16/2023		
12	Yes	Uranium	1.8714E-005	15	ug/L	Post Compliance	5/16/2023		
13	Yes	Intruder	1.2972E-001	20	mrem/yr	Compliance	5/16/2023		
14	Yes	Air Pathway	3.5248E-005	0.4	mrem/yr	Compliance	5/16/2023		
15	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	-	-	-	Compliance	5/16/2023		
16	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-	-	-	Compliance	5/16/2023		
17	No	Administrative 10% Canister Inventory Check (Key Radionuclides)	-	-	-	Compliance	5/16/2023		
18	Yes	Non-System/Unanalyzed/Non-Exempt Nuclides Check	-	-	-	Compliance	5/16/2023		
19	Yes	Canister Action Levels Check	-	-	-	Compliance	5/16/2023		

9. & 10. PA Base Case Inventory Check by Generator/Canister/Waste Form (Half Life > 1 Year)

Note: Nuclides of interest are in bold.

Generator Facility: Array

NPZ:

Nuclide	Half Life	Form	Vault	Generator	Array	East/West	Cumulative PA Amount (Ci)	Limit (Ci)	Canister Contribution (Ci)
Ac-227 (Details)	2.1800E+001	A	55-Ton Cask	HRP	3	West	2.8710E-007	2.084E-007	2.5210E-007
B-182m (Details)	2.4100E+002	A	55-Ton Cask	HRP	3	West	1.8198E-006	7.6070E-007	7.3671E-007
La-137 (Details)	5.8900E+004	A	55-Ton Cask	HRP	3	West	3.8948E-007	1.5400E-007	1.9171E-007
Pb-193 (Details)	5.0100E+001	A	55-Ton Cask	HRP	3	West	9.0803E-006	8.0303E-005	4.2243E-005
Pb-226 (Details)	1.6000E+003	A	55-Ton Cask	HRP	3	West	5.5045E-011	3.0840E-012	2.7653E-011
Pb-228 (Details)	5.7400E+000	A	55-Ton Cask	HRP	3	West	2.4903E-006	1.9187E-008	1.2519E-008
Pb-67 (Details)	4.8200E+010	A	55-Ton Cask	HRP	3	West	1.1854E-007	1.0867E-007	5.6767E-008
Th-229 (Details)	7.8900E+003	A	55-Ton Cask	HRP	3	West	2.7757E-006	2.5084E-009	1.3754E-008
Th-232 (Details)	1.4000E+010	A	55-Ton Cask	HRP	3	West	2.5032E-006	1.5802E-008	1.2594E-008

Canister Specific Test Details

Note: Tests 11-13 are canister specific.

11. Administrative 10% Canister Inventory Check (Canister Specific)

Nuclide	Form	Generator	Vault	Array	Amount (Ci)	PA Inv (Ci)	Threshold (Ci)
Ci-38	A	HRP	55-Ton Cask	3	6.1277E-003	2.2108E-003	2.2108E-003

12. PA Unanalyzed Nuclides with a half-life > 1 year (Canister Specific)

Nuclide	Form	Generator	Array	Amount (Ci)	Half Life (yr)	% Canister Activity
Co-113	A	HRP	3	5.7802E-024	7.7000E+015	1.5255E-024
Eu-152	B	HRP	3	1.0434E-006	1.3200E+001	2.4000E-007
Eu-154	B	HRP	3	1.2422E-006	8.5900E+000	2.8500E-007
Gd-152	A	HRP	3	8.8907E-017	1.0800E+014	2.0400E-017
H-3	S	HRP	3	1.3878E-006	1.2300E+001	3.1470E-007
Re-225	B	HRP	3	8.2457E-013	8.7400E+000	1.8914E-013
Sm-147	S	HRP	3	4.7887E-015	1.0000E+011	1.1010E-015
Th-228	S	HRP	3	1.0403E-006	1.8100E+000	2.3400E-006
Th-229	S	HRP	3	6.3488E-012	7.8900E+003	1.4800E-012
Th-230	S	HRP	3	6.9195E-013	7.5430E+004	1.5802E-013

12. Non-System/Non-Exempt Nuclides (Canister Specific)

Nuclide	Amount	Type	Imported as (Ci)
Hs-178n	0.0000E+000	S	Yes
Hs-178n	0.0000E+000	A	Yes
Hs-178n	0.0000E+000	R	Yes
Nb-91	0.0000E+000	S	Yes
Nb-91	0.0000E+000	A	Yes
Nb-91	0.0000E+000	R	Yes
Nb-91m	0.0000E+000	S	Yes
Nb-91m	0.0000E+000	A	Yes
Nb-91m	0.0000E+000	R	Yes
Nb-144	3.2026E-024	S	Yes
Nb-144	2.3214E-022	A	Yes
Nb-144	0.0000E+000	R	Yes
Pb-190	0.0000E+000	S	Yes
Pb-190	0.0000E+000	A	Yes
Pb-190	0.0000E+000	R	Yes
Sm-148	0.0000E+000	S	Yes
Sm-148	1.2437E-023	A	Yes
Sm-148	0.0000E+000	R	Yes

Figure 1. PA Check output screen from RHINO for waste canister ECF-05-18-106.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLW DISPOSAL FACILITY

The nine radionuclides flagged by RHINO (Ac-227, Ir-192m, La-137, Pt-193, Ra-226, Ra-228, Rb-87, Th-229, and Th-232) were screened out during the phase II and III screenings during preparation of the PA. Table 1 shows that the new cumulative inventory would still have been screened out as it was during the PA. This was done by calculating the cumulative inventory of each radionuclide as a percent of the maximum allowable inventory allowed by the phase II and III screenings. For this calculation the inventory of all placed canisters plus the proposed canister (ECF-05-18-106) was added to the total PA base case inventory. This is conservative because the PA base case inventories include some of the inventory in the placed and proposed canisters. The screenings are done on the total facility inventory and are independent of generator, canister type and waste form.

The maximum allowable inventory allowed by the phase II screening ($I_{max_{II_i}}$) was calculated using the following equation:

$$I_{max_{II_i}} \left(\frac{Ci}{yr} \right) = \frac{0.4 \left(\frac{mrem}{yr} \right)}{NCRP \text{ Screening Dose}_i \left(\frac{mrem}{Ci} \right)} \quad (\text{Equation 1})$$

where:

0.4 mrem/yr = PA Phase II screening dose standard (1/10th the allowable 40 CFR 141 drinking water dose for beta-gamma emitters). This assumes the entire inventory is leached from the source in one year.

NCRP Screening Dose Factor (mrem/Ci) (see DOE/ID-11421, Table 2-26).

The maximum allowable inventory allowed by the phase III screening ($I_{max_{III_i}}$) was calculated using the following equation:

$$I_{max_{III_i}} (Ci) = 0.4 \left(\frac{mrem}{yr} \right) \times \frac{I_{PA_i} (Ci)}{D_{III_i} \left(\frac{mrem}{yr} \right)} \quad (\text{Equation 2})$$

where:

0.4 mrem/yr = PA Phase III screening dose standard (1/10th the allowable 40 CFR 141 drinking water dose for beta-gamma emitters)

I_{PA_i} = total PA base case inventory of radionuclide i (see DOE/ID-11421, Table 2-29)

D_{III_i} = PA Phase III screening dose for radionuclide i based on total PA base case inventory of radionuclide i.

Table 1 shows that even when the projected cumulative inventory after placement of ECF-05-18-106 canister (column 3) and the total PA base case inventory (column 4) are conservatively summed together for each radionuclide, the totals (column 5) are fractions of the maximum allowable phase II and phase III screening inventories (column 7) and would still be screened out. Therefore, the inventories of the non-key radionuclides in ECF-05-18-106 are within the bounds of the PA.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Table 1. Comparison of non-key radionuclide inventories to maximum allowable screening inventories.

1	2	3	4	5	6	7	8
Radionuclides Screened During PA Phase II Screening							
Non-Key Radionuclide	ECF-05-18-106 Inventory (Ci) ^a	Projected Cumulative Inventory (Placed + ECF-05-18-106) (Ci) ^a	Total PA Base Case Inventory (All Generators, Canisters, Waste Forms) (Ci) ^b	Projected Cumulative Inventory after Placement of ECF-05-18-106 + Total PA Base Case Inventory (Cols 3+4) (Ci)	PA Phase II NCRP Screening Factor (mrem/Ci) ^c	Max Allowable Phase II Screening Inventory (Ci/yr) ^d	PA Base Case + Projected Cumulative Inventory after Placement of ECF-05-18-106 as % of Max Allowable Phase II Screening Inventory
La-137	1.92E-07	3.99E-07	2.38E-06	2.78E-06	9.62E+02	4.16E-04	0.668%
Pt-193	4.22E-05	9.09E-05	6.64E-04	7.55E-04	2.92E+02	1.37E-03	55.2%
Ra-226	2.71E-11	5.50E-11 ^e	3.14E-11	8.64E-11	2.96E+05	1.35E-06	0.006%
Ra-228	1.25E-08	2.50E-08	2.28E-07	2.53E-07	1.11E+05	3.60E-06	7.02%
Rb-87	5.88E-08	1.19E-07	1.28E-06	1.40E-06	4.44E+03	9.01E-05	1.55%
Th-229	1.38E-08	2.78E-08	5.35E-08	8.13E-08	1.18E+05	3.38E-06	2.41%
Th-232	1.26E-08	2.50E-08	2.48E-07	2.73E-07	3.66E+05	1.09E-06	25.0%
Radionuclides Screened During PA Phase III Screening							
Non-Key Radionuclide	ECF-05-18-106 Inventory (Ci) ^a	Projected Cumulative Inventory (Placed + ECF-05-18-106) (Ci) ^a	Total PA Base Case Inventory (All Generators, Canisters, Waste Forms) (Ci) ^b	Projected Cumulative Inventory after Placement of ECF-05-18-106 + Total PA Base Case Inventory (Cols 3+4) (Ci)	PA Phase III Dose (mrem/yr) ^f	Max Allowable Phase III Screening Inventory (Ci/yr) ^g	PA Base Case + Projected Cumulative Inventory after Placement of 3 Proposed Cans as % of Max Allowable Phase III Screening Inventory
Ac-227	2.52E-07	2.87E-07	5.76E-06	6.05E-06	1.00E-40	2.30E+34	2.62E-38%
Ir-192m	7.31E-07	1.52E-06	1.07E-05	1.22E-05	1.00E-40	4.28E+34	2.86E-38%

- Inventory of activated metal and surface contaminated debris.
- Table 2-14, RHLLW Performance Assessment (DOE-ID 2018).
- Table 2-26, RHLLW Performance Assessment (DOE-ID 2018).
- $I_{max,m}$ from Equation 1 above.
- Table 2-29, RHLLW Performance Assessment (DOE-ID 2018). Doses $< 1E-40$ mrem/yr are assumed = $1E-40$ mrem/yr.
- $I_{max,m}$ from Equation 2 above.
- Inventory of placed plus proposed canister exceeds the total PA base case inventory for all generators and waste forms.

PA Check 11

Figure 1 shows that PA Check 11 was flagged by RHINO because the inventory of Cl-36 as activated metal in waste canister ECF-05-18-106 exceeds 10% of the total Cl-36 base case inventory evaluated in the PA as activated metal in 55-Ton waste canisters from NRF. Cl-36 is a key radionuclide in the PA for the groundwater pathway. If a key radionuclide activity in a waste canister exceeds a 10% threshold activity level for that generator, canister type, and waste stream, the canister is flagged for further review according to the change control process to determine if the radionuclide inventory in the container being evaluated is an anomalous occurrence or indicative of a change in waste generation rates.

Waste canister ECF-05-18-106 contains 6.13E-03 Ci of Cl-36 as activated metal, which is more than the 10% threshold (0.00221) for NRF 55-Ton waste canisters. This is the second of three canisters where the inventory of Cl-36 as activated metals exceeded 10% of the total Cl-36 evaluated in the PA as activated metal in the 55-Ton waste canister. The total PA base case inventory for activated metals for this generator (NRF), canister type (55-Ton) and waste form (activated metals) is 2.21E-2 Ci Cl-36 (Table 2, Column 5).

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

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Currently, the cumulative Cl-36 inventory in the three 55-Ton NRF canisters (2 placed + 1 proposed) is $1.21\text{E-}03$ Ci, or 55% of the PA base case inventory for this generator, canister type and waste form. Although this is unexpected, it is still far less than the total Cl-36 inventory from all generators (0.115 Ci)

With only two of three canisters exceeding the 10% threshold, it is not known if the Cl-36 inventory in the canister is anomalous or indicative of a change in the inventory evaluated in the PA. However, it appears that the PA base-case Cl-36 inventory may have been underestimated. According to Figure 2 (Figure 4-22 from the PA), Cl-36 becomes an important dose contributor approximately 20,000 years after closure. Although the Cl-36 dose contribution is two orders of magnitude less than the Tc-99 contribution, the Cl-36 contribution could become more significant if larger than expected inventories of Cl-36 in 55-Ton canisters is the rule rather than the exception. Nevertheless, because Cl-36 is a key radionuclide the dose contribution is accounted for and tracked by RHINO and the contribution from canister ECF-05-18-106 is within the bounds of the PA. Continued tracking is recommended to see if this is a trend.

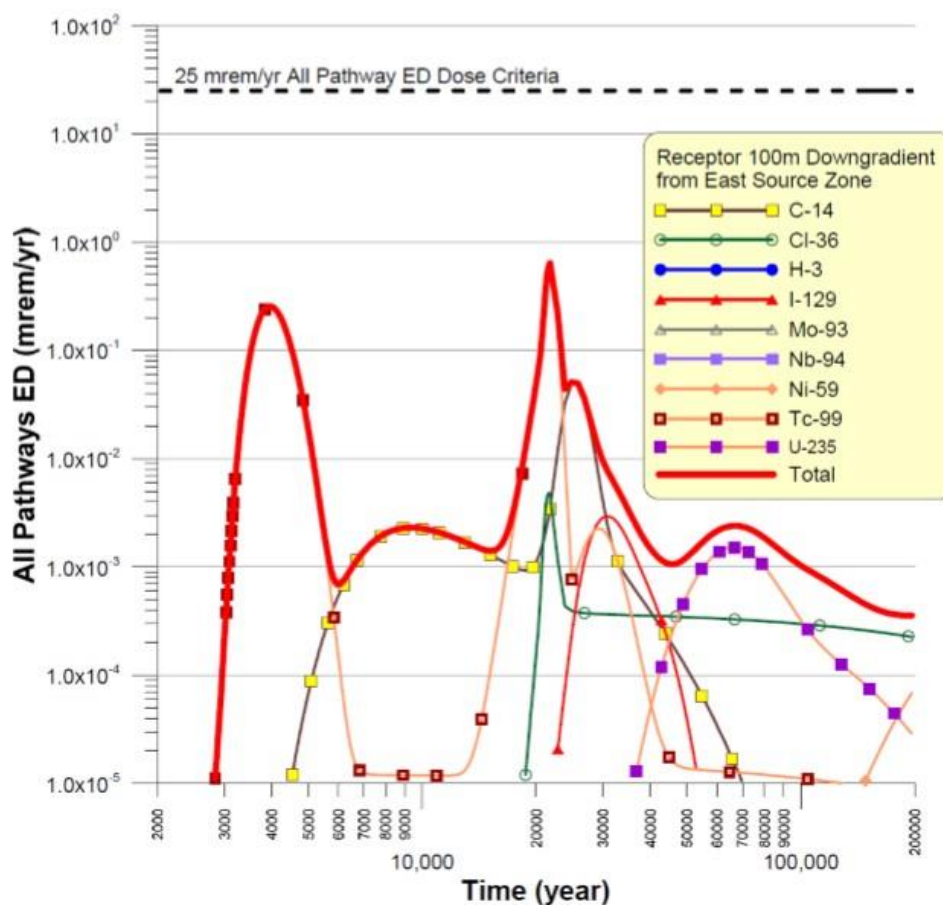


Figure 2. Groundwater all-pathways effective dose as a function of calendar year at the receptor located 100-m downgradient of the east-side source zone. This is Figure 4-22 from the PA.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

PA Check 12: Unanalyzed Radionuclides with Half-lives Greater than 1 Year

Figure 1 shows waste canister ECF-05-18-106 contains 10 unanalyzed radionuclides with half-lives greater than one year. These radionuclides in these particular waste forms were not reported in the PA base-case inventory and were not analyzed in the PA. Therefore, they must be analyzed to confirm the inventories are within the bounds of the PA.

The individual inventories of these 10 radionuclides when compared to the total canister inventory (435 Ci) are much less than 1% (see Figure 1). Therefore, with the exception of H-3 (key radionuclide) the inventory of these radionuclides are not reportable according to the WAC. Tritium, however, is a key radionuclide and must be reported if the activity is greater than 1 pCi. Because it is a key radionuclide, the dose contribution of H-3 is accounted for by RHINO. The inventory of the other radionuclides will not have an impact on the PA. To confirm this, the canister inventories were compared to the total PA base case inventories of all waste forms. Table 2 shows that eight of the 10 radionuclides were reported in other generators waste (Column 5). Column 6 shows the canister inventories of the unanalyzed radionuclides are small fractions of the total PA base-case inventory (Column 2 ÷ Column 5). Although the inventories of Cd-113 and Gd-152 (both activated metal) were not reported in any of the PA waste streams, the canister activities (5.76E-24 Ci and 8.90E-17 Ci respectively) are very low. This confirms that the unanalyzed radionuclides in canister ECF-05-18-106 will not impact the PA.

Table 2. Unanalyzed radionuclides in waste canister ECF-05-18-106 with half-lives greater than one year.

1	2	3	4	5	6
Radionuclide	Canister Inventory (Ci)	Waste Form ^a	Radionuclide Inventory as % of Total Canister Inventory	Total PA Base Case Inventory All Waste Forms(Ci) ^b	Radionuclide Inventory as % of Total PA Base Case Inventory All Waste Forms
Cd-113	5.7603E-24	A	1.3255E-24	#N/A	#N/A
Eu-152	1.0434E-06	S	2.4009E-07	4.14E+00	2.52E-05
Eu-154	1.2422E-06	S	2.8585E-07	1.56E+01	7.96E-06
Gd-152	8.8907E-17	A	2.0458E-17	#N/A	#N/A
H-3	1.3676E-06	S	3.1470E-07	1.99E+03	6.87E-08
Ra-228	8.2457E-13	S	1.8974E-13	2.28E-07	3.62E-04
Sm-147	4.7887E-15	S	1.1019E-15	1.38E-10	3.47E-03
Th-228	1.0403E-08	S	2.3938E-09	2.02E-04	5.15E-03
Th-229	6.3486E-12	S	1.4609E-12	5.35E-08	1.19E-02
Th-230	6.9195E-13	S	1.5922E-13	4.93E-08	1.40E-03

a. A = activated metals, S = surface contamination

b. Table 2-14, RHLLW Performance Assessment (DOE-ID 2018), all waste forms.

PA Check 12: Non-system Radionuclides

Figure 1 shows waste canister ECF-05-18-106 contains two non-system radionuclides (Nd-144 and Sm-148). Radionuclide Nd-144 is listed as both an activated metal waste form (A) and surface contamination waste form (S). Many radionuclides are non-system radionuclides because they have very short or very long half-lives (nearly stable). Nd-144 and Sm-148 have half-lives greater than 1E+15 years and may be considered observationally stable. The long half-lives coupled with the very small inventories indicate these radionuclides will not have an impact on the PA.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLW DISPOSAL FACILITY

Table 3. Non-system radionuclides in waste canister ECF-05-18-106.

Radionuclide	Canister Inventory (Ci)	Waste Form	Half-Life (yr)
Nd-144	2.26E-22	A	2.29E+15
Sm-148	1.21E-23	A	7.00E+15
Nd-144	2.88E-24	S	2.29E+15

Summary

The radionuclide inventory of waste canister ECF-05-18-106 has been evaluated with respect to potential impacts on the PA. Based on the evaluation, impacts to the PA are small and within the bounds of the PA. Therefore, the proposed canister is deemed acceptable for disposal.

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Jonathan Jacobson _____ Print/Type Name Originator/FDS	<i>Jonathan Jacobson</i> _____ Signature Originator/FDS	6/14/2023 _____ Date
A. R. Prather _____ Print/Type Name System Engineer/SE	<i>A. R. Prather</i> _____ Signature System Engineer/SE	6/14/23 _____ Date
A. Jeff Sondrup _____ Print/Type Name PA/CA SME	<i>Jeff Sondrup</i> _____ Signature PA/CA SME	06/14/23 _____ Date
Paul A. Velasquez _____ Print/Type Name Waste Management/WMP	<i>Paul Velasquez</i> _____ Signature Waste Management/WMP	06/14/2023 _____ Date
Timothy Arsenault _____ Print/Type Name Nuclear Facility Manger/NFM	<i>Timothy Arsenault</i> _____ Signature Nuclear Facility Manger/NFM	6/14/2023 _____ Date

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
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Section III, Special Analysis, SA (If Required in Section I or II)

PARC Assigned SME: _____

Special Analysis Document Number: _____

Proposed Activity Approved? Yes ☐ No ☐

Comments: _____

_____ Print/Type Name Originator/FDS	_____ Signature Originator/FDS	_____ Date
_____ Print/Type Name System Engineer/SE	_____ Signature System Engineer/SE	_____ Date
_____ Print/Type Name PA/CA SME	_____ Signature PA/CA SME	_____ Date
_____ Print/Type Name Waste Management/WMP	_____ Signature Waste Management/WMP	_____ Date
_____ Print/Type Name Nuclear Facility Manager/NFM	_____ Signature Nuclear Facility Manager/NFM	_____ Date
_____ Print/Type Name DOE/ID Representative	_____ Signature DOE/ID Representative	_____ Date

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

UDQE Tracking No.: UDQE-RHLLW-071

Subject: UDQE for RHINO Software Change Request SCR-RHINO-006

NOTE: *The objective of this screening is to determine whether further evaluation is required for a proposed change, new information, or discovery to ensure the validity of the existing Performance Assessment (PA; DOE/ID-11421) and Composite Analysis (CA; DOE/ID-11422) are not impacted.*

Describe the Proposed Change in Activity/New Information/Discovery:

Remote Handled Low-Level Disposal Facility Inventory Online (RHINO) Software Change Requests (SCRs) shall be subject to the RHLLW change control process as identified in RH-ADM-5214. "DOE Order 435.1 Documentation Change Control Process for the RHLLW Disposal Facility." RHINO software was developed by a vendor under an approved software quality assurance plan. Development and subsequent changes to RHINO are managed and controlled under an approved software quality-assurance plan managed by the vendor for Quality Level 1 software and meets Nuclear Quality Assurance-1 requirements. SCRs are captured as needed or as corrective-maintenance actions are identified. Even though changes to RHINO are subject to strict verification, validation, and acceptance testing, all SCRs will be subject to the UDQS/UDQE process. The following is a description of all changes associated with SCR-RHINO-006.

SCR-RHINO-006 Detailed Description of Change

1. In RHINO, under PA Reports update Chronic Intruder Primary Dose Contributors report:
 - Change the heading of the third column from "Inventory (Ci) Through FY-20XX" to "Inventory (Ci) FY-20XX."
 - The sixth and last column in the report, "Vault Array Action Level (Ci)," incorrectly displays the canister action levels, not the vault array action levels. The last column should use values from Table A-3 in ECAR-2073.R2 (or INL/EXT-18-45184 Table 20), but instead uses the canister levels from Table A-4 in ECAR-2073.R2 (or INL/EXT-18-45184 Table 19). Change the Vault Array Action Levels to the correct values.
2. Currently non-system nuclides are identified under the Nuclides tab in the Canister Details report for each canister. Add a check for non-system nuclides to PA Check 12 under the PA Check tab in the Canister Details report. Change the Performance Measure from "Unanalyzed/Not Exempt Nuclides Check" to "Non-System/Unanalyzed/Non-Exempt Nuclides Check." Then identify non-system, unanalyzed, and non-exempt nuclides in the report details below the PA Results portion of the table. If Non-System/Unanalyzed/Non-Exempt are present, change Pass from Yes to No and highlight yellow. Screen out nuclides with half-lives < 1 year and add parenthetical to header that says (Nuclides with half-life > 1 yr).
3. When adding a new canister and entering information on the Canister Details page:
 - Change "HFEF-5 ATR Activated Metals" to "ATR-5 ATR Activated Metals" under the Canister Type pull-down menu.
 - Change "ATR (HFEF-5 Like) Canister" to "ATR-5 Canister" under the Canister Configuration pull-down menu.
 - When these changes are made, we need to make sure the ATR-5 canisters still use the response functions developed for the HFEF-5 canister because the PA assumed ATR waste would be in an HFEF-5 canister.
 - Add the capability on Gross Mass and Waste Mass to be entered in grams or pounds.
4. Add to the Vault Details tab the option to select the correct date for disposal placement date.

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5. Discuss options to update “% Void Space” under the Canister Details tab for previously emplaced legacy canisters to be consistent with values in ECAR-3340.
 - Note: if this could be done, the % Void Space value under the Canister Details tab will likely be inconsistent with value in attachment FRM-2544 for placed legacy canisters. It is recommended a revision statement be attached to explain the inconsistency or some other solution be implemented to account for the inconsistency.
6. Add the dose or concentration contribution from the canister for each performance measure listed on the PA Check tab under Canister Details. This could be done by including an extra column on the table on the PA Check page or creating a separate report (tab).
7. Add a check to PA Check 9/10 that if a radionuclide exceeds the PA base-case inventory, but the radionuclides half-life is less than 1 year then it is not reported and does not cause a failure (flag). This would eliminate us having to keep explaining why they are showing up.

Section I, Unreviewed Disposal Question Screening (UDQS)

1. *Does the proposed activity/new information/discovery involve a change to the disposal facility from what has been previously or analyzed in the most recent Disposal Authorization Statement (DAS) conditions or limitations, Performance Assessment (PA), approved Special Analyses (SA), or approved UDQE?*

Yes ☐ No ☒

Comments:

2. *Does the proposed activity/new information/discovery potentially result in an increased effective dose from the disposal facility that would challenge the conclusions of the Composite Analysis (i.e., that the RHLLW Disposal Facility has **de minimus** contribution to the cumulative impacts of surrounding facilities) or otherwise have the potential to impact the CA?*

- Change to the site use plan or end state document
- Construction of a new facility near the RHLLW Disposal Facility with the potential to impact perched water
- CA inputs or assumptions
- Change to work outlined in the PA/CA Maintenance Plan (PLN-3368).

Yes ☐ No ☒

Comments:

3. *Does the proposed activity/new information/discovery involve a change to the disposal process or procedures from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?*

Yes ☐ No ☒

Comments:

4. *Does the proposed activity/new information/discovery involve a change to the Waste Acceptance Criteria (WAC) from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?*

Yes ☐ No ☒

Comments:

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5. Does the proposed activity/new information/discovery involve a change inputs or assumptions of the most recent PA or approved SA?

Yes ☐ No ☒

Comments:

6. Does the proposed activity/new information/discovery result in a change the facility preliminary closure approach or criteria from what was previously described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments:

7. Does the proposed activity/new information/discovery involve a test or experiment not described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments:

8. Does the proposed activity/new information/discovery involve any analytical errors, omissions, or deficiencies in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments:

9. Do other considerations warrant development of an evaluation or special analysis?

Yes ☐ No ☒

Comments:

NOTE: If all questions above are answered "No," then obtain signatures and implement proposed change. If any of the questions above are answered "Yes," then continue with Form and complete Unreviewed Disposal Questions Evaluation Section.

Explanation/Additional Comments:

The detailed description of the changes identified under SCR-RHINO-006 (see above) underwent appropriate reviews under the subcontractor's configuration management plan, accompanied by the required acceptance-testing reviews and testing by the INL Site contractor BEA according to PLN-5579, "Acceptance Test Plan for the RHINO database." An Unreviewed Safety Question (USQ#: USQ-MFC-2023-325) screening was performed and screened negative, meaning the change does not involve a temporary or permanent change in procedures as described in the existing documented safety analysis and does not involve a test or experiment not described in the existing documented safety analysis.

During a review of SCR-RHINO-006 for this UDQE, it was determined the changes made to RHINO were mostly cosmetic changes in the way that information is presented or involved extraction and presentation of data that was extracted/presented by RHINO. Additionally, none of these changes made to RHINO as part of SCR-RHINO-006 require changes to the PA, CA WAC, Closure Plan, or PA/CA Maintenance Plan. Based on this review, SCR-RHINO-006 will not impact the PA, CA or RWMB, and any further evaluation is not necessary.

Does the Unreviewed Disposal Question Screening screen negative or positive?

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
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Negative ☒ Positive ☐

Is an Unreviewed Disposal Question Evaluation or Special Analysis needed?

No ☒ UDQE ☐ Special Analysis ☐

Jonathan Jacobson	<i>Jonathan Jacobson</i>	6/20/2023
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
Timothy Arsenault	<i>Timothy Arsenault</i>	6/20/2023
Print/Type Name	Signature	Date
Approver/NFM	Approver/NFM	

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLW DISPOSAL FACILITY**

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Section II, Unreviewed Disposal Question Evaluation (UDQE)

Evaluation:

1. *Is the proposed activity/new information/discovery outside the bounds of the approved PA or CA (e.g., does the proposed activity/new information/discovery involve a change to the basic disposal concept as described in the PA/CA such as critical inputs/assumptions or an increase in facility inventory analyzed in the PA or considered in the CA)?*

Yes ☐ No ☐

Comments:

2. *Does the proposed activity/new information/discovery result in the PA performance objective being exceeded?*

Yes ☐ No ☐

Comments:

3. *Would the proposed activity/new information/discovery result in a change to the facility radionuclide disposal limits in the approved PA?*

Yes ☐ No ☐

Comments:

4. *Would the proposed activity/new information/discovery result in a change to DAS conditions or limitations?*

Yes ☐ No ☐

Comments:

5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

Yes ☐ No ☐

If "Yes," Special Analysis and DOE NE-ID notification required. Provide explanation.

If "No," provide an explanation and basis for the determination. Attach supplementary documentation (e.g., TEV), as required

Explanation:

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
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Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Print/Type Name System Engineer/SE	Signature System Engineer/SE	Date
Print/Type Name PA/CA SME	Signature PA/CA SME	Date
Print/Type Name Waste Management/WMP	Signature Waste Management/WMP	Date
Print/Type Name Nuclear Facility Manger/NFM	Signature Nuclear Facility Manger/NFM	Date

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
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Section III, Special Analysis, SA (If Required in Section I or II)

PARC Assigned SME: _____

Special Analysis Document Number: _____

Proposed Activity Approved? Yes ☐ No ☐

Comments: _____

_____ Print/Type Name Originator/FDS	_____ Signature Originator/FDS	_____ Date
_____ Print/Type Name System Engineer/SE	_____ Signature System Engineer/SE	_____ Date
_____ Print/Type Name PA/CA SME	_____ Signature PA/CA SME	_____ Date
_____ Print/Type Name Waste Management/WMP	_____ Signature Waste Management/WMP	_____ Date
_____ Print/Type Name Nuclear Facility Manger/NFM	_____ Signature Nuclear Facility Manger/NFM	_____ Date
_____ Print/Type Name DOE/ID Representative	_____ Signature DOE/ID Representative	_____ Date

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UDQE Tracking No.: UDQE-RHLLW-074

Subject: Canister ECF-05-18-112 from NRF flagged by RHINO during PA checks

NOTE: *The objective of this screening is to determine whether further evaluation is required for a proposed change, new information, or discovery to ensure the validity of the existing Performance Assessment (PA; DOE/ID-11421) and Composite Analysis (CA; DOE/ID-11422) are not impacted.*

Describe the Proposed Change in Activity/New Information/Discovery:

Waste canister ECF-05-18-112 is a 55-Ton waste canister containing activated metals and surface contaminated debris from Naval Reactors Facility (NRF). Prior to shipment, waste canisters details are entered into the RHLLW Inventory Online (RHINO) software which performs several checks to evaluate the canister for acceptance. Canister ECF-05-18-112 was flagged by RHINO based on the following inventory checks:

PA Check 9: PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)

PA checks 9 was flagged by RHINO because the cumulative inventories of ten radionuclides (Ac-227, Ce-142, Ir-192m, La-137, Pt-193, Ra-226, Ra-228, Rb-87, Th-229, and Th-232) with half-lives greater than 1 year exceed the PA base case inventories for a specific generator (NRF), waste form (activated metals) and canister type (55-Ton). The cumulative inventory includes the inventory of three previously emplaced canisters (ECF-05-18-121, ECF-05-18-102, ECF-05-106, see UDQE-RHLLW-068/069/070) plus the proposed canister. These non-key radionuclides must be evaluated to determine if the increased inventory (above the PA base case) would have resulted in the radionuclide not being screened out during completion of the PA.

PA Check 10: PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides Only)

PA Check 10 was flagged due to previously emplaced waste from another waste generator (MFC), canister type (HFEF-5) and vault array (HFEF). This information was evaluated in separate UDQEs and is not relevant to the acceptance process for canister ECF-05-18-112. Thus PA check 10 will not need to be evaluated.

PA Check 12: Non-system/Unanalyzed/Non-exempt Nuclides Check

This flag was checked by RHINO because unanalyzed radionuclides with half-lives greater than 1 year, and non-system/non-exempt radionuclides were identified by RHINO in waste canister ECF-05-18-112. These should be evaluated to confirm the inventories are within the bounds of the PA.

Exceedance of a threshold value flagged by RHINO does not indicate the proposed canister is unacceptable for disposal but the flagged inventory levels must be reviewed. If after review, it is determined the inventory levels (both canister and cumulative) are within the bounds of the approved PA, the proposed canister may be approved for disposal.

Section I, Unreviewed Disposal Question Screening (UDQS)

1. *Does the proposed activity/new information/discovery involve a change to the disposal facility from what has been previously or analyzed in the most recent Disposal Authorization Statement (DAS) conditions or limitations, Performance Assessment (PA), approved Special Analyses (SA), or approved UDQE?*

Yes ☒ No ☐

Comments: Canister ECF-05-18-112 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214, the canister activities must be evaluated to confirm they are within the bounds of the approved PA.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

2. Does the proposed activity/new information/discovery potentially result in an increased effective dose from the disposal facility that would challenge the conclusions of the Composite Analysis (i.e., that the RHLLW Disposal Facility has *de minimus* contribution to the cumulative impacts of surrounding facilities) or otherwise have the potential to impact the CA?

- Change to the site use plan or end state document
- Construction of a new facility near the RHLLW Disposal Facility with the potential to impact perched water
- CA inputs or assumptions
- Change to work outlined in the PA/CA Maintenance Plan (PLN-3368).

Yes ☐ No ☒

Comments: NA

3. Does the proposed activity/new information/discovery involve a change to the disposal process or procedures from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

4. Does the proposed activity/new information/discovery involve a change to the Waste Acceptance Criteria (WAC) from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

5. Does the proposed activity/new information/discovery involve a change inputs or assumptions of the most recent PA or approved SA?

Yes ☒ No ☐

Comments: Canister ECF-05-18-112 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214, the canister activities must be evaluated to confirm they are within the bounds of the approved PA

6. Does the proposed activity/new information/discovery result in a change the facility preliminary closure approach or criteria from what was previously described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

7. Does the proposed activity/new information/discovery involve a test or experiment not described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

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Comments: NA

8. Does the proposed activity/new information/discovery involve any analytical errors, omissions, or deficiencies in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

9. Do other considerations warrant development of an evaluation or special analysis?

Yes ☐ No ☒

Comments: NA

NOTE: If all questions above are answered "No," then obtain signatures and implement proposed change. If any of the questions above are answered "Yes," then continue with Form and complete Unreviewed Disposal Questions Evaluation Section.


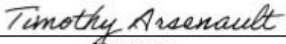
Explanation/Additional Comments:

Does the Unreviewed Disposal Question Screening screen negative or positive?

Negative ☐ Positive ☒

Is an Unreviewed Disposal Question Evaluation or Special Analysis needed?

No ☐ UDQE ☒ Special Analysis ☐

Jonathan Jacobson		7/11/2023
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
Timothy Arsenault		7/11/2023
Print/Type Name	Signature	Date
Approver/NFM	Approver/NFM	

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLW DISPOSAL FACILITY

Section II, Unreviewed Disposal Question Evaluation (UDQE)

Evaluation:

1. *Is the proposed activity/new information/discovery outside the bounds of the approved PA or CA (e.g., does the proposed activity/new information/discovery involve a change to the basic disposal concept as described in the PA/CA such as critical inputs/assumptions or an increase in facility inventory analyzed in the PA or considered in the CA)?*

Yes ☐ No ☒

Comments:

2. *Does the proposed activity/new information/discovery result in the PA performance objective being exceeded?*

Yes ☐ No ☒

Comments:

3. *Would the proposed activity/new information/discovery result in a change to the facility radionuclide disposal limits in the approved PA?*

Yes ☐ No ☒

Comments:

4. *Would the proposed activity/new information/discovery result in a change to DAS conditions or limitations?*

Yes ☐ No ☒

Comments:

5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

Yes ☐ No ☒

If "Yes," Special Analysis and DOE NE-ID notification required. Provide explanation.

If "No," provide an explanation and basis for the determination. Attach supplementary documentation (e.g., TEV), as required

This explanation contains an evaluation of flagged PA Checks 9 and 12 by RHINO, regarding the cumulative inventory of waste canister ECF-05-18-112. Canister ECF-05-18-112 is the fourth 55-Ton waste canister from NRF submitted for disposal.

PA Check 9

Canister ECF-05-18-112 contains ten radionuclides (all non-key) whose cumulative inventories (includes placed + proposed canister) exceed the PA base-case inventories for this generator (NRF), canister type (55-Ton) and waste forms (activated metals) (see Figure 1). The cumulative inventories of these radionuclides will be evaluated to determine if the increased inventory (above the PA base case) would have resulted in the radionuclide not being screened out during completion of the PA.

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Canister Details ECF-05-18-112

Canister Details
Nuclides
Rad Readings
PA Check
WAC Check
References
Attachments
Images

PA Status: Fail | Placement Vault: 55-Ton Cask

PA Results

No.	Pass	Performance Measure	Value	Limit	Units	Type	Run Date
1	Yes	All Pathways Dose	1.2750E-004	1	mrem/yr	Compliance	6/27/2023
	Yes	All Pathways Dose	7.4244E-002	12.5	mrem/yr	Post Compliance	6/27/2023
2	Yes	Beta-Gamma DE	9.0557E-005	0.16	mrem/yr	Compliance	6/27/2023
	Yes	Beta-Gamma DE	5.2706E-002	2.4	mrem/yr	Post Compliance	6/27/2023
3	Yes	Ra-226/228	2.1749E-032	0.2	pCi/L	Compliance	6/27/2023
	Yes	Ra-226/228	2.0304E-006	2.5	pCi/L	Post Compliance	6/27/2023
4	Yes	Gross Alpha	4.5196E-030	0.6	pCi/L	Compliance	6/27/2023
	Yes	Gross Alpha	6.3342E-006	7.5	pCi/L	Post Compliance	6/27/2023
5	Yes	Beta-Gamma ED	4.9545E-005	0.16	mrem/yr	Compliance	6/27/2023
	Yes	Beta-Gamma ED	2.8836E-002	2	mrem/yr	Post Compliance	6/27/2023
6	Yes	Uranium	6.7790E-028	1.2	ug/L	Compliance	6/27/2023
	Yes	Uranium	1.6714E-005	15	ug/L	Post Compliance	6/27/2023
7	Yes	Intruder	1.3524E-001	20	mrem/yr	Compliance	6/27/2023
8	Yes	Air Pathway	4.4849E-005	0.4	mrem/yr	Compliance	6/27/2023
9	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	-	-	-	Compliance	6/27/2023
10	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-	-	-	Compliance	6/27/2023
11	Yes	Administrative 10% Canister Inventory Check (Key Radionuclides)	-	-	-	Compliance	6/27/2023
12	No	Non-System/Unanalyzed/Non-Exempt Nuclides Check	-	-	-	Compliance	6/27/2023
13	Yes	Canister Action Levels Check	-	-	-	Compliance	6/27/2023

9. & 10. PA Base Case Inventory Check by Generator/Canister/Waste Form (Half Life > 1 Year)

Note: Nuclides of interest are in bold

Generator Facility
Array

NRF
All

Nuclide	Half Life	Form	Vault	Generator	Array	East/West	Cumulative PA Amount (Ci)	Limit Inv (Ci)	Canister Contribution (Ci)
Ac-227 [Details]	2.1800E+001	A	55-Ton Cask	NRF	3	West	2.9789E-007	2.0884E-007	1.0795E-008
Ce-142 [Details]	5.0100E+016	A	55-Ton Cask	NRF	3	West	7.3910E-008	5.3195E-008	2.2681E-008
Ir-192m [Details]	2.4100E+002	A	55-Ton Cask	NRF	3	West	1.7569E-006	7.6070E-007	2.4077E-007
La-137 [Details]	5.9900E+004	A	55-Ton Cask	NRF	3	West	4.5364E-007	1.5450E-007	5.4151E-008
Pl-193 [Details]	5.0100E+001	A	55-Ton Cask	NRF	3	West	9.2768E-005	8.0353E-005	1.9057E-006
Ra-226 [Details]	1.6000E+003	A	55-Ton Cask	NRF	3	West	5.5164E-011	3.0840E-012	1.1913E-013
Ra-228 [Details]	5.7400E+000	A	55-Ton Cask	NRF	3	West	3.0046E-008	1.9187E-008	5.0029E-009
Rb-87 [Details]	4.8200E+010	A	55-Ton Cask	NRF	3	West	1.8443E-007	1.0867E-007	4.5883E-008
Th-229 [Details]	7.8900E+003	A	55-Ton Cask	NRF	3	West	2.8396E-008	2.5084E-009	6.4084E-010
Th-232 [Details]	1.4000E+010	A	55-Ton Cask	NRF	3	West	3.0129E-008	1.5922E-008	5.0971E-009

Canister Specific Test Details

Note: Tests 11-13 are canister specific.

12. PA Unanalyzed Nuclides with a half-life > 1 year (Canister Specific)

Nuclide	Form	Generator	Array	Amount (Ci)	Half Life (y)	% Canister Activity
Cd-113	A	NRF	3	1.4444E-023	7.7000E+015	2.1638E-024
Eu-152	S	NRF	3	1.0434E-006	1.3500E+001	1.5631E-007
Eu-154	S	NRF	3	1.2422E-006	8.5900E+000	1.8610E-007
Gd-152	A	NRF	3	7.5724E-017	1.0800E+014	1.1344E-017
H-3	S	NRF	3	1.3678E-006	1.2300E+001	2.0489E-007
Pb-210	A	NRF	3	1.9040E-014	2.2200E+001	2.8524E-015
Ra-226	S	NRF	3	7.4241E-013	5.7400E+000	1.1122E-013
Sm-147	S	NRF	3	4.3099E-015	1.0600E+011	6.4568E-016
Th-228	S	NRF	3	9.3536E-009	1.9100E+000	1.4013E-009
Th-229	S	NRF	3	5.7333E-012	7.8900E+003	8.5892E-013
Th-230	S	NRF	3	6.2489E-013	7.5400E+004	8.3616E-014

12. Non-System/Non-Exempt Nuclides (Canister Specific)

Nuclide	Amount	Type	Imported as (Ci)
Nd-144	2.8623E-024	S	Yes
Nd-144	2.5680E-023	A	Yes
Sm-148	1.2535E-024	A	Yes

Figure 1. PA Check output screen from RHINO for waste canister ECF-05-18-112.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Of the ten non-key radionuclides flagged by RHINO, one (Ce-142) was screened out during phase I of a three-phase screening process for the PA because there is no NCRP screening factor or groundwater ingestion dose coefficient from DOE-STD-1196-2011. Ce-142 has a half-life greater than 1E+18 years and may be considered observationally stable. The long half-life coupled with the very small inventory indicate this radionuclide will not have an impact on the PA.

Of the ten radionuclides flagged by RHINO nine (Ac-227, Ir-192m, La-137, Pt-193, Ra-226, Ra-228, Rb-87, Th-229, and Th-232) were screened out during the phase II and III screenings during preparation of the PA. Table 1 shows that the new cumulative inventory would still have been screened out as it was during the PA. This was done by calculating the cumulative inventory of each radionuclide as a percent of the maximum allowable inventory allowed by the phase II and III screenings. For this calculation the inventory of all placed canisters plus the proposed canister (ECF-05-18-112) was added to the total PA base case inventory. This is conservative because the PA base case inventories include some of the inventory in the placed and proposed canisters. The screenings are done on the total facility inventory and are independent of generator, canister type and waste form.

The maximum allowable inventory allowed by the phase II screening ($I_{max_{II_i}}$) was calculated using the following equation:

$$I_{max_{II_i}} \left(\frac{Ci}{yr} \right) = \frac{0.4 \left(\frac{mrem}{yr} \right)}{NCRP \text{ Screening Dose}_i \left(\frac{mrem}{Ci} \right)} \quad (\text{Equation 1})$$

where:

0.4 mrem/yr = PA Phase II screening dose standard (1/10th the allowable 40 CFR 141 drinking water dose for beta-gamma emitters). This assumes the entire inventory is leached from the source in one year.

NCRP Screening Dose Factor (mrem/Ci) (see DOE/ID-11421, Table 2-26).

The maximum allowable inventory allowed by the phase III screening ($I_{max_{III_i}}$) was calculated using the following equation:

$$I_{max_{III_i}} (Ci) = 0.4 \left(\frac{mrem}{yr} \right) \times \frac{I_{PAi} (Ci)}{D_{III_i} \left(\frac{mrem}{yr} \right)} \quad (\text{Equation 2})$$

where:

0.4 mrem/yr = PA Phase III screening dose standard (1/10th the allowable 40 CFR 141 drinking water dose for beta-gamma emitters)

I_{PAi} = total PA base case inventory of radionuclide i (see DOE/ID-11421, Table 2-29)

D_{III_i} = PA Phase III screening dose for radionuclide i based on total PA base case inventory of radionuclide i.

Table 1 shows that even when the projected cumulative inventory after placement of ECF-05-18-112 canister (column 3) and the total PA base case inventory (column 4) are conservatively summed together for each radionuclide, the totals (column 5) are fractions of the maximum allowable phase II and phase III screening inventories (column 7) and would still be screened out. Therefore, the inventories of the non-key radionuclides in ECF-05-18-112 are within the bounds of the PA.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Table 1. Comparison of non-key radionuclide inventories to maximum allowable screening inventories.

1	2	3	4	5	6	7	8
Radionuclides Screened During PA Phase II Screening							
Non-Key Radionuclide	ECF-05-18-112 Inventory (Ci) ^a	Projected Cumulative Inventory (Placed + ECF-05-18-112) (Ci) ^a	Total PA Base Case Inventory (All Generators, Canisters, Waste Forms) (Ci) ^a	Projected Cumulative Inventory after Placement of ECF-05-18-112 + Total PA Base Case Inventory (Cols 3+4) (Ci)	PA Phase II NCRP Screening Factor(mrem/Ci) ^c	Max Allowable Phase II Screening Inventory(Ci/yr) ^d	PA Base Case + Projected Cumulative Inventory after Placement of ECF-05-18-112 as % of Max Allowable Phase II Screening Inventory
La-137	5.42E-08	4.54E-07	2.38E-06	2.83E-06	9.62E+02	4.16E-04	0.681%
Pt-193	1.91E-06	9.28E-05	6.64E-04	7.57E-04	2.92E+02	1.37E-03	55.3%
Ra-226	1.19E-13	5.52E-11*	3.14E-11	8.66E-11	2.96E+05	1.35E-06	0.006%
Ra-228	5.08E-09	3.00E-08	2.28E-07	2.58E-07	1.11E+05	3.60E-06	7.16%
Rb-87	4.59E-08	1.64E-07	1.28E-06	1.44E-06	4.44E+03	9.01E-05	1.60%
Th-229	6.41E-10	2.84E-08	5.35E-08	8.19E-08	1.18E+05	3.38E-06	2.42%
Th-232	5.10E-09	3.01E-08	2.48E-07	2.78E-07	3.66E+05	1.09E-06	25.5%
Radionuclides Screened During PA Phase III Screening							
Non-Key Radionuclide	ECF-05-18-112 Inventory (Ci) ^a	Projected Cumulative Inventory (Placed + ECF-05-18-112) (Ci) ^a	Total PA Base Case Inventory (All Generators, Canisters, Waste Forms) (Ci) ^a	Projected Cumulative Inventory after Placement of ECF-05-18-112 + Total PA Base Case Inventory (Cols 3+4) (Ci)	PA Phase III Dose (mrem/yr) ^e	Max Allowable Phase III Screening Inventory (Ci/yr) ^f	PA Base Case + Projected Cumulative Inventory after Placement of 3 Proposed Cans as % of Max Allowable Phase III Screening Inventory
Ac-227	1.08E-08	2.98E-07	5.76E-06	6.06E-06	1.00E-40	2.30E+34	2.63E-38
Ir-192m	2.41E-07	1.76E-06	1.07E-05	1.25E-05	1.00E-40	4.28E+34	2.91E-38

- Inventory of activated metal.
- Table 2-14, RHLLW Performance Assessment (DOE-ID 2018).
- Table 2-26, RHLLW Performance Assessment (DOE-ID 2018).
- $I_{max,II}$ from Equation 1 above.
- Table 2-29, RHLLW Performance Assessment (DOE-ID 2018). Doses $< 1E-40$ mrem/yr are assumed = $1E-40$ mrem/yr.
- $I_{max,III}$ from Equation 2 above.
- Inventory of placed plus proposed canister exceeds the total PA base case inventory for all generators and waste forms.

PA Check 12: Unanalyzed Radionuclides with Half-lives Greater than 1 Year

Figure 1 shows waste canister ECF-05-18-112 contains 11 unanalyzed radionuclides with half-lives greater than one year. These radionuclides in these particular waste forms were not reported in the PA base-case inventory and were not analyzed in the PA. Therefore, they must be evaluated to confirm the inventories are within the bounds of the PA.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLW DISPOSAL FACILITY

The individual inventories of these 11 radionuclides when compared to the total canister inventory (667 Ci) are much less than 1% (see Figure 1). Therefore, with the exception of H-3 (key radionuclide) the inventory of these radionuclides are not reportable according to the WAC. Tritium, however, is a key radionuclide and must be reported if the activity is greater than 1 pCi. Because it is a key radionuclide, the dose contribution of H-3 is accounted for by RHINO. The inventory of the other radionuclides will not have an impact on the PA. To confirm this, the canister inventories were compared to the total PA base case inventories of all waste forms. Table 2 shows that nine of the 11 radionuclides were reported in other generators waste (Column 5). Column 6 shows the canister inventories of the unanalyzed radionuclides are small fractions of the total PA base-case inventory (Column 2 ÷ Column 5). Although the inventories of Cd-113 and Gd-152 (both activated metal) were not reported in any of the PA waste streams, the canister activities (1.444E-23 Ci and 7.572E-17 Ci respectively) are very low. This confirms that the unanalyzed radionuclides in canister ECF-05-18-112 will not impact the PA.

Table 2. Unanalyzed radionuclides in waste canister ECF-05-18-112 with half-lives greater than one year.

1	2	3	4	5	6
Radionuclide	Canister Inventory (Ci)	Waste Form	Radionuclide Inventory as % of Total Canister Inventory	Total PA Base Case Inventory All Waste Forms(Ci)	Radionuclide Inventory as % of Total PA Base Case Inventory All Waste Forms
Cd-113	1.4440E-23	A	2.16E-24		
Eu-152	1.0434E-06	S	1.56E-07	4.14E+00	2.52E-05
Eu-154	1.2422E-06	S	1.86E-07	1.56E+01	7.96E-06
Gd-152	7.5724E-17	A	1.13E-17		
H-3	1.3676E-06	S	2.05E-07	1.99E+03	6.87E-08
Pb-210	1.9040E-14	A	2.85E-15	2.89E-12	6.59E-01
Ra-228	7.4240E-13	S	1.11E-13	2.28E-07	3.26E-04
Sm-147	4.3099E-15	S	6.46E-16	1.38E-10	3.12E-03
Th-228	9.3536E-09	S	1.40E-09	2.02E-04	4.63E-03
Th-229	5.7333E-12	S	8.59E-13	5.35E-08	1.07E-02
Th-230	6.2489E-13	S	9.36E-14	4.93E-08	1.27E-03

PA Check 12: Non-system Radionuclides


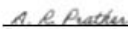

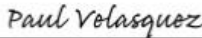

Figure 1 shows waste canister ECF-05-18-112 contains two non-system radionuclides (Nd-144 and Sm-148). Radionuclide Nd-144 is listed as both an activated metal waste form (A) and surface contamination waste form (S). Many radionuclides are non-system radionuclides because they have very short or very long half-lives (nearly stable). Nd-144 and Sm-148 have half-lives greater than 1E+15 years and may be considered observationally stable. The long half-lives coupled with the very small inventories indicate these radionuclides will not have an impact on the PA.

Table 3. Non-system radionuclides in waste canister ECF-05-18-112.

Radionuclide	Canister Inventory (Ci)	Waste Form	Half-Life (yr)
Nd-144	2.26E-22	A	2.29E+15
Sm-148	1.21E-23	A	7.00E+15
Nd-144	2.88E-24	S	2.29E+15

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**Summary**

The radionuclide inventory of waste canister ECF-05-18-112 has been evaluated with respect to potential impacts on the PA. Based on the evaluation, impacts to the PA are small and within the bounds of the PA. Therefore, the proposed canister is deemed acceptable for disposal.

Jonathan Jacobson		7/12/2023
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
A. R. Prather		7/11/23
Print/Type Name	Signature	Date
System Engineer/SE	System Engineer/SE	
A. Jeff Sondrup		07/11/2023
Print/Type Name	Signature	Date
PA/CA SME	PA/CA SME	
Paul A. Velasquez		07/12/2023
Print/Type Name	Signature	Date
Waste Management/WMP	Waste Management/WMP	
Tim Arsenault		7/20/23
Print/Type Name	Signature	Date
Nuclear Facility Manager/NFM	Nuclear Facility Manager/NFM	

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

Section III, Special Analysis, SA (If Required in Section I or II)

PARC Assigned SME: _____

Special Analysis Document Number: _____

Proposed Activity Approved? Yes ☐ No ☐

Comments: _____

_____ Print/Type Name Originator/FDS	_____ Signature Originator/FDS	_____ Date
_____ Print/Type Name System Engineer/SE	_____ Signature System Engineer/SE	_____ Date
_____ Print/Type Name PA/CA SME	_____ Signature PA/CA SME	_____ Date
_____ Print/Type Name Waste Management/WMP	_____ Signature Waste Management/WMP	_____ Date
_____ Print/Type Name Nuclear Facility Manger/NFM	_____ Signature Nuclear Facility Manger/NFM	_____ Date
_____ Print/Type Name DOE/ID Representative	_____ Signature DOE/ID Representative	_____ Date

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UDQE Tracking No.: UDQE-RHLLW-075

Subject: Canister ECF-05-18-122 from NRF flagged by RHINO during PA checks

NOTE: *The objective of this screening is to determine whether further evaluation is required for a proposed change, new information, or discovery to ensure the validity of the existing Performance Assessment (PA; DOE/ID-11421) and Composite Analysis (CA; DOE/ID-11422) are not impacted.*

Describe the Proposed Change in Activity/New Information/Discovery:

Waste canister ECF-05-18-122 is a 55-Ton waste canister containing activated metals and surface contaminated debris from Naval Reactors Facility (NRF). Prior to shipment, waste canisters details are entered into the RHLLW Inventory Online (RHINO) software which performs several checks to evaluate the canister for acceptance. Canister ECF-05-18-122 was flagged by RHINO based on the following inventory checks:

PA Check 9: PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)

PA check 9 was flagged by RHINO because the cumulative inventories of seven radionuclides (Hf-178m, Ac-227, Pt-193, Ra-226, Rb-87, Th-229, and Th-232) with half-lives greater than 1 year exceed the PA base case inventories for a specific generator (NRF), waste form (activated metals) and canister type (55-Ton). The cumulative inventory includes the inventory of four previously emplaced canisters plus the proposed canister. These non-key radionuclides must be evaluated to determine if the increased inventory (above the PA base case) would have resulted in the radionuclide not being screened out during preparation of the PA.

PA Check 10: PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides Only)

PA Check 10 was flagged due to previously emplaced waste from another waste generator (MFC), canister type (HFEF-5) and vault array (HFEF) and this information is not relevant to the acceptance process for canister ECF-05-18-122 and PA check 10 will not need to be evaluated.

PA Check 12: Non-system/Unanalyzed/Non-exempt Nuclides Check

This flag was checked by RHINO because unanalyzed radionuclides with half-lives greater than 1 year, and non-system/non-exempt radionuclides were identified by RHINO in waste canister ECF-05-18-122. These should be evaluated to confirm the inventories are within the bounds of the PA.

Exceedance of a threshold value flagged by RHINO does not indicate the proposed canister is unacceptable for disposal but the flagged inventory levels must be reviewed. If after review, it is determined the inventory levels (both canister and cumulative) are within the bounds of the approved PA, the proposed canister may be approved for disposal.

Section I, Unreviewed Disposal Question Screening (UDQS)

1. *Does the proposed activity/new information/discovery involve a change to the disposal facility from what has been previously or analyzed in the most recent Disposal Authorization Statement (DAS) conditions or limitations, Performance Assessment (PA), approved Special Analyses (SA), or approved UDQE?*

Yes ☒ No ☐

Comments: Canister ECF-05-18-122 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214, the canister activities must be evaluated to confirm they are within the bounds of the approved PA.

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2. Does the proposed activity/new information/discovery potentially result in an increased effective dose from the disposal facility that would challenge the conclusions of the Composite Analysis (i.e., that the RHLLW Disposal Facility has *de minimus* contribution to the cumulative impacts of surrounding facilities) or otherwise have the potential to impact the CA?
- Change to the site use plan or end state document
 - Construction of a new facility near the RHLLW Disposal Facility with the potential to impact perched water
 - CA inputs or assumptions
 - Change to work outlined in the PA/CA Maintenance Plan (PLN-3368).

Yes ☐ No ☒

Comments: NA

3. Does the proposed activity/new information/discovery involve a change to the disposal process or procedures from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

4. Does the proposed activity/new information/discovery involve a change to the Waste Acceptance Criteria (WAC) from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

5. Does the proposed activity/new information/discovery involve a change inputs or assumptions of the most recent PA or approved SA?

Yes ☒ No ☐

Comments: Canister ECF-05-18-122 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214, the canister activities must be evaluated to confirm they are within the bounds of the approved PA

6. Does the proposed activity/new information/discovery result in a change the facility preliminary closure approach or criteria from what was previously described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

7. Does the proposed activity/new information/discovery involve a test or experiment not described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

8. Does the proposed activity/new information/discovery involve any analytical errors, omissions, or deficiencies in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

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EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

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Comments: NA

9. Do other considerations warrant development of an evaluation or special analysis?

Yes ☐ No ☒

Comments: NA

NOTE: If all questions above are answered "No," then obtain signatures and implement proposed change. If any of the questions above are answered "Yes," then continue with Form and complete Unreviewed Disposal Questions Evaluation Section.


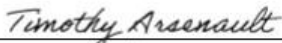
Explanation/Additional Comments:

Does the Unreviewed Disposal Question Screening screen negative or positive?

Negative ☐ Positive ☒

Is an Unreviewed Disposal Question Evaluation or Special Analysis needed?

No ☐ UDQE ☒ Special Analysis ☐

Jonathan Jacobson		08/28/2023
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
Tim Arsenault		8/28/2023
Print/Type Name	Signature	Date
Approver/NFM	Approver/NFM	

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLW DISPOSAL FACILITY

Section II, Unreviewed Disposal Question Evaluation (UDQE)

Evaluation:

1. *Is the proposed activity/new information/discovery outside the bounds of the approved PA or CA (e.g., does the proposed activity/new information/discovery involve a change to the basic disposal concept as described in the PA/CA such as critical inputs/assumptions or an increase in facility inventory analyzed in the PA or considered in the CA)?*

Yes ☐ No ☒

Comments:

2. *Does the proposed activity/new information/discovery result in the PA performance objective being exceeded?*

Yes ☐ No ☒

Comments:

3. *Would the proposed activity/new information/discovery result in a change to the facility radionuclide disposal limits in the approved PA?*

Yes ☐ No ☒

Comments:

4. *Would the proposed activity/new information/discovery result in a change to DAS conditions or limitations?*

Yes ☐ No ☒

Comments:

5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

Yes ☐ No ☒

If "Yes," Special Analysis and DOE NE-ID notification required. Provide explanation.

If "No," provide an explanation and basis for the determination. Attach supplementary documentation (e.g., TEV), as required

This explanation contains an evaluation of flagged PA Checks 9 and 12 by RHINO, regarding the cumulative inventory of waste canister ECF-05-18-122. Canister ECF-05-18-122 is the fifth 55-Ton waste canister from NRF submitted for disposal.

PA Check 9

Canister ECF-05-18-122 contains seven radionuclides (all non-key) whose cumulative inventories (includes placed + proposed canister) exceed the PA base-case inventories for this generator (NRF), canister type (55-Ton) and waste forms (activated metals) (see Figure 1). The cumulative inventories of these radionuclides will be evaluated to determine if the increased inventory (above the PA base case) would have resulted in the radionuclide not being screened out during preparation of the PA.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Canister Details ECF-05-18-122

Canister Details | Nuclides | Rad Readings | PA Check | WAC Check | References | Attachments | Images

PA Status: Fail | Placement Vault: 55-Ton Cask

PA Results							
No.	Pass	Performance Measure	Value	Limit	Units	Type	Run Date
1	Yes	All Pathways Dose	1.2750E-004	1	mrem/yr	Compliance	8/28/2023
	Yes	All Pathways Dose	7.4244E-002	12.5	mrem/yr	Post Compliance	8/28/2023
2	Yes	Beta Gamma DE	9.0057E-005	0.16	mrem/yr	Compliance	8/28/2023
	Yes	Beta Gamma DE	5.2709E-002	2.4	mrem/yr	Post Compliance	8/28/2023
3	Yes	Ra-226/228	2.1749E-032	0.2	pCi/L	Compliance	8/28/2023
	Yes	Ra-226/228	2.0304E-006	2.5	pCi/L	Post Compliance	8/28/2023
4	Yes	Gross Alpha	4.5199E-030	0.6	pCi/L	Compliance	8/28/2023
	Yes	Gross Alpha	5.3342E-006	7.0	pCi/L	Post Compliance	8/28/2023
5	Yes	Beta Gamma ED	4.9545E-005	0.16	mrem/yr	Compliance	8/28/2023
	Yes	Beta Gamma ED	2.9639E-002	2	mrem/yr	Post Compliance	8/28/2023
6	Yes	Uranium	8.7759E-028	1.2	ug/L	Compliance	8/28/2023
	Yes	Uranium	1.6714E-005	15	ug/L	Post Compliance	8/28/2023
7	Yes	Intruder	1.3527E-001	20	mrem/yr	Compliance	8/28/2023
8	Yes	Air Pathway	5.7826E-005	0.4	mrem/yr	Compliance	8/28/2023
9	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	--	--	--	Compliance	8/28/2023
10	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	--	--	--	Compliance	8/28/2023
11	No	Administrative 10% Canister Inventory Check (Key Radionuclides)	--	--	--	Compliance	8/28/2023
12	No	Non-System/Unanalyzed/Non-Exempt Nuclides Check	--	--	--	Compliance	8/28/2023
13	Yes	Canister Action Levels Check	--	--	--	Compliance	8/28/2023

9. & 10. PA Base Case Inventory Check by Generator/Canister/Waste Form (Half Life > 1 Year)

Note: Nuclides of interest are in bold

Generator Facility: Array
NRF All

Nuclide	Half Life	Form	Vault	Generator	Array	East/West	Cumulative PA Amount (Ci)	Limit Inv (Ci)	Canister Contribution (Ci)
Ac-227 [Details]	2.1800E+001	A	55-Ton Cask	NRF	3	West	2.5789E-007	2.0884E-007	1.0314E-012
Ce-142 [Details]	5.0100E+016	A	55-Ton Cask	NRF	3	West	7.3910E-008	5.3195E-008	
Hf-178m [Details]	3.1000E+001	A	55-Ton Cask	NRF	3	West	4.7690E-006	4.0123E-008	3.8278E-006
Ir-192m [Details]	2.4100E+002	A	55-Ton Cask	NRF	3	West	1.7565E-006	7.6070E-007	
La-137 [Details]	5.9900E+004	A	55-Ton Cask	NRF	3	West	4.5964E-007	1.5400E-007	
Pt-193 [Details]	5.0100E+001	A	55-Ton Cask	NRF	3	West	9.2768E-005	8.0353E-005	1.1004E-012
Ra-226 [Details]	1.6000E+003	A	55-Ton Cask	NRF	3	West	5.5414E-011	3.0840E-012	2.4976E-013
Ra-228 [Details]	5.7400E+000	A	55-Ton Cask	NRF	3	West	3.0648E-008	1.9187E-008	
Rb-47 [Details]	4.8200E+010	A	55-Ton Cask	NRF	3	West	1.6443E-007	1.0667E-007	7.6903E-013
Th-229 [Details]	7.8900E+003	A	55-Ton Cask	NRF	3	West	2.8398E-008	2.5064E-009	4.1187E-016
Th-232 [Details]	1.4000E+010	A	55-Ton Cask	NRF	3	West	3.0129E-008	1.5922E-008	1.2863E-018

Canister Specific Test Details

Note: Tests 11-13 are canister specific.

12. PA Unanalyzed Nuclides with a half-life > 1 year (Canister Specific)

Nuclide	Form	Generator	Array	Amount (Ci)	Half Life (yr)	% Canister Activity
Al-26	A	NRF	3	1.8259E-009	7.1600E+005	3.1304E-009
Os-113	A	NRF	3	1.4352E-022	7.7000E+015	2.4605E-022
Eu-152	S	NRF	3	1.0434E-006	1.3500E+001	1.7866E-006
Eu-154	S	NRF	3	2.6845E-006	8.5900E+000	4.6034E-006
Eu-155	S	NRF	3	6.5736E-007	4.7500E+000	1.1270E-006
H-3	S	NRF	3	2.9406E-006	1.2300E+001	5.0414E-006
Li-173	A	NRF	3	7.3412E-006	1.5700E+000	1.2566E-005
Li-174	A	NRF	3	2.8363E-006	3.3000E+000	4.8665E-006
Mn-53	A	NRF	3	2.2952E-009	3.7400E+006	3.7804E-009
Pd-210	A	NRF	3	1.9341E-014	2.2200E+001	3.3159E-014
Ra-226	S	NRF	3	3.9385E-013	5.7400E+000	6.7523E-013
Re-186m	A	NRF	3	1.6114E-008	2.0000E+005	2.7626E-008
Sm-147	S	NRF	3	3.7885E-015	1.0600E+011	6.5122E-015
Ta-179	A	NRF	3	4.0908E-006	1.8200E+003	7.0134E-006
Th-226	S	NRF	3	1.5783E-006	1.9100E+000	2.7059E-006
Th-229	S	NRF	3	1.0950E-012	7.8900E+003	1.8772E-012
Th-230	S	NRF	3	1.1900E-013	7.5400E+004	2.0411E-013

12. Non-System/Non-Exempt Nuclides (Canister Specific)

Nuclide	Amount	Type	Imported as (Ci)
Nb-91	1.7089E-007	A	Yes
Nb-91m	4.9480E-016	A	Yes
Nb-144	5.9307E-024	S	Yes

Figure 1. PA Check output screen from RHINO for waste canister ECF-05-18-122.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLW DISPOSAL FACILITY

PA base case inventories of the seven radionuclides flagged by RHINO (Ac-227, Hf-178m, Pt-193, Ra-226, Rb-87, Th-229, and Th-232) were screened out during the Phase II and III screenings during preparation of the PA. Table 1 shows that the new cumulative inventories would still have been screened out as it was during the PA for all radionuclides except for Hf-178m. This was done by calculating the cumulative inventory of each radionuclide as a percent of the maximum inventory allowed by the Phase II and III screenings. For this calculation the inventory of all placed canisters plus the proposed canister (ECF-05-18-122) was added to the total PA base case inventory. This is conservative because the PA base case inventories include some or all of the inventory in the placed and proposed canisters. The screenings are done on the total facility inventory and are independent of generator, canister type and waste form.

The maximum inventory allowed by the Phase II screening ($I_{max_{II_i}}$) was calculated using the following equation:

$$I_{max_{II_i}} \left(\frac{Ci}{yr} \right) = \frac{0.4 \left(\frac{mrem}{yr} \right)}{NCRP \text{ Screening Dose}_i \left(\frac{mrem}{Ci} \right)} \quad (\text{Equation 1})$$

where:

0.4 mrem/yr = PA Phase II screening dose standard (1/10th the allowable 40 CFR 141 drinking water dose for beta-gamma emitters). This assumes the entire inventory is leached from the source in one year.

NCRP Screening Dose Factor (mrem/Ci) (see DOE/ID-11421, Table 2-26).

The maximum inventory allowed by the Phase III screening ($I_{max_{III_i}}$) was calculated using the following equation:

$$I_{max_{III_i}}(Ci) = 0.4 \left(\frac{mrem}{yr} \right) \times \frac{I_{PA_i}(Ci)}{D_{III_i} \left(\frac{mrem}{yr} \right)} \quad (\text{Equation 2})$$

where:

0.4 mrem/yr = PA Phase III screening dose standard (1/10th the allowable 40 CFR 141 drinking water dose for beta-gamma emitters)

I_{PA_i} = total PA base case inventory of radionuclide i (see DOE/ID-11421, Table 2-29)

D_{III_i} = PA Phase III screening dose for radionuclide i based on total PA base case inventory of radionuclide i.

The PA base case inventory of Hf-178m was screened during the PA Phase II screening, but the cumulative inventory (placed + proposed + PA base case) exceeds the maximum allowable Phase II screening inventory. Therefore, it was necessary to show the cumulative inventory of Hf-178m would be screened by the Phase III criteria in the PA. To do this, Hf-178m was modeled with the same Phase III screening model (GWSCREEN, Rood 2003) used for the PA (see DOE-ID 2018 and ECAR-1892). The same sorption coefficient used in the PA for the element Hf (450 ml/gm) was used. The other radionuclide specific parameters include half-life (31 years) and ingestion dose coefficient (18,389 rem/Ci, DOE-STD-1196-2011). The Hf-178m source in the Phase III model was assumed to be 1 Ci so the calculated dose would be the Phase III screening dose for an inventory of 1 Ci. The maximum allowable Phase III screening inventory for Hf-178m was then calculated with the following equation:

$$I_{max_{III_{Hf-178m}}}(Ci) = 0.4 \left(\frac{mrem}{yr} \right) / DCR_{III_{Hf-178m}} \left(\frac{mrem}{Ci-yr} \right) \quad (\text{Equation 3})$$

where:

$DCR_{III_{Hf-178m}}$ = PA Phase III screening dose for 1 Ci of Hf-178m or the dose-to-Ci ratio (DCR). This is the dose from the GWSCREEN model.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Table 1 shows that even when the projected cumulative inventory after placement of ECF-05-18-122 canister (column 3) and the total PA base case inventory (column 4) are conservatively summed together for each radionuclide, the totals (column 5) are fractions of the maximum allowable Phase II and Phase III screening inventories (column 7) and would still be screened out. Even though the cumulative inventory of Hf-178m would fail the Phase II screening, it would not fail the Phase III screening. This is because the maximum allowable Phase III inventory is very high due to a large sorption coefficient (450 mL/gm) and a relatively short half-life. Because the cumulative inventories of the seven non-key radionuclides would still be screened by the PA screening criteria, the inventories in waste canister ECF-05-18-122 are within the bounds of the PA.

Table 1. Comparison of non-key radionuclide inventories to maximum allowable screening inventories.

1	2	3	4	5	6	7	8
Radionuclides Screened During PA Phase II Screening							
Non-Key Radionuclide	ECF-05-18-122 Inventory (Ci) ^a	Projected Cumulative Inventory (Placed + ECF-05-18-122) (Ci) ^a	Total PA Base Case Inventory (All Generators, Canisters, Waste Forms) (Ci) ^b	Projected Cumulative Inventory after Placement of ECF-05-18-122 + Total PA Base Case Inventory (Cols 3+4) (Ci)	PA Phase II NCRP Screening Factor (mrem/Ci) ^c	Max Allowable Phase II Screening Inventory (Ci/yr) ^d	PA Base Case + Projected Cumulative Inventory after Placement of ECF-05-18-122 as % of Max Allowable Phase II Screening Inventory
Hf-178m ^h	3.83E-06	4.77E-06 ^e	4.01E-08	4.81E-06	9.25E+04	4.32E-06	111%
Pt-193	1.10E-12	9.28E-05	6.64E-04	7.57E-04	2.92E+02	1.37E-03	55.3%
Ra-226	2.50E-13	5.54E-11 ^e	3.14E-11	8.68E-11	2.96E+05	1.35E-06	0.006%
Rb-87	7.69E-13	1.64E-07	1.28E-06	1.44E-06	4.44E+03	9.01E-05	1.60%
Th-229	4.12E-16	2.84E-08	5.35E-08	8.19E-08	1.18E+05	3.38E-06	2.42%
Th-232	1.29E-18	3.01E-08	2.48E-07	2.78E-07	3.66E+05	1.09E-06	25.5%
Radionuclides Screened During PA Phase III Screening							
Non-Key Radionuclide	ECF-05-18-122 Inventory (Ci) ^a	Projected Cumulative Inventory (Placed + ECF-05-18-122) (Ci) ^a	Total PA Base Case Inventory (All Generators, Canisters, Waste Forms) (Ci) ^b	Projected Cumulative Inventory after Placement of ECF-05-18-122 + Total PA Base Case Inventory (Cols 3+4) (Ci)	PA Phase III Dose (mrem/yr) ^c	Max Allowable Phase III Screening Inventory (Ci/yr) ^f	PA Base Case + Projected Cumulative Inventory after Placement of ECF-05-18-122 as % of Max Allowable Phase III Screening Inventory
Ac-227	1.03E-12	2.98E-07	5.76E-06	6.06E-06	1.00E-40	2.30E+34	2.63E-38
Hf-178m ^h	3.83E-06	4.77E-06 ^e	4.01E-08	4.81E-06	1.00E-40	1.60E+32	3.00E-36

- Inventory of activated metal.
- Table 2-14, RHLLW Performance Assessment (DOE-ID 2018).
- Table 2-26, RHLLW Performance Assessment (DOE-ID 2018).
- $I_{max,II}$ from Equation 1 above.
- Table 2-29, RHLLW Performance Assessment (DOE-ID 2018). Doses $< 1E-40$ mrem/yr are assumed = $1E-40$ mrem/yr.
- $I_{max,III}$ from Equation 2 above.
- Inventory of placed plus proposed canister exceeds the total PA base case inventory for all generators and waste forms.
- Hf-178m was screened out during the PA Phase II screening, but the cumulative inventory (placed + proposed + PA base case) is greater than the maximum allowable Phase II screening inventory. So Hf-178m was modeled with the PA Phase III screening model. The cumulative inventory is significantly less than the maximum allowable Phase III screening inventory.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLW DISPOSAL FACILITYPA Check 12: Unanalyzed Radionuclides with Half-lives Greater than 1 Year

Figure 1 shows waste canister ECF-05-18-122 contains 17 unanalyzed radionuclides with half-lives greater than one year. These radionuclides in these particular waste forms from this generator (NRF) were not reported in the PA base-case inventory and were not analyzed in the PA. Therefore, they must be analyzed to confirm the inventories are within the bounds of the PA.

The individual inventories of these 17 radionuclides when compared to the total canister inventory (58.3 Ci) are much less than 1% (see Figure 1). Therefore, with the exception of H-3 (key radionuclide) the inventory of these radionuclides are not reportable according to the WAC. Tritium, however, is a key radionuclide and must be reported if the activity is greater than 1 pCi. Because it is a key radionuclide, the dose contribution of H-3 is accounted for by RHINO. The inventory of the other radionuclides will not have an impact on the PA. To confirm this, the canister inventories were compared to the total PA base case inventories of all generators and waste forms. Table 2 shows that ten of the 17 radionuclides were reported in other generators waste (Column 5 > 0). Column 6 shows the canister inventories of the 10 unanalyzed radionuclides reported in other PA waste streams are small fractions of the total PA base-case inventory (Column 2 ÷ Column 5).

Table 2. Unanalyzed radionuclides in waste canister ECF-05-18-122 with half-lives greater than one year compared to total PA base case inventory.

1	2	3	4	5	6
Radionuclide	Canister Inventory (Ci)	Waste Form	Radionuclide Inventory as % of Total Canister Inventory	Total PA Base Case Inventory All Waste Forms (Ci)	Radionuclide Inventory as % of Total PA Base Case Inventory All Waste Forms
Al-26	1.8259E-09	A	3.13E-09	0	N/A
Cd-113	1.4352E-22	A	2.46E-22	0	N/A
Eu-152	1.0434E-06	S	1.79E-06	4.14E+00	2.52E-05
Eu-154	2.6845E-06	S	4.60E-06	1.56E+01	1.72E-05
Eu-155	6.5736E-07	S	1.13E-06	1.65E+00	3.98E-05
H-3	2.9406E-06	S	5.04E-06	1.99E+03	1.48E-07
Lu-173	7.3412E-06	A	1.26E-05	0	N/A
Lu-174	2.8383E-06	A	4.87E-06	0	N/A
Mn-53	2.2062E-09	A	3.78E-09	0	N/A
Pb-210	1.9340E-14	A	3.32E-14	2.89E-12	6.69E-01
Ra-228	3.9385E-13	S	6.75E-13	2.28E-07	1.73E-04
Re-186m	1.6114E-08	A	2.76E-08	0	N/A
Sm-147	3.7985E-15	S	6.51E-15	1.38E-10	2.75E-03
Ta-179	4.0908E-06	A	7.01E-06	0	N/A
Th-228	4.1187E-16	S	7.06E-16	2.02E-04	2.04E-10
Th-229	1.0950E-12	S	1.88E-12	5.35E-08	2.05E-03
Th-230	1.1906E-13	S	2.04E-13	4.93E-08	2.42E-04

The inventories of the other seven radionuclides that were not reported in any PA waste streams (Table 2, Column 5 = 0) were compared to the maximum inventory allowed by the Phase II screening (I_{maxII}) calculated from Equation 1 (see Table 3). This is similar to what was done in Table 1 except in this case, there is no PA base case inventory for these radionuclides. Table 3 shows that the inventories of these seven radionuclides in canister ECF-05-18-122 would be screened by the Phase II screening criteria. The percentages of radionuclides Lu-173 and Lu-174 are the largest at approximately 1% of the maximum

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

allowable Phase II screening inventory and could potentially fail the Phase II screening if all 55-Ton canister inventories were similar, but only one of the four 55-Ton canisters placed at the facility (ECF-05-18-121) to date reported these radionuclides and the inventories in that canister were similar to the canister being evaluated. Furthermore, given that the half-life of these radionuclides are 1.37 and 3.31 years respectively, it is extremely unlikely they would impact the PA. Therefore, because the unanalyzed radionuclide inventories are not reportable by WAC standards (tritium excepted), and the inventories would be screened by the Phase II PA screening, the inventory of these unanalyzed radionuclides are within the bounds of the PA.

Table 3. Unanalyzed radionuclides in waste canister ECF-05-18-122 with half-lives greater than one year compared to maximum allowable Phase II screening inventory.

1	2	3	4	5	6	7
Radionuclide	Canister Inventory (Ci)	Waste Form	Half-life (yrs)	PA Phase II NCRP Screening Factor (mrem/Ci) ^a	Max Allowable Phase II Screening Inventory (Ci) ^b	Canister Inventory as % of Max Allowable Phase II Screening Inventory (%)
Al-26	1.8259E-09	A	717,000	1.11E+05	3.6036E-06	0.051%
Cd-113	1.4352E-22	A	7.7E+15	2.07E+05	1.9305E-06	7.43E-15%
Lu-173	7.3412E-06	A	1.37	5.55E+02	7.2072E-04	1.02%
Lu-174	2.8383E-06	A	3.31	1.22E+03	3.2760E-04	0.866%
Mn-53	2.2062E-09	A	3,700,000	1.67E+02	2.4024E-03	0.000092%
Re-186m	1.6114E-08	A	200,000	1.37E+04	2.9218E-05	0.055%
Ta-179	4.0908E-06	A	1.82	1.89E+02	2.1198E-03	0.193%

a. NCRP 1996.

b. This is the maximum allowable inventory from all generators in all waste forms that would be allowed by the Phase II screening used in the PA (see Equation 1).

PA Check 12: Non-system Radionuclides

Table 3 shows waste canister ECF-05-18-122 contains three non-system radionuclides. Many radionuclides are non-system radionuclides because they have very short or very long half-lives (nearly stable). Nb-91m and Nd-144 have half-lives greater than 1E+15 years and may be considered observationally stable. The long half-lives coupled with the very small inventories indicate these radionuclides will not have an impact on the PA.

Nb-91 was previously identified as a non-system radionuclide in HFEF-5 waste canister MFC210277 (UDQE-RHLLW-053) and NRF 55-Ton waste canister ECF-05-18-121 (UDQE-RHLLW-068). The Nb-91 inventory was analyzed using the Phase III screening methodology from the PA. As documented in previous UDQEs, the RHLLW Disposal Facility could conservatively accept up to 9E+16 Ci of Nb-91 and not exceed the Phase III dose limit criteria of 0.4 mrem/yr. The current inventory of Nb-91 is well below 9E+16 Ci. Therefore, the amount of Nb-91 in waste canister ECF-05-18-122 is inconsequential with respect to potential impacts on the PA.

Table 3. Non-system radionuclides in waste canister ECF-05-18-122.

Radionuclide	Canister Inventory (Ci)	Waste Form	Half-Life (yr)
Nb-91	1.7089E-07	A	680
Nb-91m	4.0480E-16	A	7.00E+15
Nd-144	5.9307E-24	S	2.29E+15

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

Summary

The radionuclide inventory of waste canister ECF-05-18-122 has been evaluated with respect to potential impacts on the PA. Based on the evaluation, impacts to the PA are small and within the bounds of the PA. Therefore, the proposed canister is deemed acceptable for disposal.






During preparation of this UDQE it was discovered that a previous 55-Ton waste canister reported a radionuclide using a different notation. Waste canister ECF-05-18-121 (UDQE-RHLLW-068) reported 9.41E-07 Ci of Hf-178m as Hf-178n. Hf-178m is the second metastable isotope of Hf and is sometimes identified as Hf-178n. However, RHINO recognizes this isotope as Hf-178m so it was not evaluated properly by RHINO or in UDQE-RHLLW-068. If it had been entered as Hf-178m, it would have been flagged by RHINO PA Check 9 because the canister inventory is greater than the PA base case inventory for this generator/canister/waste form. The radionuclide name in the previously placed canister (ECF-05-18-121) has been changed from Hf-178m to Hf-178m in RHINO. Additionally, there is no need to modify or redo UDQE-RHLLW-068 because the proper cumulative inventory of Hf-178m was evaluated in this UDQE and found to be acceptable.

References

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Jonathan Jacobson		08/28/2023
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
A. R. Prather		8/28/23
Print/Type Name	Signature	Date
System Engineer/SE	System Engineer/SE	
A. Jeff Sondrup		08/28/2023
Print/Type Name	Signature	Date
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Paul A. Velasquez		08/28/2023
Print/Type Name	Signature	Date
Waste Management/WMP	Waste Management/WMP	
Tim Arsenault		8/28/2023
Print/Type Name	Signature	Date
Nuclear Facility Manger/NFM	Nuclear Facility Manger/NFM	

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

Section III, Special Analysis, SA (If Required in Section I or II)

PARC Assigned SME: _____

Special Analysis Document Number: _____

Proposed Activity Approved? Yes ☐ No ☐

Comments: _____

_____ Print/Type Name Originator/FDS	_____ Signature Originator/FDS	_____ Date
_____ Print/Type Name System Engineer/SE	_____ Signature System Engineer/SE	_____ Date
_____ Print/Type Name PA/CA SME	_____ Signature PA/CA SME	_____ Date
_____ Print/Type Name Waste Management/WMP	_____ Signature Waste Management/WMP	_____ Date
_____ Print/Type Name Nuclear Facility Manger/NFM	_____ Signature Nuclear Facility Manger/NFM	_____ Date
_____ Print/Type Name DOE/ID Representative	_____ Signature DOE/ID Representative	_____ Date

<<UDQE-RHLLW-076 Canister MFC170303 from FCF flagged by RHINO during PA checks.pdf>>

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

UDQE Tracking No.: UDQE-RHLLW-076

Subject: Canister MFC170303 from FCF flagged by RHINO during PA checks

NOTE: *The objective of this screening is to determine whether further evaluation is required for a proposed change, new information, or discovery to ensure the validity of the existing Performance Assessment (PA; DOE/ID-11421) and Composite Analysis (CA; DOE/ID-11422) are not impacted.*

Describe the Proposed Change in Activity/New Information/Discovery:

Waste canister MFC170303 is an HFEF-5 waste canister containing remote-handled low-level waste (RHLLW) from the Fuel Conditioning Facility (FCF) hot cell at the Materials and Fuels Complex (MFC). Prior to shipment, waste canisters details are entered into the RHLLW Inventory Online (RHINO) software which performs several checks to evaluate the canister for acceptance. Canister MFC170303 was flagged by RHINO based on the following inventory checks:

PA Check 9: PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)

PA Check 9 was flagged by RHINO because the cumulative inventories of several radionuclides with half-lives greater than 1 year exceed the PA base case inventories for a specific generator (MFC), waste form (combined activated metals with surface contaminated debris) and canister type (HFEF-5). The cumulative inventory includes the inventory of previously emplaced HFEF-5 waste canisters plus the proposed canister MFC170303. All but two of these radionuclides are not included in canister MFC170303. These radionuclides were flagged due to previously emplaced waste and this information is not relevant to the acceptance process for canister MFC170303. The two radionuclides that are present in canister MFC170303 (Ni-63 and Sr-90) are key radionuclides and will be addressed under PA check 10..

PA Check 10: PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides Only)

PA check 10 was flagged by RHINO because the cumulative inventories of two key radionuclides (Ni-63 and Sr-90) exceed performance assessment (PA) base-case inventories for this generator (MFC), waste forms (activated metal for Ni-63 and surface contamination for Sr-90) and canister type (HFEF-5). The cumulative inventory includes the inventory of previously emplaced canisters plus the proposed canister MFC170303. These two key radionuclides must be evaluated to determine if the increased inventory and accompanying dose is within the bounds of the PA.

PA Check 12: Non-system/Unanalyzed/Non-exempt Nuclides Check

This flag was checked by RHINO because unanalyzed radionuclides with half-lives greater than 1 year, and non-system/non-exempt radionuclides were identified by RHINO in waste canister MFC170303. These should be evaluated to confirm the inventories are within the bounds of the PA.

Exceedance of a threshold value flagged by RHINO does not indicate the proposed canister is unacceptable for disposal but the flagged inventory levels must be reviewed. If after review, it is determined the inventory levels (both canister and cumulative) are within the bounds of the approved PA, the proposed canister may be approved for disposal.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Section I, Unreviewed Disposal Question Screening (UDQS)

1. Does the proposed activity/new information/discovery involve a change to the disposal facility from what has been previously or analyzed in the most recent Disposal Authorization Statement (DAS) conditions or limitations, Performance Assessment (PA), approved Special Analyses (SA), or approved UDQE?

Yes ☒ No ☐

Comments: Canister MFC170303 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214, the canister activities must be evaluated to confirm they are within the bounds of the approved PA.

2. Does the proposed activity/new information/discovery potentially result in an increased effective dose from the disposal facility that would challenge the conclusions of the Composite Analysis (i.e., that the RHLLW Disposal Facility has *de minimus* contribution to the cumulative impacts of surrounding facilities) or otherwise have the potential to impact the CA?

- Change to the site use plan or end state document
- Construction of a new facility near the RHLLW Disposal Facility with the potential to impact perched water
- CA inputs or assumptions
- Change to work outlined in the PA/CA Maintenance Plan (PLN-3368).

Yes ☐ No ☒

Comments: NA

3. Does the proposed activity/new information/discovery involve a change to the disposal process or procedures from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

4. Does the proposed activity/new information/discovery involve a change to the Waste Acceptance Criteria (WAC) from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

5. Does the proposed activity/new information/discovery involve a change inputs or assumptions of the most recent PA or approved SA?

Yes ☒ No ☐

Comments: Canister MFC170303 was flagged by RHINO while performing PA checks of the waste canister

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inventory. According to RH-ADM-5214, the canister activities must be evaluated to confirm they are within the bounds of the approved PA

6. Does the proposed activity/new information/discovery result in a change the facility preliminary closure approach or criteria from what was previously described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

7. Does the proposed activity/new information/discovery involve a test or experiment not described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

8. Does the proposed activity/new information/discovery involve any analytical errors, omissions, or deficiencies in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

9. Do other considerations warrant development of an evaluation or special analysis?

Yes ☐ No ☒

Comments: NA

NOTE: If all questions above are answered "No," then obtain signatures and implement proposed change. If any of the questions above are answered "Yes," then continue with Form and complete Unreviewed Disposal Questions Evaluation Section.

Explanation/Additional Comments:

Does the Unreviewed Disposal Question Screening screen negative or positive?

Negative ☐ Positive ☒

Is an Unreviewed Disposal Question Evaluation or Special Analysis needed?

No ☐ UDQE ☒ Special Analysis ☐

Jonathan Jacobson		9/13/2023
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Tim Arsenaault		9/13/2023
Print/Type Name Approver/NFM	Signature Approver/NFM	Date

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLW DISPOSAL FACILITY**

Section II, Unreviewed Disposal Question Evaluation (UDQE)

Evaluation:

1. *Is the proposed activity/new information/discovery outside the bounds of the approved PA or CA (e.g., does the proposed activity/new information/discovery involve a change to the basic disposal concept as described in the PA/CA such as critical inputs/assumptions or an increase in facility inventory analyzed in the PA or considered in the CA)?*

Yes ☐ No ☒

Comments:

2. *Does the proposed activity/new information/discovery result in the PA performance objective being exceeded?*

Yes ☐ No ☒

Comments:

3. *Would the proposed activity/new information/discovery result in a change to the facility radionuclide disposal limits in the approved PA?*

Yes ☐ No ☒

Comments:

4. *Would the proposed activity/new information/discovery result in a change to DAS conditions or limitations?*

Yes ☐ No ☒

Comments:

5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

Yes ☐ No ☒

If "Yes," Special Analysis and DOE NE-ID notification required. Provide explanation.

If "No," provide an explanation and basis for the determination. Attach supplementary documentation (e.g., TEV), as required

This explanation contains an evaluation of flagged PA Checks 10 and 12 by RHINO for waste canister MFC170303. Figure 1 shows the canisters details page from RHINO and the results of the PA check.

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Canister Details MFC170303

Tasks: Add New Canister

Canister Details | Nuclides | Rad Readings | PA Check | WAC Check | References | Attachments | Images

PA Status: Fail | **Placement Vault:** HFEF-5 Can

[Clear/Cancel PA Result](#)

PA Results						
No.	Pass	Performance Measure	Value	Limit	Units	Run Date
1	Yes	All Pathways Dose	1.2758E-004	1	mrem/yr	8/22/2023
	Yes	All Pathways Dose	7.4287E-002	12.5	mrem/yr	Post Compliance 8/22/2023
2	Yes	Beta-Gamma DE	9.0622E-005	0.16	mrem/yr	8/22/2023
	Yes	Beta-Gamma DE	5.2743E-002	2.4	mrem/yr	Post Compliance 8/22/2023
3	Yes	Ra-226/228	2.1749E-032	0.2	pCi/L	8/22/2023
	Yes	Ra-226/228	2.0904E-006	2.5	pCi/L	Post Compliance 8/22/2023
4	Yes	Gross Alpha	4.5190E-030	0.9	pCi/L	8/22/2023
	Yes	Gross Alpha	6.3342E-006	7.5	pCi/L	Post Compliance 8/22/2023
5	Yes	Beta-Gamma ED	4.9500E-005	0.16	mrem/yr	8/22/2023
	Yes	Beta-Gamma ED	2.5857E-002	2	mrem/yr	Post Compliance 8/22/2023
6	Yes	Uranium	5.7796E-028	1.2	ug/L	8/22/2023
	Yes	Uranium	1.6714E-005	15	ug/L	Post Compliance 8/22/2023
7	Yes	Intruder	1.3520E-001	20	mrem/yr	8/22/2023
8	Yes	Air Pathway	4.4852E-005	0.4	mrem/yr	8/22/2023
9	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	-	-	-	Compliance 8/22/2023
10	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-	-	-	Compliance 8/22/2023
11	Yes	Administrative 10% Canister Inventory Check (Key Radionuclides)	-	-	-	Compliance 8/22/2023
12	No	Non-System/Unanalyzed/Condition Exempt Nuclides Check	-	-	-	Compliance 8/22/2023
13	Yes	Canister Action Levels Check	-	-	-	Compliance 8/22/2023

9. & 10. PA Base Case Inventory Check by Generator/Canister/Waste Form (Half Life > 1 Year)

Note: Nuclides of interest are in bold.

Generator Facility: MFC | Array: AB

Nuclide	Half Life	Form	Vault	Generator	Array	East/West	Cumulative PA Amount (Ci)	Limit Inv (Ci)	Canister Contribution (Ci)
Co-60 [Details]	5.2600E+008	S	HFEF-5 Can	MFC	2	East	1.5530E+000	7.5130E-001	
Ca-43 [Details]	3.0100E+001	S	HFEF-5 Can	MFC	2	East	9.3019E+000	3.3072E+000	
Cs-137 [Details]	3.0100E+001	S	HFEF-5 Can	MFC	2	East	1.1233E-002	8.7567E-003	
Cs-154 [Details]	8.3900E+000	S	HFEF-5 Can	MFC	2	East	1.2976E-002	5.1631E-003	
Eu-155 [Details]	4.7800E+000	S	HFEF-5 Can	MFC	2	East	3.9951E-000	4.4004E-009	
I-129 [Details]	1.5700E+007	S	HFEF-5 Can	MFC	2	East	8.6399E+003	9.3298E+002	1.0220E-001
Ni-63 [Details]	1.0000E+002	A	HFEF-5 Can	MFC	2	East	1.8004E-006	8.5655E-005	
Np-237 [Details]	2.1500E+006	S	HFEF-5 Can	MFC	2	East	4.8543E-012	4.6793E-017	
Pb-210 [Details]	2.2200E+001	S	HFEF-5 Can	MFC	2	East	5.5555E-004	1.0061E-004	
Pm-147 [Details]	2.6200E+000	S	HFEF-5 Can	MFC	2	East	9.9496E-007	1.7604E-007	
Pu-238 [Details]	8.7600E+001	S	HFEF-5 Can	MFC	2	East	6.7206E-004	1.6411E-004	
Pu-240 [Details]	6.5600E+003	S	HFEF-5 Can	MFC	2	East	8.3306E-004	8.1053E-005	
Pu-241 [Details]	1.4300E+001	S	HFEF-5 Can	MFC	2	East	2.1750E-003	3.9447E-004	
Pu-242 [Details]	3.7400E+005	S	HFEF-5 Can	MFC	2	East	7.0103E-005	1.7966E-005	
Ra-226 [Details]	1.6000E+003	S	HFEF-5 Can	MFC	2	East	4.1048E-011	4.1935E-016	
Sm-151 [Details]	9.0000E+001	S	HFEF-5 Can	MFC	2	East	3.7320E-003	4.1750E-004	
Sr-90 [Details]	2.8000E+001	S	HFEF-5 Can	MFC	2	East	1.8515E+001	6.7541E+000	3.5156E-015
Th-229 [Details]	7.8000E+003	S	HFEF-5 Can	MFC	2	East	8.5219E-005	1.8644E-015	
Th-230 [Details]	7.5400E+004	S	HFEF-5 Can	MFC	2	East	1.5400E-005	2.1520E-013	
U-232 [Details]	6.8800E+001	S	HFEF-5 Can	MFC	2	East	1.0918E-005	3.4376E-007	
U-233 [Details]	1.5900E+005	S	HFEF-5 Can	MFC	2	East	3.0607E-005	3.3797E-006	
U-234 [Details]	2.4800E+005	S	HFEF-5 Can	MFC	2	East	2.2644E-004	1.1728E-004	
U-235 [Details]	7.0300E+008	S	HFEF-5 Can	MFC	2	East	2.9560E-006	1.8102E-006	
U-236 [Details]	2.3400E+007	S	HFEF-5 Can	MFC	2	East	4.6901E-006	2.3053E-006	
U-238 [Details]	4.4700E+008	S	HFEF-5 Can	MFC	2	East	2.0124E-006	9.1146E-007	

Canister Specific Test Details

Note: Tests 11-13 are canister specific.

12. PA Unanalyzed Nuclides with a half-life > 1 year (Canister Specific)

Nuclide	Form	Generator	Array	Amount (Ci)	Half Life (y)	% Canister Activity
Na-22	A	MFC	2	1.7318E-020	2.6005E+000	6.3179E-019
Nb-93m	A	MFC	2	6.1738E-004	1.8100E+001	7.2845E-002

Figure 1. Canister Details page from RHINO and the results of PA checks for waste canister MFC170303.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**PA Check 10**

Canister MFC170303 contains two key radionuclides (Ni-63 and Sr-90) whose cumulative inventories (includes placed + proposed canisters) exceed the PA base-case inventories for this generator (MFC), canister type (HFEF-5) and waste forms (combined activated metals with surface contaminated debris) (see Figure 1). Key radionuclides are radionuclides that were not screened out during preparation of the PA and dose impacts are included in the PA all-pathway dose calculation. The cumulative inventories of Ni-63 and Sr-90 in the RHLLW Disposal Facility already exceeds the PA base-case inventory for this generator/canister/waste form. Thus, the amount in canister MFC170303 would add to the exceedance of the cumulative inventory for the PA base-case inventory for this generator/canister/waste form.

It is allowable for the proposed cumulative inventory of a radionuclide to exceed the PA base-case inventory for a specific generator/canister/waste form so long as the impact of the proposed cumulative inventory is within the bounds of the PA. This is demonstrated by comparing the projected all-pathways dose and concentration impacts to the performance objectives (Figure 1, Column 1 numbers 1-7). Table 2 shows the all-pathway dose impact before and after disposal of canister MFC170303. The projected increase in the all-pathways dose after disposal of canister MFC170303 is very small very small for both the compliance period and post-compliance periods. Additionally, the projected all-pathways dose after disposal of canister MFC170303 is significantly less than the PA limit of 25 mrem/yr from DOE Order 435.1-1. The other doses and concentrations are also much less than performance objectives as shown in Figure 1. Based on this information, the inventories of Ni-63 and Sr-90 in waste canister MFC170303 are within the bounds of the PA.

Table 2. All-pathway dose impact after disposal of canister MFC170303.

	Current RHLLW all-pathways dose (previous canisters) (mrem/yr)	All pathways dose after disposal of MFC170303 (proposed can) (mrem/yr)	% Increase in all-pathways dose after disposal of MFC170303
Compliance Period	1.2750E-04	1.2759E-04	0.071%
Post-Compliance Period	7.4244E-02	7.4297E-02	0.071%

a. After disposal of MFC170303

PA Check 12: Unanalyzed Radionuclides with Half-lives Greater than 1 Year

Figure 1 shows waste canister MFC170303 contains 2 unanalyzed radionuclides (Na-22 and Nb-93m) with half-lives greater than one year. These radionuclides in these particular waste forms were not reported in the PA base-case inventory and were not analyzed in the PA. Therefore, they must be analyzed to confirm the inventories are within the bounds of the PA.

The inventories of the 2 unanalyzed radionuclides when compared to the total canister inventory (2.7415 Ci) are much less than 1% (see Table 3, column 4) and are not reportable according to the WAC and will not have an impact on the PA. To confirm this, the radionuclide inventories were compared to the total PA base case inventories of all waste forms. Table 3 shows that Na-22 was not reported in any of the other PA waste streams. Although Na-22 wasn't reported in any other PA waste stream the curie amount of Na-22 in canister MFC170303 is very small (1.7318E-20 Ci). Column 6 shows the canister inventory for Nb-93m is a small fraction of the total PA base case inventory (column 2 ÷ column 5). This confirms that the unanalyzed radionuclides in canister MFC170303 are within the bounds of the approved PA.

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLW DISPOSAL FACILITY**

Table 3. Unanalyzed radionuclides in waste canister ECF-05-18-112 with half-lives greater than one year.

1	2	3	4	5	6
Radionuclide	Canister Inventory (Ci)	Waste Form	Radionuclide Inventory as % of Total Canister Inventory	Total PA Base Case Inventory All Waste Forms(Ci)	Radionuclide Inventory as % of Total PA Base Case Inventory All Waste Forms
Na-22	1.7318E-20	A	6.3170E-19	#N/A	#N/A
Nb-93m	6.1736E-04	A	7.2845E-02	5.70E+02 ^a	1.08E-04

a. 494 Ci of the 570 Ci is from activated metals, the same as the Nb-93m in canister MFC170303.

Summary

The radionuclide inventory of waste canister MFC170303 has been evaluated with respect to potential impacts on the PA. Based on the evaluation, impacts to the PA are small and within the bounds of the PA. Therefore, the proposed canister is deemed acceptable for disposal.

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLW DISPOSAL FACILITY**

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Jonathan Jacobson _____ Print/Type Name Originator/FDS	<i>Jonathan Jacobson</i> _____ Signature Originator/FDS	9/13/2023 _____ Date
A. R. Prather _____ Print/Type Name System Engineer/SE	<i>A. R. Prather</i> _____ Signature System Engineer/SE	9/13/23 _____ Date
A. Jeff Sondrup _____ Print/Type Name PA/CA SME	<i>Jeff Sondrup</i> _____ Signature PA/CA SME	09/13/2023 _____ Date
Paul A. Velasquez _____ Print/Type Name Waste Management/WMP	<i>Paul Velasquez</i> _____ Signature Waste Management/WMP	09/13/2023 _____ Date
Tim Arsenault _____ Print/Type Name Nuclear Facility Manger/NFM	<i>Timothy Arsenault</i> _____ Signature Nuclear Facility Manger/NFM	9/13/2023 _____ Date

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

Section III, Special Analysis, SA (If Required in Section I or II)

PARC Assigned SME: _____

Special Analysis Document Number: _____

Proposed Activity Approved? Yes ☐ No ☐

Comments: _____

_____ Print/Type Name Originator/FDS	_____ Signature Originator/FDS	_____ Date
_____ Print/Type Name System Engineer/SE	_____ Signature System Engineer/SE	_____ Date
_____ Print/Type Name PA/CA SME	_____ Signature PA/CA SME	_____ Date
_____ Print/Type Name Waste Management/WMP	_____ Signature Waste Management/WMP	_____ Date
_____ Print/Type Name Nuclear Facility Manager/NFM	_____ Signature Nuclear Facility Manager/NFM	_____ Date
_____ Print/Type Name DOE/ID Representative	_____ Signature DOE/ID Representative	_____ Date

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UDQE Tracking No.: UDQE-RHLLW-077

Subject: Canister OWC-301-H5 from RSWF flagged by RHINO during performance assessment (PA) checks

NOTE: *The objective of this screening is to determine whether further evaluation is required for a proposed change, new information, or discovery to ensure the validity of the existing Performance Assessment (PA; DOE/ID-11421) and Composite Analysis (CA; DOE/ID-11422) are not impacted.*

Describe the Proposed Change in Activity/New Information/Discovery:

Waste canister OWC-301-H5 is an HFEF-5 waste canister containing remote-handled low-level waste (RHLLW) from the Hot Fuel Examination Facility (HFEF) hot cell at the Materials and Fuels Complex (MFC). Prior to shipment, waste canisters details are entered into the RHLLW Inventory Online (RHINO) software which performs several checks to evaluate the canister for acceptance. Canister OWC-301-H5 was flagged by RHINO based on the following inventory checks:

PA Check 9: PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)

PA check 9 was flagged by RHINO because the cumulative inventories of eleven radionuclides (Co-60, Cs-137, Eu-155, Ni-63, Pb-210, Pu-238, Ra-226, Sm-151, Sr-90, Th-230, and U-234) with half-lives greater than 1 year exceed the PA base-case inventories for this generator (MFC), waste form (combined activated metals with surface contaminated debris) and canister type (HFEF-5). The cumulative inventory includes the inventory of previously emplaced canisters plus the proposed canister, OWC-301-H5. Ten of the eleven radionuclides are considered "non-key" radionuclides because they were screened out of the all-pathways dose calculation during preparation of the PA. The ten non-key radionuclides must be evaluated to determine if the increased inventory (above the PA base case) would have resulted in the radionuclide not being screened out during completion of the PA. The one key radionuclide (U-234) is addressed under PA Check 10 (see below).

PA Check 10: PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides Only)

PA check 10 was flagged by RHINO because the cumulative inventory of one key radionuclide (U-234) exceeds the PA base-case inventory for this generator (MFC), waste form (combined activated metals with surface contaminated debris) and canister type (HFEF-5). The cumulative inventory includes the inventory of previously placed canisters plus the proposed canister, OWC-301-H5. The inventory of this key radionuclide must be evaluated to determine if the increased inventory and accompanying dose is within the bounds of the approved PA.

Exceedance of a threshold value flagged by RHINO does not indicate the proposed canister is unacceptable for disposal but the flagged inventory levels must be reviewed. If after review, it is determined the inventory levels are within the bounds of the approved PA, the proposed canister may be approved for disposal.

It should be noted that RHINO also identified unanalyzed radionuclides Pb-210, Ra-226 and Th-230 but did not fail the check. The radionuclides were identified as unanalyzed because canister OWC-301-H5 is a new-generation (non-legacy) canister and these radionuclides were not included in the PA base-case inventory for this generator/canister/waste form. However, because they are included in PA base-case legacy waste for this generator/canister/waste form, and waste in the HFEF-5 legacy and new-generation canisters is treated the same in the PA, the radionuclides were not flagged by RHINO. Therefore, no evaluation is necessary.

Section I, Unreviewed Disposal Question Screening (UDQS)

1. *Does the proposed activity/new information/discovery involve a change to the disposal facility from what has been previously or analyzed in the most recent Disposal Authorization Statement (DAS) conditions or limitations, Performance Assessment (PA), approved Special Analyses (SA), or approved UDQE?*

Yes ☒ No ☐

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Comments: Canister OWC-301-H5 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214, the canister activities must be evaluated to confirm they are within the bounds of the approved PA.

2. Does the proposed activity/new information/discovery potentially result in an increased effective dose from the disposal facility that would challenge the conclusions of the Composite Analysis (i.e., that the RHLLW Disposal Facility has *de minimus* contribution to the cumulative impacts of surrounding facilities) or otherwise have the potential to impact the CA?
- Change to the site use plan or end state document
 - Construction of a new facility near the RHLLW Disposal Facility with the potential to impact perched water
 - CA inputs or assumptions
 - Change to work outlined in the PA/CA Maintenance Plan (PLN-3368).

Yes ☐ No ☒

Comments: NA

3. Does the proposed activity/new information/discovery involve a change to the disposal process or procedures from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

4. Does the proposed activity/new information/discovery involve a change to the Waste Acceptance Criteria (WAC) from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

5. Does the proposed activity/new information/discovery involve a change inputs or assumptions of the most recent PA or approved SA?

Yes ☒ No ☐

Comments: Canister OWC-301-H5 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214, the canister activities must be evaluated to confirm they are within the bounds of the approved PA.

6. Does the proposed activity/new information/discovery result in a change the facility preliminary closure approach or criteria from what was previously described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

Comments: NA

7. Does the proposed activity/new information/discovery involve a test or experiment not described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?

Yes ☐ No ☒

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
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Comments: NA

8. *Does the proposed activity/new information/discovery involve any analytical errors, omissions, or deficiencies in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?*

Yes ☐ No ☒

Comments: NA

9. *Do other considerations warrant development of an evaluation or special analysis?*

Yes ☐ No ☒

Comments: NA

NOTE: *If all questions above are answered "No," then obtain signatures and implement proposed change. If any of the questions above are answered "Yes," then continue with Form and complete Unreviewed Disposal Questions Evaluation Section.*

Explanation/Additional Comments:

Does the Unreviewed Disposal Question Screening screen negative or positive?

Negative ☐ Positive ☒

Is an Unreviewed Disposal Question Evaluation or Special Analysis needed?

No ☐ UDQE ☒ Special Analysis ☐

Mary Baeza	<i>Mary Baeza</i>	9/18/2023
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
Tim Arsenault	<i>Timothy Arsenault</i>	9/18/2023
Print/Type Name	Signature	Date
Approver/NFM	Approver/NFM	

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

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Section II, Unreviewed Disposal Question Evaluation (UDQE)

Evaluation:

1. *Is the proposed activity/new information/discovery outside the bounds of the approved PA or CA (e.g., does the proposed activity/new information/discovery involve a change to the basic disposal concept as described in the PA/CA such as critical inputs/assumptions or an increase in facility inventory analyzed in the PA or considered in the CA)?*

Yes ☐ No ☒

Comments:

2. *Does the proposed activity/new information/discovery result in the PA performance objective being exceeded?*

Yes ☐ No ☒

Comments:

3. *Would the proposed activity/new information/discovery result in a change to the facility radionuclide disposal limits in the approved PA?*

Yes ☐ No ☒

Comments:

4. *Would the proposed activity/new information/discovery result in a change to DAS conditions or limitations?*

Yes ☐ No ☒

Comments:

5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

Yes ☐ No ☒

If "Yes," Special Analysis and DOE NE-ID notification required. Provide explanation.

If "No," provide an explanation and basis for the determination. Attach supplementary documentation (e.g., TEV), as required.

This explanation contains an evaluation of flagged PA Checks 9 and 10 by RHINO, regarding the inventory of waste canister OWC-301-H5. Figure 1 shows the canisters details page from RHINO and the results of the PA check.

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Canister Details OWC-301-H5

Canister Details
Nuclides
Rad Readings
PA Check
WAC Check
References
Attachments
Images

PA Status: Fail | **Placement Vault:** HFEF-5 Can

PA Results						
No.	Pass	Performance Measure	Value	Limit	Units	Run Date
1	Yes	All Pathways Dose	1.3529E-004	1	mrem/yr	8/22/2023
	Yes	All Pathways Dose	7.8782E-002	12.5	mrem/yr	8/22/2023
2	Yes	Beta-Gamma DE	9.6062E-005	0.16	mrem/yr	8/22/2023
	Yes	Beta-Gamma DE	5.5627E-002	2.4	mrem/yr	8/22/2023
3	Yes	Ra-226/228	2.1749E-032	0.2	pCi/L	8/22/2023
	Yes	Ra-226/228	2.0004E-006	2.5	pCi/L	8/22/2023
4	Yes	Gross Alpha	4.5198E-030	0.6	pCi/L	8/22/2023
	Yes	Gross Alpha	6.3343E-008	7.5	pCi/L	8/22/2023
5	Yes	Beta-Gamma ED	5.2573E-005	0.16	mrem/yr	8/22/2023
	Yes	Beta-Gamma ED	3.0599E-002	2	mrem/yr	8/22/2023
6	Yes	Uranium	8.7798E-028	1.2	ug/L	8/22/2023
	Yes	Uranium	1.6714E-005	15	ug/L	8/22/2023
7	Yes	Intruder	1.3548E-001	20	mrem/yr	8/22/2023
8	Yes	Air Pathway	4.4877E-005	0.4	mrem/yr	8/22/2023
9	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	-	-	-	8/22/2023
10	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-	-	-	8/22/2023
11	Yes	Administrative 10% Canister Inventory Check (Key Radionuclides)	-	-	-	8/22/2023
12	Yes	Non-System/Unanalyzed/Non-Exempt Nuclides Check	-	-	-	8/22/2023
13	Yes	Canister Action Levels Check	-	-	-	8/22/2023

9. & 10. PA Base Case Inventory Check by Generator/Canister/Waste Form (Half Life > 1 Year)

Note: Nuclides of interest are in bold.

Generator Facility: MFC
Array: All

Nuclide	Half Life	Form	Vault	Generator	Array	East/West	Cumulative PA Amount (Ci)	Limit Inv (Ci)	Canister Contribution (Ci)
Co-60 [Details]	5.2600E+000	S	HFEF-5 Can	MFC	2	East	1.5539E+000	7.9139E-001	2.8315E-006
Cs-137 [Details]	3.0100E+001	S	HFEF-5 Can	MFC	2	East	9.3095E+000	3.3072E+000	7.8130E-003
Eu-154 [Details]	8.5900E+000	S	HFEF-5 Can	MFC	2	East	1.1233E-002	8.7567E-003	
Eu-155 [Details]	4.7500E+000	S	HFEF-5 Can	MFC	2	East	1.2977E-002	8.1631E-003	2.4221E-007
I-129 [Details]	1.5700E+007	S	HFEF-5 Can	MFC	2	East	3.9651E-008	4.4004E-009	
Ni-63 [Details]	1.0000E+002	A	HFEF-5 Can	MFC	2	East	8.6497E+003	9.3298E+002	9.8484E+000
Np-237 [Details]	2.1500E+006	S	HFEF-5 Can	MFC	2	East	1.8004E-006	6.8505E-008	
Pb-210 [Details]	2.2200E+001	S	HFEF-5 Can	MFC	2	East	4.8543E-012	4.6703E-017	4.3757E-016
Pm-147 [Details]	2.6200E+000	S	HFEF-5 Can	MFC	2	East	5.8506E-004	1.0801E-004	
Pu-236 [Details]	2.8600E+000	S	HFEF-5 Can	MFC	2	East	9.9496E-007	1.7984E-007	
Pu-238 [Details]	8.7800E+001	S	HFEF-5 Can	MFC	2	East	8.3688E-004	1.8411E-004	1.0396E-004
Pu-240 [Details]	6.5600E+003	S	HFEF-5 Can	MFC	2	East	6.3309E-004	6.1053E-005	
Pu-241 [Details]	1.4300E+001	S	HFEF-5 Can	MFC	2	East	2.1759E-003	3.0447E-004	
Pu-242 [Details]	3.7400E+005	S	HFEF-5 Can	MFC	2	East	7.0183E-008	1.7995E-008	
Ra-226 [Details]	1.6000E+003	S	HFEF-5 Can	MFC	2	East	4.1048E-011	4.1935E-016	7.8904E-017
Sm-151 [Details]	9.0000E+001	S	HFEF-5 Can	MFC	2	East	4.0232E-003	4.1756E-004	2.9038E-004
Sr-90 [Details]	2.8900E+001	S	HFEF-5 Can	MFC	2	East	1.8542E+001	6.7941E+000	6.5514E-003
Th-228 [Details]	7.8900E+003	S	HFEF-5 Can	MFC	2	East	6.5215E-008	1.9944E-015	
Th-230 [Details]	7.5400E+004	S	HFEF-5 Can	MFC	2	East	1.5488E-008	2.1520E-013	7.2568E-014
U-232 [Details]	6.8800E+001	S	HFEF-5 Can	MFC	2	East	1.0919E-005	3.4376E-007	
U-233 [Details]	1.5900E+005	S	HFEF-5 Can	MFC	2	East	3.0687E-005	3.3797E-006	
U-234 [Details]	2.4600E+005	S	HFEF-5 Can	MFC	2	East	2.2664E-004	1.1729E-004	2.1290E-000
U-236 [Details]	7.0300E+008	S	HFEF-5 Can	MFC	2	East	2.9500E-006	1.8102E-006	
U-238 [Details]	2.3400E+007	S	HFEF-5 Can	MFC	2	East	4.6881E-006	2.3053E-006	
U-238 [Details]	4.4700E+009	S	HFEF-5 Can	MFC	2	East	2.0124E-006	9.1146E-007	

Canister Specific Test Details

Note: Tests 11-13 are canister specific.

12. PA Unanalyzed Nuclides with a half-life > 1 year (Canister Specific)

Nuclide	Form	Generator	Array	Amount (Ci)	Half Life (y)	% Canister Activity
Pb-210	S	MFC	2	4.3757E-016	2.2200E+001	1.4696E-016
Ra-226	S	MFC	2	7.8904E-017	1.6000E+003	2.6501E-017
Th-230	S	MFC	2	7.2568E-014	7.5400E+004	2.4373E-014

Figure 1. Canister Details page of RHINO and the results of the PA checks for canister OWC-301-H5.

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The canister checks flagged by RHINO that require evaluation are contained below.

PA Check 9

Canister OWC-301-H5 contains eleven radionuclides whose cumulative inventories (includes placed canisters + the proposed canister) exceed the PA base-case inventories for this generator (MFC), canister type (HFEF-5) and waste forms (combined activated metals with surface contaminated debris) (see Figure 1). Of the eleven radionuclides, ten are considered “non-key” radionuclides because they were screened out of the all-pathways dose calculation during preparation of the PA. The cumulative inventories of these radionuclides will be evaluated to determine if the increased inventory (above the PA base case) would have resulted in the radionuclide not being screened out during preparation of the PA. The one key radionuclide (U-234) will be evaluated under PA Check 10 (see below). Radionuclides that were flagged by PA Checks 9 and 10 that are not in canister OWC-301-H5 (see Figure 1, last column of PA Checks 9 & 10, Canister Contribution = 0) were evaluated under a separate UDQE and do not need to be evaluated here.

The ten non-key radionuclides (Co-60, Cs-137, Eu-155, Ni-63, Pb-210, Pu-238, Ra-226, Sm-151, Sr-90, and Th-230) were screened out during the Phase II and III screenings during preparation of the PA. Table 1 shows that the new cumulative inventories would still be screened out using the Phase II and III screening criteria of the PA. This was done by calculating the cumulative inventory of each radionuclide as a percent of the maximum allowable inventory allowed by the PA Phase II and III screenings. For this calculation the inventory of all placed canisters plus the proposed canister (OWC-301-H5) was added to the total PA base case inventory. This is conservative because the PA base case inventories include some of the inventory in the placed and proposed canisters. The screenings are done on the total facility inventory and are independent of generator, canister type and waste form.

The maximum allowable inventory allowed by the Phase II screening ($I_{max_{II_i}}$) was calculated using the following equation:

$$I_{max_{II_i}} \left(\frac{Ci}{yr} \right) = \frac{0.4 \left(\frac{mrem}{yr} \right)}{NCRP \text{ Screening Dose}_i \left(\frac{mrem}{Ci} \right)} \quad (\text{Equation 1})$$

where:

0.4 mrem/yr = PA Phase II screening dose standard (1/10th the allowable 40 CFR 141 drinking water dose for beta-gamma emitters). This assumes the entire inventory is leached from the source in one year.

NCRP Screening Dose Factor (mrem/Ci) (see DOE/ID-11421, Table 2-26).

The maximum allowable inventory allowed by the Phase III screening ($I_{max_{III_i}}$) was calculated using the following equation:

$$I_{max_{III_i}}(Ci) = 0.4 \left(\frac{mrem}{yr} \right) \times \frac{I_{PAi}(Ci)}{D_{III_i} \left(\frac{mrem}{yr} \right)} \quad (\text{Equation 2})$$

where:

0.4 mrem/yr = PA Phase III screening dose standard (1/10th the allowable 40 CFR 141 drinking water dose for beta-gamma emitters)

I_{PAi} = total PA base case inventory of radionuclide i (see DOE/ID-11421, Table 2-29)

D_{III_i} = PA Phase III screening dose for radionuclide i based on total PA base case inventory of radionuclide i.

Table 1 shows that even when the projected cumulative inventory after placement of OWC-301-H5 (column 3) and the total PA base case inventory (column 4) are conservatively summed together for each radionuclide, the totals (column 5) are fractions (column 8) of the maximum allowable Phase II and Phase

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III screening inventories (column 7) and would still be screened out. Therefore, the inventories of the non-key radionuclides in OWC-301-H5 are within the bounds of the PA.

Table 1. Comparison of non-key radionuclide inventories to maximum allowable screening inventories.

1	2	3	4	5	6	7	8
Radionuclides Screened During PA Phase II Screening							
Non-Key Radionuclide	OWC-301-H5 Inventory (Ci) ^a	Projected Cumulative Inventory (Placed + OWC-301-H5) (Ci) ^a	Total PA Base Case Inventory (All Generators, Canisters, Waste Forms) (Ci) ^b	Projected Cumulative Inventory after Placement of OWC-301-H5 + Total PA Base Case Inventory (Cols 3+4) (Ci)	PA Phase II NCRP Screening Factor (mrem/Ci) ^c	Max Allowable Phase II Screening Inventory (Ci/yr)	PA Base Case + Projected Cumulative Inventory after Placement of OWC-301-H5 as % of Max Allowable Phase II Screening Inventory
Pb-210	4.38E-18	4.85E-12 ^d	2.89E-12	7.74E-12	7.77E+04	5.15E-06	0.00015%
Ra-226	7.89E-17	4.10E-11 ^e	3.14E-11	7.24E-11	2.96E+05	1.35E-06	0.0054%
Th-230	7.26E-14	1.55E-08	4.93E-08	6.48E-08	1.59E+05	2.51E-06	2.58%
Radionuclides Screened During PA Phase III Screening							
Non-Key Radionuclide	OWC-301-H5 Inventory (Ci) ^a	Projected Cumulative Inventory (Placed + OWC-301-H5) (Ci) ^a	Total PA Base Case Inventory (All Generators, Canisters, Waste Forms) (Ci) ^b	Projected Cumulative Inventory after Placement of OWC-301-H5 + Total PA Base Case Inventory (Cols 3+4) (Ci)	PA Phase III Dose (mrem/yr) ^c	Max Allowable Phase III Screening Inventory (Ci/yr)	PA Base Case + Projected Cumulative Inventory after Placement of OWC-301-H5 as % of Max Allowable Phase III Screening Inventory
Co-60	2.63E-06	1.55E+00	3.09E+05	3.09E+05	<1.00E-40	1.24E+45	2.50E-38%
Cs-137	7.61E-03	9.31E+00	9.45E+02	9.54E+02	<1.00E-40	3.78E+42	2.52E-38%
Eu-155	2.42E-07	1.30E-02	1.65E+00	1.66E+00	<1.00E-40	6.60E+39	2.52E-38%
Ni-63	9.85E+00	8.65E+03	2.18E+05	2.27E+05	<1.00E-40	8.72E+44	2.60E-38%
Pu-238	1.64E-04	8.37E-04	3.68E-01	3.69E-01	2.57E-02	5.73E+00	6.44% ^h
Sm-151	2.90E-04	4.02E-03	5.27E+01	5.27E+01	<1.00E-40	2.11E+41	2.50E-38%
Sr-90	6.55E-03	1.85E+01	6.73E+02	6.92E+02	<1.00E-40	2.69E+42	2.57E-38%

- Inventory of activated metal and surface contaminated debris.
- Table 2-14, RHLLW Performance Assessment (DOE-ID 2018).
- Table 2-26, RHLLW Performance Assessment (DOE-ID 2018).
- I_{max} from Equation 1 above.
- Table 2-29, RHLLW Performance Assessment (DOE-ID 2018). Doses < 1E-40 mrem/yr are assumed = 1E-40 mrem/yr.
- I_{max} from Equation 2 above.
- Inventory of placed plus proposed canister exceeds the total PA base case inventory for all generators and waste forms.
- Although the projected cumulative inventory of Pu-238 after placement + the total PA base case inventory is 6.44% of the maximum allowable Phase III screening inventory, this percentage is due mostly to the PA base case inventory.

PA Check 10

Canister OWC-301-H5 contains a key radionuclide (U-234) whose cumulative inventory (includes placed + proposed canister) exceeds the PA base-case inventory for this generator (MFC), canister type (HFEF-5) and waste forms (combined activated metals with surface contaminated debris) (see Figure 1). A key radionuclide is one that was not screened out during preparation of the PA and dose impacts are included in the PA all-pathway dose calculation. The current cumulative inventory of U-234 in the RHLLW Disposal Facility (2.27E-04 Ci) for this generator/canister/waste form already exceeds the PA base-case inventory (1.17E-04 Ci). Thus, the amount in canister OWC-301-H5 would add to the exceedance of the cumulative inventory for the PA base-case inventory for this generator/canister/waste form.

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It is allowable for the proposed cumulative inventory of a radionuclide to exceed the PA base-case inventory for a specific generator/canister/waste form so long as the impact of the proposed cumulative inventory is within the bounds of the PA. This is demonstrated by calculating the projected dose impact from placement of the proposed canister. Table 2 shows the all-pathway dose impact before and after disposal of proposed canister OWC-301-H5. The projected all-pathway dose after disposal of canister OWC-301-H5 would increase 6.11% for both the compliance period and post-compliance periods. This is a relatively small increase and the all-pathways dose after disposal of OWC-301-H5 is significantly less than the PA limit of 25 mrem/yr from DOE Order 435.1-1. So although the U-234 inventory would exceed the PA base case inventory, the total inventory after disposal of canister OWC-301-H5 is within the bounds of the PA.

Table 2. All-pathway dose impact from placement of canister OWC-301-H5.

Period	Current All-Pathways Dose from all Placed + Approved Canisters (mrem/yr)	All-Pathways Dose from OWC-301-H5 (mrem/yr) ^a	All-Pathways Dose After Placement of OWC-301-H5 (mrem/yr)	% Increase in All-Pathways Dose After Placement of OWC-301-H5
Compliance	1.2750E-04	7.7934E-06	1.3529E-04	6.11%
Post-Compliance	7.4244E-02	4.5380E-03	7.8782E-02	6.11%

a. Dose contribution not just from U-234. OWC-301-H5 also contains key radionuclides C-14, H-3, Nb-94, Ni-59 in activated metal waste form, and Tc-99 as surface contamination.


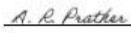


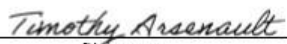
Summary

The radionuclide inventory of waste canister OWC-301-H5 has been evaluated with respect to potential impacts on the PA. Based on the evaluation, impacts to the PA are within the bounds of the PA. Therefore, the proposed canister is deemed acceptable for disposal.

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Mary Baeza		9/18/2023
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
A. R. Prather		9/18/23
Print/Type Name System Engineer/SE	Signature System Engineer/SE	Date
A. Jeff Sondrup		09/18/2023
Print/Type Name PA/CA SME	Signature PA/CA SME	Date
Paul A. Velasquez		09/18/2023
Print/Type Name Waste Management/WMP	Signature Waste Management/WMP	Date
Tim Arsenault		9/18/2023
Print/Type Name Nuclear Facility Manger/NFM	Signature Nuclear Facility Manger/NFM	Date

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Section III, Special Analysis, SA (If Required in Section I or II)

PARC Assigned SME: _____

Special Analysis Document Number: _____

Proposed Activity Approved? Yes ☐ No ☐

Comments: _____

_____ Print/Type Name Originator/FDS	_____ Signature Originator/FDS	_____ Date
_____ Print/Type Name System Engineer/SE	_____ Signature System Engineer/SE	_____ Date
_____ Print/Type Name PA/CA SME	_____ Signature PA/CA SME	_____ Date
_____ Print/Type Name Waste Management/WMP	_____ Signature Waste Management/WMP	_____ Date
_____ Print/Type Name Nuclear Facility Manger/NFM	_____ Signature Nuclear Facility Manger/NFM	_____ Date
_____ Print/Type Name DOE/ID Representative	_____ Signature DOE/ID Representative	_____ Date

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UDQE Tracking No.: UDQE-RHLLW-078

Subject: Canister ECF-05-18-120 from NRF flagged by RHINO during PA checks

NOTE: *The objective of this screening is to determine whether further evaluation is required for a proposed change, new information, or discovery to ensure the validity of the existing Performance Assessment (PA; DOE/ID-11421) and Composite Analysis (CA; DOE/ID-11422) are not impacted.*

Describe the Proposed Change in Activity/New Information/Discovery:

Waste canister ECF-05-18-120 is a 55-Ton waste canister containing activated metals and surface contaminated debris from Naval Reactors Facility (NRF). Prior to shipping the canister to the Remote-Handled Low-Level Waste (RHLLW) Disposal Facility, waste canisters details are entered into the RHLLW Inventory Online (RHINO) software which performs several checks to evaluate the canister for acceptance. Canister ECF-05-18-120 was flagged by RHINO based on the following inventory checks:

PA Check 9: PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)

PA check 9 was flagged by RHINO because the cumulative inventories of six radionuclides (Cm-245, Cm-246, Np-237, Pu-238, U-234 and U-236) with half-lives greater than 1 year exceed the PA base-case inventories for this generator (NRF), waste form (combined activated metals with surface contaminated debris) and canister type (55-Ton). The cumulative inventory includes the inventory of five previously placed canisters plus the proposed canister. Four of the six radionuclides are considered "non-key" radionuclides because they were screened out of the all-pathways dose calculation during preparation of the PA. The four non-key radionuclides (Cm-245, Cm-246, Pu-238, and U-236) must be evaluated to determine if the increased inventory (above the PA base case) would have resulted in the radionuclide not being screened out during completion of the PA. The two key radionuclides (Np-237 and U-234) are addressed under PA Check 10 (see below).

PA Check 10: PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides Only)

PA check 10 was flagged by RHINO because the cumulative inventory of two key radionuclides (Np-237, and U-234) exceed the PA base-case inventory for this generator (NRF), waste form (combined activated metals with surface contaminated debris) and canister type (55-Ton). The cumulative inventory includes the inventory of five previously placed canisters plus the proposed canister. The inventory of these key radionuclides must be evaluated to determine if the increased inventory and accompanying impact on PA performance measures (dose and concentration limits) is within the bounds of the approved PA.

PA Check 11: Administrative 10% Canister Inventory Check (Key Radionuclides Only)

This flag was checked by RHINO because the canister inventories of five radionuclides (Cs-137, Np-237, Pu-240, Sr-90 and U-234) exceed the 10% threshold levels of the PA base-case inventory for this generator, waste form and canister type. A threshold of 10% was selected by considering the total number of waste disposal vaults, the variance in expected container radionuclide inventory levels, and other pathway-specific considerations presented in INL (2018). According to INL (2018), if a single container exceeds 10% of the radionuclide-specific base-case inventory modeled in the PA for a specific generator, waste form, and canister type, the container will be flagged for further review to determine if the canister inventory is an anomalous occurrence or indicative of a change in waste generation rates. This check is performed for the 18 key radionuclides listed in Table 18 of INL (2018) that were analyzed in the PA for the groundwater, air and intruder pathways.

PA Check 12: Unanalyzed/Non-exempt/Non-system Nuclides Check

This flag was checked by RHINO because unanalyzed radionuclides with half-lives greater than 1 year, and non-system/non-exempt radionuclides were identified by RHINO in waste canister ECF-05-18-120. These radionuclides must be evaluated to confirm the inventories are within the bounds of the PA.

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Exceedance of a threshold value flagged by RHINO does not indicate the proposed canister is unacceptable for disposal but the flagged inventory levels must be reviewed. If after review, it is determined the inventory levels (both canister and cumulative) are within the bounds of the approved PA, the proposed canister may be approved for disposal.

Section I, Unreviewed Disposal Question Screening (UDQS)

1. Does the proposed activity/new information/discovery involve a change to the disposal facility from what has been previously or analyzed in the most recent Disposal Authorization Statement (DAS) conditions or limitations, Performance Assessment (PA), approved Special Analyses (SA), or approved UDQE?

Yes ☒ No ☐

Comments: Canister ECF-05-18-120 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214, the canister activities must be evaluated to confirm they are within the bounds of the approved PA.

2. Does the proposed activity/new information/discovery potentially result in an increased effective dose from the disposal facility that would challenge the conclusions of the Composite Analysis (i.e., that the RHLLW Disposal Facility has *de minimus* contribution to the cumulative impacts of surrounding facilities) or otherwise have the potential to impact the CA?

- Change to the site use plan or end state document
- Construction of a new facility near the RHLLW Disposal Facility with the potential to impact perched water
- CA inputs or assumptions
- Change to work outlined in the PA/CA Maintenance Plan (PLN-3368).

Yes ☐ No ☒

Comments: NA

3. Does the proposed activity/new information/discovery involve a change to the disposal process or procedures from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

4. Does the proposed activity/new information/discovery involve a change to the Waste Acceptance Criteria (WAC) from what has been previously described or analyzed in the most recent PA, approved SA, or approved UDQE?

Yes ☐ No ☒

Comments: NA

5. Does the proposed activity/new information/discovery involve a change inputs or assumptions of the most recent PA or approved SA?

Yes ☒ No ☐

Comments: Canister ECF-05-18-120 was flagged by RHINO while performing PA checks of the waste canister inventory. According to RH-ADM-5214, the canister activities must be evaluated to confirm they are within the bounds of the approved PA.

6. Does the proposed activity/new information/discovery result in a change the facility preliminary closure approach or criteria from what was previously described or analyzed in the most recent PA, approved SA,

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*approved UDQE, or associated closure plan (PLN-5503)?*Yes ☐ No ☒

Comments: NA

7. *Does the proposed activity/new information/discovery involve a test or experiment not described or analyzed in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?*Yes ☐ No ☒

Comments: NA

8. *Does the proposed activity/new information/discovery involve any analytical errors, omissions, or deficiencies in the most recent PA, approved SA, approved UDQE, or associated closure plan (PLN-5503)?*Yes ☐ No ☒

Comments: NA

9. *Do other considerations warrant development of an evaluation or special analysis?*Yes ☐ No ☒

Comments: NA

NOTE: *If all questions above are answered "No," then obtain signatures and implement proposed change. If any of the questions above are answered "Yes," then continue with Form and complete Unreviewed Disposal Questions Evaluation Section.*

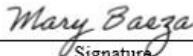
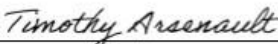
Explanation/Additional Comments:

Does the Unreviewed Disposal Question Screening screen negative or positive?

Negative ☐ Positive ☒

Is an Unreviewed Disposal Question Evaluation or Special Analysis needed?

No ☐ UDQE ☒ Special Analysis ☐

Mary Baeza		9/21/23
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
Tim Arsenault		9/22/23
Print/Type Name	Signature	Date
Approver/NFM	Approver/NFM	

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Section II, Unreviewed Disposal Question Evaluation (UDQE)

Evaluation:

1. *Is the proposed activity/new information/discovery outside the bounds of the approved PA or CA (e.g., does the proposed activity/new information/discovery involve a change to the basic disposal concept as described in the PA/CA such as critical inputs/assumptions or an increase in facility inventory analyzed in the PA or considered in the CA)?*

Yes ☐ No ☒

Comments:

2. *Does the proposed activity/new information/discovery result in the PA performance objective being exceeded?*

Yes ☐ No ☒

Comments:

3. *Would the proposed activity/new information/discovery result in a change to the facility radionuclide disposal limits in the approved PA?*

Yes ☐ No ☒

Comments:

4. *Would the proposed activity/new information/discovery result in a change to DAS conditions or limitations?*

Yes ☐ No ☒

Comments:

5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

Yes ☐ No ☒

If "Yes," Special Analysis and DOE NE-ID notification required. Provide explanation.

If "No," provide an explanation and basis for the determination. Attach supplementary documentation (e.g., TEV), as required

This explanation contains an evaluation of flagged PA Checks 9, 10, 11 and 12 by RHINO regarding the inventory of waste canister ECF-05-18-120. Canister ECF-05-18-120 is the sixth 55-Ton waste canister from NRF submitted for disposal.

Figure 1 shows the canisters details page from RHINO and the results of the PA check. Evaluations of each canister check flagged by RHINO are contained below.

UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY

Canister Details ECF-05-18-120

Canister Details
Nuclides
Rad Readings
PA Check
WAC Check
References
Attachments
Images

PA Status: Fail | Placement Vault: 55-Ton Cask

PA Results		No.	Pass	Performance Measure	Value	Limit	Units	Type	Run Date
1	Yes		Yes	All Pathways Dose	1.2759E-004	5	mrem/yr	Compliance	9/7/2023
	Yes		Yes	All Pathways Dose	7.4244E-002	13.5	mrem/yr	Post Compliance	9/7/2023
2	Yes		Yes	Beta-Gamma CE	9.0587E-005	5.16	mrem/yr	Compliance	9/7/2023
	Yes		Yes	Beta-Gamma CE	5.2705E-002	2.4	mrem/yr	Post Compliance	9/7/2023
3	Yes		Yes	Ra-226/228	2.1749E-032	0.2	pCi/L	Compliance	9/7/2023
	Yes		Yes	Ra-226/228	2.0364E-006	2.8	pCi/L	Post Compliance	9/7/2023
4	Yes		Yes	Gross Alpha	4.5190E-030	0.6	pCi/L	Compliance	9/7/2023
	Yes		Yes	Gross Alpha	6.3346E-006	7.8	pCi/L	Post Compliance	9/7/2023
5	Yes		Yes	Beta-Gamma ED	4.9542E-005	5.16	mrem/yr	Compliance	9/7/2023
	Yes		Yes	Beta-Gamma ED	2.8836E-002	2	mrem/yr	Post Compliance	9/7/2023
6	Yes		Yes	Uranium	8.7759E-028	1.2	ug/L	Compliance	9/7/2023
	Yes		Yes	Uranium	1.8714E-003	16	ug/L	Post Compliance	9/7/2023
7	Yes		Yes	Intruder	1.3054E-001	20	mrem/yr	Compliance	9/7/2023
8	Yes		Yes	Air Pathway	5.4475E-003	0.4	mrem/yr	Compliance	9/7/2023
9	No		No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	-	-	-	Compliance	9/7/2023
10	No		No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-	-	-	Compliance	9/7/2023
11	No		No	Administrative 10% Canister Inventory Check (Key Radionuclides)	-	-	-	Compliance	9/7/2023
12	No		No	Non-System/Unanalyzed/Non-Exempt Nuclides Check	-	-	-	Compliance	9/7/2023
13	Yes		Yes	Canister Action Levels Check	-	-	-	Compliance	9/7/2023

9 & 10. PA Base Case Inventory Check by Generator/Canister/Waste Form (Half Life > 1 Year)

Note: Nuclides of interest are in **bold**

Generator Facility		Array
NRF	All	

Nuclide	Half Life	Form	Vault	Generator	Array	East/West	Cumulative PA Amount (Ci)	Limit (Ci)	Canister Contribution (Ci)
Ac-227 (Details)	2.1800E+001	A	55-Ton Cask	NRF	3	West	2.9799E-007	2.0564E-007	
Ce-142 (Details)	5.0100E+016	A	55-Ton Cask	NRF	3	West	7.3910E-008	5.3195E-008	
Co-246 (Details)	8.4900E+003	B	55-Ton Cask	NRF	3	West	1.2362E-007	6.9997E-008	1.2242E-007
Co-246 (Details)	4.7300E+003	B	55-Ton Cask	NRF	3	West	5.0495E-008	3.5211E-008	5.0000E-008
Hf-178m (Details)	3.1000E+001	A	55-Ton Cask	NRF	3	West	4.7600E-006	4.0123E-006	
Ir-192m (Details)	2.4100E+002	A	55-Ton Cask	NRF	3	West	1.7968E-006	7.6070E-007	
La-137 (Details)	5.9900E+004	A	55-Ton Cask	NRF	3	West	4.5364E-007	1.5420E-007	
Np-237 (Details)	2.1500E+006	B	55-Ton Cask	NRF	3	West	2.5973E-007	3.3543E-009	2.5949E-007
Pu-193 (Details)	5.0100E+001	A	55-Ton Cask	NRF	3	West	9.2768E-005	8.0503E-005	
Pu-238 (Details)	8.7600E+005	B	55-Ton Cask	NRF	3	West	6.7252E-004	3.8088E-004	6.5802E-004
Ra-226 (Details)	1.6000E+003	A	55-Ton Cask	NRF	3	West	5.5414E-011	3.0840E-012	
Ra-226 (Details)	5.7400E+000	A	55-Ton Cask	NRF	3	West	3.0948E-008	1.9187E-008	
Rb-87 (Details)	4.8200E+010	A	55-Ton Cask	NRF	3	West	1.6433E-007	1.0867E-007	
Th-232 (Details)	7.8900E+003	A	55-Ton Cask	NRF	3	West	2.8388E-008	2.3564E-009	
Th-232 (Details)	1.4000E+010	A	55-Ton Cask	NRF	3	West	5.0129E-008	1.5020E-008	
U-234 (Details)	2.8900E+005	B	55-Ton Cask	NRF	3	West	2.8585E-005	4.7781E-007	2.2307E-006
U-238 (Details)	3.3400E+007	B	55-Ton Cask	NRF	3	West	7.3195E-007	5.2607E-009	7.3195E-007

Canister Specific Test Details

Note: Tests 11-13 are canister specific.

11. Administrative 10% Canister Inventory Check (Canister Specific)						
Nuclide	Form	Generator	Vault	Array	Amount (Ci)	PA Inv (Ci)
Cs-137	B	NRF	55-Ton Cask	3	2.1028E-002	5.9179E-002
Np-237	B	NRF	55-Ton Cask	3	2.5949E-007	3.3543E-009
Pu-240	B	NRF	55-Ton Cask	3	1.3415E-005	6.2158E-005
Rb-87	B	NRF	55-Ton Cask	3	2.8571E-002	5.9832E-002
U-234	B	NRF	55-Ton Cask	3	2.2307E-006	4.7781E-007

12. PA Unanalyzed Nuclides with a half-life > 1 year (Canister Specific)				
Nuclide	Form	Generator	Array	Amount (Ci)
Eu-152	B	NRF	3	1.0434E-006
Eu-154	B	NRF	3	2.6795E-004
Eu-155	B	NRF	3	5.9189E-005
H-3	B	NRF	3	5.8430E-005
Ra-226	B	NRF	3	2.5971E-013
Rm-147	B	NRF	3	2.3060E-015
Rm-151	B	NRF	3	5.5223E-003
Th-230	B	NRF	3	7.9642E-008
Th-232	B	NRF	3	7.9080E-013
Th-230	B	NRF	3	5.5827E-014

12. Non-System/Non-Exempt Nuclides (Canister Specific)				
Nuclide	Form	Generator	Array	Amount (Ci)
Nb-144	B	NRF	3	3.0200E-024
Nb-144	B	NRF	3	1.6544E-023

Figure 1. PA Check output screen from RHINO for waste canister ECF-05-18-120.

PA Check 9

Waste canister ECF-05-18-120 contains six radionuclides whose cumulative inventories (includes placed canisters + the proposed canister) exceed the PA base-case inventories for this generator (NRF), canister type (55-Ton) and waste form (combined activated metals with surface contaminated debris) (see Figure 1). Of the six radionuclides, four (Cm-245, Cm-246, Pu-238, and U-236) are considered "non-key" radionuclides because they were screened out of the all-pathways dose calculation during preparation of the PA. The cumulative inventories of these radionuclides will be evaluated to determine if the increased inventory (above the PA base case) would have resulted in the radionuclides not being screened out during preparation of the PA. The two key radionuclides (Np-237 and U-234) are evaluated under PA Check 10 (see below). Radionuclides that were flagged by PA Checks 9 and 10 that are not in canister ECF-05-18-120 (see Figure 1, last column of PA Checks 9 & 10, Canister Contribution = 0) were evaluated under a previous UDQE and do not need to be evaluated here.

The four non-key radionuclides were screened out during the Phase II and III screenings during preparation of the PA. Table 1 shows that the new cumulative inventories would still be screened out using the Phase II and III screening criteria of the PA. This was done by calculating the cumulative inventory of each radionuclide as a percentage of the maximum allowable inventory allowed by the PA Phase II and III screenings. For this calculation the inventory of all placed canisters plus the proposed canister (ECF-05-18-120) was added to the total PA base case inventory. This is conservative because the PA base case inventories include some of the inventory in the placed and proposed canisters. The screenings are done on the total facility inventory and are independent of generator, canister type and waste form.

The maximum allowable inventory allowed by the Phase II screening ($I_{max_{II_i}}$) was calculated using the following equation:

$$I_{max_{II_i}} \left(\frac{Ci}{yr} \right) = \frac{0.4 \left(\frac{mrem}{yr} \right)}{NCRP \text{ Screening Dose}_i \left(\frac{mrem}{Ci} \right)} \quad (\text{Equation 1})$$

where:

0.4 mrem/yr = PA Phase II screening dose standard (1/10th the allowable 40 CFR 141 drinking water dose for beta-gamma emitters). This assumes the entire inventory is leached from the source in one year.

NCRP Screening Dose Factor (mrem/Ci) (see DOE-ID 2018, Table 2-26).

The maximum allowable inventory allowed by the Phase III screening ($I_{max_{III_i}}$) was calculated using the following equation:

$$I_{max_{III_i}} (Ci) = 0.4 \left(\frac{mrem}{yr} \right) \times \frac{I_{PA_i} (Ci)}{D_{III_i} \left(\frac{mrem}{yr} \right)} \quad (\text{Equation 2})$$

where:

0.4 mrem/yr = PA Phase III screening dose standard (1/10th the allowable 40 CFR 141 drinking water dose for beta-gamma emitters)

I_{PA_i} = total PA base case inventory of radionuclide i (see DOE-ID 2018, Table 2-29)

D_{III_i} = PA Phase III screening dose for radionuclide i based on total PA base case inventory of radionuclide i .

Table 1 shows that even when the projected cumulative inventory after placement of ECF-05-18-120 (column 3) and the total PA base case inventory (column 4) are conservatively summed together for each radionuclide, the totals (column 5) are fractions (column 8) of the maximum allowable Phase II and Phase

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III screening inventories (column 7) and would still be screened out. Therefore, the inventories of the non-key radionuclides in canister ECF-05-18-120 are within the bounds of the PA.

Table 1. Comparison of non-key radionuclide inventories to maximum allowable screening inventories.

1	2	3	4	5	6	7	8
Radionuclides Screened During PA Phase II Screening							
Non-Key Radionuclide	Canister ECF-05-18-120 Inventory (Ci) ^a	Projected Cumulative Inventory (Placed + ECF-05-18-120) (Ci) ^b	Total PA Base Case Inventory (All Generators, Canisters, Waste Forms) (Ci) ^c	Projected Cumulative Inventory after Placement of ECF-05-18-120 + Total PA Base Case Inventory (Cols 3+4) (Ci)	PA Phase II NCRP Screening Factor (mrem/Ci) ^d	Max Allowable Phase II Screening Inventory (Ci/yr) ^e	PA Base Case + Projected Cumulative Inventory after Placement of ECF-05-18-120 as % of Max Allowable Phase II Screening Inventory
Cm-245	1.22E-07	1.24E-07	5.28E-07	6.52E-07	6.29E+04	6.36E-06	10.2% ^h
Cm-246	5.00E-08	5.05E-08	3.52E-07	4.02E-07	3.00E+04	1.33E-05	3.02%
Radionuclides Screened During PA Phase III Screening							
Non-Key Radionuclide	Canister ECF-05-18-120 Inventory (Ci) ^a	Projected Cumulative Inventory (Placed + ECF-05-18-120) (Ci) ^b	Total PA Base Case Inventory (All Generators, Canisters, Waste Forms) (Ci) ^c	Projected Cumulative Inventory after Placement of ECF-05-18-120 + Total PA Base Case Inventory (Cols 3+4) (Ci)	PA Phase III Dose (mrem/yr) ^f	Max Allowable Phase III Screening Inventory (Ci/yr) ^g	PA Base Case + Projected Cumulative Inventory after Placement of ECF-05-18-120 as % of Max Allowable Phase III Screening Inventory
Pu-238	6.59E-04	6.73E-04	3.68E-01	3.69E-01	2.57E-02	5.73E+00	6.44% ⁱ
U-236	7.32E-07	7.32E-07	5.88E-05	5.95E-05	1.04E-02	2.26E-03	2.63%

a. Inventory of activated metal and surface contaminated debris in the proposed canister (see Figure 1).

b. Placed inventory includes canisters placed as of 9/7/2023 (see Figure 1).

c. Table 2-14, RHLLW Performance Assessment (DOE-ID 2018).

d. Table 2-26, RHLLW Performance Assessment (DOE-ID 2018).

e. $I_{max,II}$ from Equation 1 above.

f. Table 2-29, RHLLW Performance Assessment (DOE-ID 2018). Doses < 1E-40 mrem/yr are assumed = 1E-40 mrem/yr.

g. $I_{max,III}$ from Equation 2 above.

h. Although the projected cumulative inventory of Cm-245 after placement + the total PA base case inventory is 10.2% of the maximum allowable Phase II screening inventory, 8.30% is due to the PA base case inventory.

i. Although the projected cumulative inventory of Pu-238 after placement + the total PA base case inventory is 6.44% of the maximum allowable Phase III screening inventory, this percentage is due mostly to the PA base case inventory.

PA Check 10

Canister ECF-05-18-120 contains two key radionuclides (Np-237 and U-234) whose cumulative inventory (includes placed + proposed canisters) exceeds the PA base-case inventory for this generator (NRF), canister type (55-Ton) and waste form (combined activated metals with surface contaminated debris) (see Figure 1). These key radionuclides were not screened out during preparation of the PA and their contributions are included in the RHINO all-pathway dose calculation and other performance measures.

It is allowable for the proposed cumulative inventory of a radionuclide to exceed the PA base-case inventory for a specific generator/canister/waste form so long as the impact of the proposed cumulative inventory is within the bounds of the PA. This is demonstrated by calculating the projected impacts on PA performance measures from placement of the proposed canister. Table 2 shows the impact on PA performance measures from placement of canister ECF-05-18-120. The projected all-pathway dose after disposal of canister ECF-05-18-120 would increase less than 0.01% for the compliance period and 0.07% for the post-compliance period. These are very small increases and the all-pathways dose after disposal of ECF-05-18-120 is significantly less than the PA limit of 25 mrem/yr from DOE Order 435.1-1. The increases in other performance measures are also very small with the exception of the post-compliance period gross alpha concentration increase (9.32%), and the air-pathway dose increase (11.5%). However, the values after placement of canister ECF-05-18-120 are very small and far below the PA limits. Additionally, the increase in the air pathway dose is due to other radionuclides (C-14, H-3, and I-129)

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whose cumulative inventories are less than the PA base case values. Thus, this evaluation shows that although the cumulative inventories of Np-237 and U-234 would exceed the PA base case inventory for this generator/canister/waste form, the total inventory after disposal of canister ECF-05-18-120 is within the bounds of the PA.

Table 2. Impact on performance measures from placement of canister ECF-05-18-120.

1	2	3	4	5	6	7	8	9
Performance Measure	Period	Units	Project Limit	PA Limit	Contribution of Placed Canisters ^a	Contribution of Proposed Canister ECF-05-18-120	Contribution of Placed Canisters + Proposed Canister ECF-05-18-120 (Col 6 + Col 7)	Percent Increase in Performance Measure from Placement of Canister ECF-05-18-120 (Col 8/Col 6)
All Pathways Dose	Compliance	mrem/yr	1	25	1.2759E-04	1.0565E-13	1.2759E-04	<0.01%
All Pathways Dose	Post Compliance	mrem/yr	12.5	25	7.4297E-02	5.4775E-05	7.4352E-02	0.07%
Beta-Gamma DE	Compliance	mrem/yr	0.16	4	9.0622E-05	7.5008E-14	9.0622E-05	<0.01%
Beta-Gamma DE	Post Compliance	mrem/yr	2.4	4	5.2743E-02	1.8824E-05	5.2762E-02	0.04%
Ra-226/228 Concentration	Compliance	pCi/L	0.2	0.2	2.1749E-32	7.5211E-39	2.1749E-32	<0.01%
Ra-226/228 Concentration	Post Compliance	pCi/L	2.5	2.5	2.0304E-06	3.1659E-08	2.0621E-06	1.56%
Gross Alpha Concentration	Compliance	pCi/L	0.6	15	4.5198E-30	1.4903E-36	4.5198E-30	<0.01%
Gross Alpha Concentration	Post Compliance	pCi/L	7.5	15	6.3342E-06	5.9045E-07	6.9247E-06	9.32%
Beta-Gamma ED	Compliance	mrem/yr	0.16	4	4.9580E-05	4.1038E-14	4.9580E-05	<0.01%
Beta-Gamma ED	Post Compliance	mrem/yr	2	4	2.8857E-02	1.5965E-05	2.8873E-02	0.06%
Uranium Concentration	Compliance	ug/L	1.2	30	8.7798E-28	1.4754E-34	8.7798E-28	<0.01%
Uranium Concentration	Post Compliance	ug/L	15	30	1.6714E-05	3.0249E-08	1.6744E-05	0.18%
Intruder Dose	Compliance	mrem/yr	20	100	1.3530E-01	7.6997E-04	1.3607E-01	0.57%
Air Pathway Dose	Compliance	mrem/yr	0.4	10	5.7829E-05	6.6495E-06	6.4479E-05	11.50%

a. Numbers in this column may be slightly different from those shown in Figure 1. The numbers in Figure 1 show the contribution of canisters placed as of 9/7/23 plus the proposed canister. The numbers in this column include the contribution of canisters placed since 9/7/2023 (Canister MFC170303, placed 9/19/23) and do not include the proposed canister.

PA Check 11

Figure 1 shows PA Check 11 was flagged by RHINO because the surface contamination (SC) inventory of five radionuclides (Cs-137, Np-237, Pu-240, Sr-90, and U-234) in waste canister ECF-05-18-120 exceeds 10% of the respective base case inventories evaluated in the PA as SC in 55-Ton waste canisters from NRF. This check is only performed for key radionuclides. Np-237, Pu-240, and U-234 are key radionuclides in the PA for the groundwater pathway. Cs-137 and Sr-90 are key radionuclides for the intruder pathway. If a key radionuclide activity in a waste canister exceeds a 10% threshold activity level for that generator, canister type, and waste stream, the canister is flagged for further review according to the change control process to determine if the radionuclide inventory in the container being evaluated is an anomalous occurrence or indicative of a change in waste generation rates. The canister was also evaluated to determine if the inventories of the five radionuclides are within the bounds of the PA.

Table 3 shows the inventories of the radionuclides in canister ECF-05-18-120 that exceed the 10% criteria. Column 5 shows that while all exceed the 10% criteria, U-234 and Np-237 exceed the total PA base case inventory for this generator/canister/waste form (>100%). While this is high, Table 3 shows the inventories as a percentage of total 20-year base case inventory of SC for all generators are low (0.002 to 1.78%, see Column 7). Therefore, the inventory of the five radionuclides as SC in canister ECF-05-18-120 are well within the bounds of the PA.

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
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1	2	3	4	5	6	7
Nuclide	Waste Form ^a	Canister ECF-05-18-120 SC Inventory (Ci)	PA 20-yr Base Case Inventory for SC in NRF 55-Ton Canisters (Ci)	Canister ECF-05-18-120 Inventory as % of PA 20-yr Base Case Inventory for SC in NRF 55-Ton Canisters (Col 3/Col 4) ^b	PA 20-yr Base Case SC Inventory for RHLLW Facility (Ci)	Canister ECF-05-18-120 Inventory as % of PA 20-yr Base Case SC Inventory for RHLLW Facility (Col 3/Col 6)
Cs-137	SC	2.10E-02	6.92E-02	30.4%	9.18E+02	0.002%
Np-237	SC	2.59E-07	3.35E-09	7736%	5.82E-04	0.045%
Pu-240	SC	1.34E-05	6.22E-05	21.6%	2.28E-03	0.588%
Sr-90	SC	2.86E-02	6.98E-02	40.9%	6.42E+02	0.004%
U-234	SC	2.23E-06	4.78E-07	467%	1.25E-04	1.78%

a. SC = surface contamination.

b. Radionuclide flagged by RHINO because percentage exceeds 10%.

To determine if the inventories of the five key radionuclides are anomalous compared to other 55-Ton canisters, Table 4 compared the inventories in canister ECF-05-18-120 to the total inventories as SC in the five 55-Ton canisters placed at the facility. Because the percentages in Column 5 are high (86% to 111,007%), the inventories in canister ECF-05-18-120 seem anomalous compared to 55-Ton canisters previously placed at the facility. Continued tracking is recommended to see if this continues to be the case.

Table 4. Radionuclide inventories in canister ECF-05-18-120 that exceed the 10% criteria for SC in NRF 55-Ton canisters compared to SC inventories in all previously placed 55-Ton canisters.

1	2	3	4	5
Nuclide	Waste Form	Canister ECF-05-18-120 SC Inventory (Ci)	SC Inventory in Previously Placed NRF 55-Ton Canisters (Ci)	Canister ECF-05-18-120 Inventory as % of SC in Previously Placed NRF 55-Ton Canisters (Col 3/Col 4)
Cs-137	SC	2.10E-02	2.45E-02	86%
Np-237	SC	2.59E-07	2.34E-10	111,007%
Pu-240	SC	1.34E-05	1.22E-06	1,099%
Sr-90	SC	2.86E-02	1.38E-03	2,064%
U-234	SC	2.23E-06	1.49E-08	14,970%

PA Check 12**Unanalyzed Radionuclides with Half-lives Greater than 1 Year**

Figure 1 shows waste canister ECF-05-18-120 contains 10 unanalyzed radionuclides with half-lives greater than one year. These radionuclides for this generator (NRF), canister type (55-Ton) and waste forms were not reported in the PA base-case inventory and were not analyzed in the PA [see appropriate table in Appendix B of the WAC (PLN-5546) for list of analyzed radionuclides]. Therefore, they must be analyzed to confirm the inventories are within the bounds of the PA.

The individual inventories of these 10 radionuclides (see Figure 1) when compared to the total canister inventory of 1,018 Ci show they are much less than 1%. Therefore, the inventory of these radionuclides are not reportable according to the WAC and should not impact the PA. To confirm this, the canister inventories were compared to the total PA base-case inventories of all waste forms. Table 5 shows that all 10 radionuclides were reported in other generators waste (Column 5). Column 6 shows the canister

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inventories of the unanalyzed radionuclides are small fractions of the total PA base-case inventory (Column 2 ÷ Column 5). This confirms that the unanalyzed radionuclides in canister ECF-05-18-120 are within the bounds of the PA.

Table 5. Unanalyzed radionuclides in waste canister ECF-05-18-120 with half-lives greater than one year.

1	2	3	4	5	6
Radionuclide	Canister ECF-05-18-120 Inventory (Ci)	Waste Form ^a	Radionuclide Inventory as % of Total Canister ECF-05-18-120 Inventory (Col 2/1,018) (Ci) ^b	Total PA Base-Case Inventory, All Waste Forms (Ci) ^c	Canister ECF-05-18-120 Inventory as % of Total PA Base Case Inventory, All Waste Forms (Col 2/Col 5)
Eu-152	1.0434E-06	SC	1.0248E-06	4.14E+00	2.52E-05%
Eu-154	2.4095E-04	SC	2.3665E-04	1.56E+01	1.54E-03%
Eu-155	6.8189E-05	SC	6.6971E-05	1.65E+00	4.13E-03%
H-3	5.6435E-05	SC	5.5427E-05	1.99E+03	2.84E-06%
Ra-228	2.5971E-13	SC	2.5507E-13	2.28E-07	1.14E-04%
Sm-147	2.3066E-15	SC	2.2654E-15	1.38E-10	1.67E-03%
Sm-151	5.6225E-05	SC	5.5221E-05	5.27E+01	1.07E-04%
Th-228	7.9642E-09	SC	7.8220E-09	2.02E-04	3.94E-03%
Th-229	7.9086E-13	SC	7.7673E-13	5.35E-08	1.48E-03%
Th-230	8.5827E-14	SC	8.4294E-14	4.93E-08	1.74E-04%

a. SC = surface contamination.

b. 1,018 Ci is the total Curie content of all radionuclides in canister ECF-05-18-120.

c. Table 2-14, RHLLW Performance Assessment (DOE-ID 2018), all waste forms.

Non-system Radionuclides

Figure 1 shows waste canister ECF-05-18-120 contains non-system radionuclide Nd-144. Non-system radionuclides are not included in the RHINO database typically because they have very short or very long half-lives. Nd-144 was previously identified in other 55-Ton canisters from NRF. Table 6 shows Nd-144 is listed as both an activated metal (AM) waste form and SC waste form in canister ECF-05-18-120. Nd-144 is a non-system radionuclide because it has a very long half-life and may be considered observationally stable. The long half-life coupled with the very small inventories indicate Nd-144 will not have an impact on the PA.

Table 6. Non-system radionuclides in waste canister ECF-05-18-120.

Radionuclide	Canister ECF-05-18-120 Inventory (Ci)	Waste Form	Half-Life (yr)
Nd-144	3.03E-24	SC	2.29E+15
Nd-144	1.63E-23	AM	2.29E+15

Summary

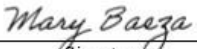
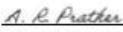



Canister ECF-05-18-120 was flagged by RHINO while performing PA checks during acceptance testing. The radionuclide inventory of waste canister ECF-05-18-120 has been evaluated with respect to potential impacts on the PA. Based on the evaluation, impacts are small and within the bounds of the PA. Therefore, the proposed canister is deemed acceptable for disposal.

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References

- DOE-ID, 2018, "Performance Assessment for the INL Remote-Handled Low-Level Waste Disposal Facility," DOE/ID-11421, Revision 2, U.S. Department of Energy, Idaho Operations Office, February 2018.
- INL, 2018, "Methods, Implementation, and Testing to Support Determination of Performance Assessment Compliance for the RHLLW Disposal Facility WAC," INL/EXT-18-45184, Idaho National Laboratory, June 2018.
- PLN-5446, 2022, "Waste Acceptance Criteria for the Remote-Handled Low-Level Waste Disposal Facility," Revision 2, Idaho National Laboratory, December 2022.

Mary Baeza		9/21/2023
Print/Type Name	Signature	Date
Originator/FDS	Originator/FDS	
A. R. Prather		9/21/23
Print/Type Name	Signature	Date
System Engineer/SE	System Engineer/SE	
A. Jeff Sondrup		09/21/2023
Print/Type Name	Signature	Date
PA/CA SME	PA/CA SME	
Paul A. Velasquez		09/25/2023
Print/Type Name	Signature	Date
Waste Management/WMP	Waste Management/WMP	
Tim Arsenault		9/21/23
Print/Type Name	Signature	Date
Nuclear Facility Manger/NFM	Nuclear Facility Manger/NFM	

**UNREVIEWED DISPOSAL QUESTION SCREENING (UDQS) AND
EVALUATION (UDQE) FORM FOR THE RHLLW DISPOSAL FACILITY**

Section III, Special Analysis, SA (If Required in Section I or II)

PARC Assigned SME: _____

Special Analysis Document Number: _____

Proposed Activity Approved? Yes ☐ No ☐

Comments: _____

_____ Print/Type Name Originator/FDS	_____ Signature Originator/FDS	_____ Date
_____ Print/Type Name System Engineer/SE	_____ Signature System Engineer/SE	_____ Date
_____ Print/Type Name PA/CA SME	_____ Signature PA/CA SME	_____ Date
_____ Print/Type Name Waste Management/WMP	_____ Signature Waste Management/WMP	_____ Date
_____ Print/Type Name Nuclear Facility Manager/NFM	_____ Signature Nuclear Facility Manager/NFM	_____ Date
_____ Print/Type Name DOE/ID Representative	_____ Signature DOE/ID Representative	_____ Date

Appendix B

Compliance and Performance-Monitoring Data for the RHLLW Disposal Facility

Aquifer and lysimeter sampling are conducted according to the facility-monitoring plan (PLN-5501) and the following laboratory instructions:

- LI-849, “Groundwater Monitoring at the Remote-Handled Low-Level Waste Disposal Facility.”
- LI-859, “Sampling Vadose Zone Water at the Remote-Handled Low-Level Waste Disposal Facility.”

FY 2023 aquifer- and lysimeter-sample analysis was performed by GEL Laboratories, LLC, Charleston, South Carolina. Data were validated to Radioanalytical Validation Level B by Analytical Quality Associates, Inc., Albuquerque, New Mexico. Aquifer sample and validation results are documented in the following reports:

- Lab Data Report for Sample Data Group: BEA02-3592-01, Work Order 594084.
- Limitations and Validation Report: AR0023_BEA02-3592-01_LVR for Idaho National Laboratory, Analytical Quality Associates, Albuquerque New Mexico, November 2022.
- Lab Data Report for Sample Data Group: BEA01-4520-01, Work Order 623414.
- Limitations and Validation Report: AR0030_BEA01-4520-01_LVR for Idaho National Laboratory, Analytical Quality Associates, Albuquerque New Mexico, August 2023.
- Lab Data Report for Sample Data Group: BEA01-4520-01RE, Work Order 628269.
- Limitations and Validation Report: AR0031_BEA01-4520-01RE_LVR for Idaho National Laboratory, Analytical Quality Associates, Albuquerque New Mexico, August 2023.
- Lab Data Report for Sample Data Group: BEA01-4524-01, Work Order 623250.
- Limitations and Validation Report: AR0028_BEA01-4524-01_LVR_REV01 for Idaho National Laboratory, Analytical Quality Associates, Albuquerque New Mexico, August 2023.
- Lab Data Report for Sample Data Group: BEA01-4524-01RE, Work Order 628268.
- Limitations and Validation Report: AR0029_BEA01-4524-01RE_LVR for Idaho National Laboratory, Analytical Quality Associates, Albuquerque New Mexico, August 2023.
- Lab Data Report for Sample Data Group: BEA02-4520-01, Work Order 638638.
- Limitations and Validation Report: AR0034_BEA02-4520-01_LVR for Idaho National Laboratory, Analytical Quality Associates, Albuquerque New Mexico, October 2023.

Lysimeter sample results are documented in the following reports:

- Lab Data Report for Sample Data Group: BEA02-3611-05, Work Order 599014.
- Limitations and Validation Report: AR0025_BEA02-3611-05 for Idaho National Laboratory, Analytical Quality Associates, Albuquerque New Mexico, January 2023.
- Lab Data Report for Sample Data Group: BEA01-4256-04, Work Order 598463.
- Limitations and Validation Report AR0024_BEA01-4256-04_LVR for Idaho National Laboratory, Analytical Quality Associates, Albuquerque New Mexico, December 2022.
- Lab Data Report for Sample Data Group: BEA02-4480-01, Work Order 624323.

- Limitations and Validation Report AR0026_BEAO2-4480-01_LVR_REV01 for Idaho National Laboratory, Analytical Quality Associates, Albuquerque New Mexico, August 2023.
- Lab Data Report for Sample Data Group: BEAO2-4478-02_Rev1, Work Order 626746.
- Limitations and Validation Report AR0027_BEAO2-4478-02 for Idaho National Laboratory, Analytical Quality Associates, Albuquerque New Mexico, August 2023.
- Lab Data Report for Sample Data Group: BEAO1-4625-02, Work Order 622597.
- Limitations and Validation Report AR0032_BEAO1-4625-02_LVR for Idaho National Laboratory, Analytical Quality Associates, Albuquerque New Mexico, August 2023.
- Lab Data Report for Sample Data Group: BEAO1-4625-02RE, Work Order 628270.
- Limitations and Validation Report AR0033_BEAO1-4625-02RE_LVR for Idaho National Laboratory, Analytical Quality Associates, Albuquerque New Mexico, August 2023.

All aquifer and lysimeter results are uploaded and maintained in the INL Environmental Data Warehouse. The following Tables and Figures are shown below:

- Table B-1. Aquifer sampling results for RHLLW Disposal Facility compliance monitoring wells for FY 2023.
- Table B-2. Average groundwater concentrations in RHLLW Disposal Facility compliance monitoring wells for FY 2023.
- Table B-3. Average tritium concentration in groundwater in RHLLW Disposal Facility compliance monitoring wells (FY 2019-2023). Data is shown graphically in Figure B-1.
- Table B-4. Summary of RHLLW Disposal Facility lysimeter sampling results for spring 2023.
- Table B-5. Summary of RHLLW Disposal Facility lysimeter sampling results for fall 2022 (FY 2023).
- Figure B-1. Average tritium concentration in groundwater in RHLLW Disposal Facility compliance monitoring wells (FY 2019–2023).

Table B-1. Aquifer sampling results for RHLLW Disposal Facility compliance monitoring wells for FY 2023.

Constituent	Result Type	Date Collected	Concentration (pCi/L)	Uncertainty	Validation Qualifier
Well USGS-136					
Spring 2023					
Gross alpha	Original	5/15/2023	1.30	0.325	—
Gross beta	Original	5/15/2023	1.77	0.171	—
C-14	Original	5/15/2023	2.12	9.59	U
H-3	Original	5/15/2023	583	140	—
I-129	Original	5/15/2023	0.159	0.156	U
Tc-99	Original	5/15/2023	-1.97	9.6	U
Gross alpha	Duplicate	5/15/2023	0.566	0.337	U
Gross beta	Duplicate	5/15/2023	1.54	0.19	—
C-14	Duplicate	5/15/2023	8.13	9.72	U
H-3	Duplicate	5/15/2023	714	151	—
I-129	Duplicate	5/15/2023	0.109	0.247	U
Tc-99	Duplicate	5/15/2023	-22.2	9.15	U
Fall 2023					
Gross alpha	Original	9/18/2023	0.887	0.344	UJ
Gross beta	Original	9/18/2023	1.18	0.227	—
C-14	Original	9/18/2023	5.96	7.54	U
H-3	Original	9/18/2023	748	136	—
I-129	Original	9/18/2023	0.0515	0.0785	U
Tc-99	Original	9/18/2023	-7.47	6.68	U
Well USGS-140					
Spring 2023					
Gross alpha	Original	5/16/2023	0.738	0.458	U
Gross beta	Original	5/16/2023	2.15	0.294	—
C-14	Original	5/16/2023	6.35	9.68	U
H-3	Original	5/16/2023	835	159	—
I-129	Original	5/16/2023	-0.113	0.101	U
Tc-99	Original	5/16/2023	1.46	5.23	U
Fall 2023					
Gross alpha	Original	9/25/2023	1.1	0.409	UJ
Gross beta	Original	9/25/2023	1.47	0.267	—
C-14	Original	9/25/2023	-5.38	7.27	U
H-3	Original	9/25/2023	485	115	—
I-129	Original	9/25/2023	-0.628	0.313	U
Tc-99	Original	9/25/2023	-12.3	6.68	U

Constituent	Result Type	Date Collected	Concentration (pCi/L)	Uncertainty	Validation Qualifier
Well USGS-141					
Spring 2023					
Gross alpha	Original	5/16/2023	-0.0899	0.518	U
Gross beta	Original	5/16/2023	1.69	0.244	—
C-14	Original	5/16/2023	9.11	9.81	U
H-3	Original	5/16/2023	683	147	—
I-129	Original	5/16/2023	0.0444	0.213	U
Tc-99	Original	5/16/2023	-3.01	5	U
Fall 2023					
Gross alpha	Original	9/25/2023	1.31	0.369	—
Gross beta	Original	9/25/2023	1.03	0.179	—
C-14	Original	9/25/2023	6.43	7.63	U
H-3	Original	9/25/2023	561	122	—
I-129	Original	9/25/2023	-0.0481	0.23	U
Tc-99	Original	9/25/2023	-10.3	6.68	U
<p>U = Analyte was analyzed for but not detected above the minimum detectable activity. Results should not be used.</p> <p>UJ = Analyte may or may not be present and the result is considered highly questionable. Results should not be used.</p> <p>Results with no U or UJ flag were statistically positive at the 95% confidence interval and above the minimum detectable concentration. This generally corresponds to the result being greater than three times the measurement uncertainty.</p>					

Table B-2. Average groundwater concentrations in RHLLW Disposal Facility compliance monitoring wells for FY 2023.

Well	Average Sample Result (pCi/L) ^a					
	Gross alpha	Gross beta	C-14	H-3	I-129	Tc-99
USGS-136	1.30	1.50	U	682	U	U
USGS-140	U/UJ	1.81	U	660	U	U
USGS-141	1.31	1.36	U	622	U	U
Action Level ^b	15	50	2,000	20,000	1	900
Regional Background Range ^c	ND - 26.4	0.4 - 43.5	ND - 64.3	ND - 18,800	ND - 0.48	ND - 4.8
<p>U = Analyte was analyzed for but not detected above the minimum detectable activity. Results should not be used.</p> <p>UJ = Analyte may or may not be present and the result is considered highly questionable. Results should not be used.</p> <p>Results with no U or UJ flag were statistically positive at the 95% confidence interval and above the minimum detectable concentration. This generally corresponds to the result being greater than three times the measurement uncertainty (see Table B-1).</p> <p>ND = Non-detect</p> <p>a. Average values do not include U- or UJ-qualified data. Average values include duplicate sample data only if the analyte was detected in both the original and duplicate samples.</p> <p>b. Action levels are MCLs except for gross beta. The MCL for gross alpha does not include radon or uranium. There is no MCL for gross beta and it is not listed in the monitoring plan (PLN-5501) as an action level. 50 pCi/L is a screening level for sensitive drinking water systems based on the EPA Radionuclides Rule, 66 FR 76708 (EPA 2000). Other MCLs are based on a 4 mrem/year critical organ dose for beta/photon emitters.</p> <p>c. <i>Assessment of Aquifer Baseline Conditions at the INL RHLLW Disposal Facility</i> (INL 2017).</p>						

Table B-3. Average tritium concentration in groundwater in RHLLW Disposal Facility compliance monitoring wells (FY 2019–2023). Data is shown graphically in Figure B-1.

Well	Date	Average Tritium Concentration ^a (pCi/L)
USGS-136	10/1/2018	1380
	4/30/2019	1485
	4/27/2020	932
	4/15/2021	916
	4/18/2022	1110
	9/16/2022	535
	5/15/2023	649
	9/18/2023	748
USGS-140	10/1/2018	1490
	4/30/2019	1060
	4/28/2020	964
	4/19/2021	739
	4/19/2022	992
	9/21/2022	842
	5/16/2023	835
	9/25/2023	485
USGS-141	10/1/2018	1140
	4/30/2019	1520
	4/28/2020	815
	4/19/2021	608
	4/19/2022	825
	9/21/2022	874
	5/16/2023	683
	9/25/2023	561
a. Average values include duplicate sample data only if the analyte was detected in both the original and duplicate samples.		

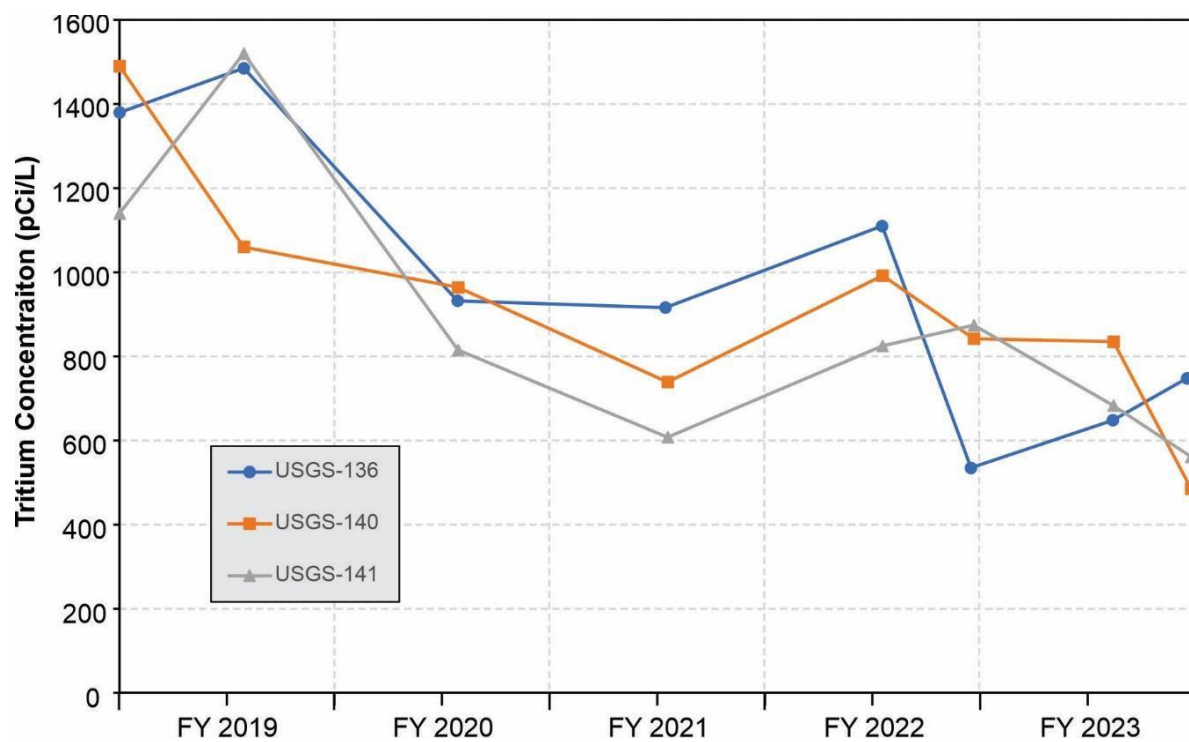


Figure B-1. Average tritium concentration in groundwater in RHLLW Disposal Facility compliance-monitoring wells (FY 2019–2023).

Table B-4. Summary of RHLLW Disposal Facility lysimeter-sampling results for spring 2023.

Table D-1. Summary of KLEW Disposal Facility Lysimeter Sampling Results for Spring 2023.							
Lysimeter	Total Sample Volume (mL)	Sample Result (pCi/L)					
		Gross alpha	Gross beta	C-14	H-3	I-129	Tc-99
Shallow-Alluvium Lysimeters (26–29 ft below land surface)							
PA-North	599 ^a	12.9	8.28	-54.5 U	182 U	1.27 U	6.19 U
PA-South	361	5.04	3.74	---	231	---	---
NuPac-West	1091 ^b	1.32 UJ (1.97)	0.836 (1.42)	0.679 U	228 J	-2.03 U	5.47 U (12.7 U)
NuPac-East	997 ^b	1.78 (4.43)	2.33 (2.78)	5.45 U	-11.7 U	-1.28 U	-7.86 U
55-ton-South	642 ^a	1.37 U	1.58	-21.1 U	79.1 U	1.02 U	3.51 U
HFEF-South	594 ^a	2.63	3.2	-51.3 U	4350	0.167 U	-2.81 U
LCC-West	505	3.2	1.7	1.84 U	427	-0.539 U	--
LCC-East	727 ^a	0.653 U	1.79	7.85 U	96.5 U	2.35 U	3.63 U
MFTC-West	960 ^b	2.95	1.37	-3.53 U (10.7 U)	268	0.054 U	10.8 U (5.83 U)
MFTC-East	1036 ^b	1.8 (1.24 UJ)	2.56 (1.51)	13 U	188 UJ (94.4 U)	-0.218 U	4.03 U
Deep-Alluvium Lysimeters (40–44 ft below land surface)							
HFEF-South-45	161 ^c	14.0	6.36	-18.8 U	728	-0.0428 U	9.1 U
LCC-West-45	229 ^c						
LCC-East-45	75 ^c						
NuPac-West-45	40 ^c						
NuPac-East-45	36 ^c						
55-ton-South-45	33 ^c						
MFTC-West-45	30 ^c						
MFTC-East-45	23 ^c						
Sedimentary-Interbed Lysimeters (170–176 ft below land surface)							
NuPac-SIW	91	---	---	---	49.5 U	---	---
MFTC-West-SIW	219	7.62	8.26	---	---	---	---
MFTC-East-SIW	1080 ^b	2.38 (1.71)	2.02 (2.54)	2.61 U	-6.61 U (-93.4 U)	-0.239 U	3.64 U
Action Level ^d or MCL ^e		10 ^d	40 ^d	2000 ^e	20,000 ^e	1 ^e	900 ^e
<p>a. Sample volume sufficient for full suite of analytes.</p> <p>b. Sample volume sufficient for full suite of analytes and duplicates (Dup) of some analytes. Duplicate results are shown in parentheses.</p> <p>c. Sample volumes from eight lysimeters combined into single sample volume (627 ml) for analysis.</p> <p>d. Action levels (PLN-5501) are only defined for gross alpha and gross beta.</p> <p>e. Federal drinking-water MCLs are not action levels and do not apply to lysimeter samples. They are provided for comparison and informational purposes only.</p> <p>--- Indicates sample volume was insufficient for analysis.</p> <p>U = Radionuclide is not considered to be present in the sample.</p> <p>UJ = Radionuclide may or may not be present in the sample and the sample result is considered highly questionable.</p> <p>J = Radionuclide is considered present in the sample, but the sample result is questionable.</p> <p>Results with no U or UJ flag were statistically positive at the 95% confidence interval and above the minimum detectable concentration. This generally corresponds to the result being greater than 3 times the measurement uncertainty.</p> <p>BOLD font indicates result above action level (see footnote d).</p>							

Table B-5. Summary of RHLLW Disposal Facility lysimeter-sampling results for fall 2022 (FY 2023).

Table D-3. Summary of RLEEW Disposal Facility Lysimeter Sampling Results for Fall 2022 (F1 2023).							
Lysimeter	Total Sample Volume (mL) ^a	Sample Result (pCi/L)					
		Gross alpha	Gross beta	C-14	H-3	I-129	Tc-99
Shallow-Alluvium Lysimeters (26–29 ft below land surface)							
PA-North	421	---	---	5.48 U	655	-1.01 U	-21.7 U
PA-South	200	---	---	6.4 U	759	---	---
NuPac-West	885	3.07	2.43	-20.4 U	23.1 U	0.326 U	-12.5 U
NuPac-East	661	0.419 U	3.77	-4.19 U	276 UJ	-1.31 U	-4.87 U
55-ton-South	527	4.66	2.59	---	-14.6 U	2.18 U	-20.2 U
HFEF-South	308	---	---	12.4 U	20300	0.254 U	---
LCC-West	220	---	---	---	778	0.104 U	---
LCC-East	666	2.52	3.38	5.22 U	180 U	0 U	-3.84 U
MFTC-West	831	2.33	2.12	-1.86 U	56.1 U	-1.24 U	0.462 U
MFTC-East	912	2.19	4.71	5.25 U	9.83 U	0.00679 U	-21.1 U (-13.8 U)
Deep-Alluvium Lysimeters (40–44 ft below land surface)							
HFEF-South-45	85	---	---	---	440	---	---
LCC-West-45	125	---	---	---	533	---	---
LCC-East-45	48 ^d	---	---	---	328 UJ	---	-10.9 U
Nupac-West-45	21 ^d						
Nupac-East-45	24 ^d						
55-ton-South-45	32 ^d						
MFTC-West-45	21 ^d						
MFTC-East-45	12 ^d						
Sedimentary-Interbed Lysimeters (170–176 ft below land surface)							
NuPac-SIW	39						
MFTC-West-SIW	115	---	---	---	147 U	---	---
MFTC-East-SIW	1050	1.21 UJ (2.03 J)	1.44 (2.12)	7.32 U	-47.9 U	0.565 U	-17.5 U
Action Level ^b or MCL ^c		10 ^b	40 ^b	2000 ^c	20,000 ^c	1 ^c	900 ^c
<p>a. Samples collected in the fall are from a limited set of six lysimeters and analyzed for tritium. Tritium analysis requires approximately 50 ml. Additional sample volume was analyzed for non-tritium target analytes and were selected based on available volume and data needs for establishing baseline concentrations.</p> <p>b. Action levels (PLN-5501) are only defined for gross alpha and gross beta.</p> <p>c. Federal drinking-water MCLs are not action levels and do not apply to lysimeter samples. They are provided for comparison and informational purposes only.</p> <p>d. Sample volumes from six lysimeters combined into single sample volume (158 ml) for analysis.</p> <p>--- Indicates sample volume was insufficient for analysis. A blank cell shaded gray indicates no attempt was made to collect a sample.</p> <p>U = Radionuclide is not considered to be present in the sample. Sample result is not included.</p> <p>UJ = Radionuclide may or may not be present in the sample and the sample result (not included) is considered highly questionable.</p> <p>J = Radionuclide is considered present in the sample, but the sample result is questionable.</p> <p>Results with no U or UJ flag were statistically positive at the 95% confidence interval and above the minimum detectable concentration. This generally corresponds to the result being greater than 3 times the measurement uncertainty.</p> <p>BOLD font indicates result above action level (see footnote b).</p>							