INL/RPT-22-65681

Annual Summary Report for the Remote-Handled Low-Level Waste Disposal Facility—FY 2021

July 2022

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EXECUTIVE SUMMARY

This Fiscal Year (FY) 2021 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 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 2021, 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. Sixteen waste canister shipments were received at the RHLLW Disposal Facility, and 16 waste canisters were emplaced.

Except for the PA/CA maintenance plan (PLN-3368), there were no updates to the PA, CA, ODAS, radioactive-waste-management basis (RWMB) or other technical-basis documents in FY 2021. The update of PLN-3368 is discussed in Section 2.9.2 (see also Table 2, UDQE-RHLLW-037). The current revisions of the documents as of FY 2021 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
- "Maintenance Plan for the Remote-Handled Low-Level Waste Disposal Facility Performance Assessment and Composite Analysis," PLN-3368, Revision 3
- "Monitoring Plan for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility," PLN-5501, Revision 2
- "Preliminary Closure Plan for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility," PLN-3370, Revision 0
- "Addendum to the Preliminary Closure Plan for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility," PLN-5503, Revision 0
- "Waste Acceptance Criteria for the Remote-Handled Low-Level Waste Disposal Facility," PLN-5446, Revision 1
- "DOE Order 435.1 Documentation Change Control Process for the RHLLW Disposal Facility," standing directive (SD)-52.1.4, 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 2021, routine PA and CA maintenance activities remained unchanged in accordance with PLN-3368, the PA/CA maintenance plan, and PLN-5501, the facility-monitoring plan. No new activities or information were identified in FY 2021 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 (UDQS/UDQE) process, as detailed in SD-52.1.4, "DOE Order 435.1 Documentation Change Control Process for the RHLLW Disposal Facility." Work was performed on 13 potential changes in FY 2021. No special analyses were required or performed, and no impacts to the PA, CA, ODAS, or RWMB were identified as a result of the evaluations that have been completed and approved.

Waste Receipts

The only waste streams approved for shipment to the RHLLW Disposal Facility in FY 2021 were activated metals and surface-contaminated debris in Hot Fuel Examination Facility (HFEF)-5 canisters from the Materials and Fuels Complex (MFC). Sixteen HFEF-5 waste canisters were shipped to the facility and disposed of in the HFEF vault array in FY 2021. A total of forty-five HFEF-5 canisters from MFC have been received and disposed of at RHLLW Disposal Facility. This leaves space for 135 additional canisters of this type. No other vault arrays received waste, and the facility is at 4.8% of capacity based on 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 the 16 waste canisters placed in FY 2021, 22 radionuclides were reported in activated metals and 70 radionuclides were reported as surface contamination. Ten radionuclides were reported as both activated metal and surface contamination. Of the 14 radionuclides fully analyzed in the PA for the groundwater (all-pathway) dose, only Cl-36 and I-129 were not reported. All five radionuclides that contribute to the PA intruder-pathway dose were reported. Of the three radionuclides that contribute to the PA air-pathway dose, two (C-14 and H-3) were reported. Radionuclides reported that contribute to the PA beta-gamma dose equivalent, or the beta-gamma effective dose include C-14, H-3, Mo-93, Nb-94, Ni-59, and Tc-99.

[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."

The cumulative inventory of radionuclides disposed of is approximately as expected or less than expected for all but two of 14 groundwater-pathway radionuclides for each waste stream. Np-237 and Pu-240 as surface contamination in three HFEF-5 waste canisters disposed of to date is higher than projected for the PA. Because of this apparent discrepancy, the inventory projections of new-generation waste from MFC will being evaluated in FY 2022.

Facility performance was calculated and tracked using RHINO. The calculated maximum dose and concentration performance measures from the 16 waste canisters disposed of in FY 2021 are an insignificant fraction of the applicable performance objectives, and the impact of disposals is consistent with 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 and 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 2021 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 inspection revealed damage to three vault shield plugs. The damage is relatively minor, and repairs will be completed in FY 2022. 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 2021 in accordance with PLN-5501, “Monitoring Plan for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility.” Compliance monitoring consists of annual sampling of three aquifer wells (one upgradient, two downgradient) near the facility. Samples were analyzed for indicator analytes gross alpha and gross beta, and for target analytes C-14, H-3, I-129, and Tc-99. H-3 and gross beta were positively detected in all three aquifer wells, while gross alpha was positively detected in one of the three 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 and below the base of the vault arrays. Samples were analyzed for the same target and indicator analytes as the aquifer samples (gross alpha, gross beta, H-3, C-14, I-129, and Tc-99) according to sample availability. Sampling was conducted in the spring on several occasions in order to extract enough porewater for analysis of the full suite of analytes. In general, sample collection from the lysimeters was moderately successful in terms of sample recovery. Sample collection from shallow-alluvium lysimeters was reasonably good, while sample collection from deep-alluvium lysimeters continued to be problematic.

All performance monitoring sample results were less than action levels with one exception. The porewater sample from shallow-alluvium lysimeter PA-North slightly exceeded the gross-alpha action level of 10 pCi/L. This is consistent with

results from the previous 2 years. Although action levels are only defined for gross alpha and gross beta, the tritium concentration in HFEF-South exceeded the federal drinking water maximum contaminant level (MCL) and Idaho groundwater quality standard of 20,000 pCi/L both in the fall 2020 (37,300 pCi/L) and spring 2021 (34,100 pCi/L). The monitoring plan states that if gross alpha or gross beta action levels are exceeded, lysimeter samples will be analyzed for target analytes and the results will be trended and compared to MCLs. The tritium results for HFEF-South in FY 2021 are less than the than the 47,100 pCi/L result from spring 2020 and exhibit a downward trend since that result. An evaluation prompted by the high tritium concentrations in lysimeter HFEF-South determined small amounts of tritium (well below established limits) present on the exteriors of some waste containers offers a plausible explanation for the elevated concentration. The evaluation also determined the current levels of tritium detected in lysimeter HFEF-South represent an insignificant impact to the aquifer and health risk to the public. The evaluation recommended continued semi-annual sampling for tritium in selected lysimeters.

Design, Operations, and Closure Conditions

During FY 2021, there were no changes in the design, construction, or operation of the RHLLW Disposal Facility.

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.

Special Analyses

No UDQEs were evaluated as requiring a special analysis; therefore, no special analyses were required or prepared. The waste-acceptance criteria allow for special-case disposals on a case-by-case basis after a documented request for deviation and subsequent approval of a special analysis. However, no special-case disposals were performed or are anticipated as of this ASR.

Research and Development Activities

No research and development activities were conducted at the RHLLW Disposal Facility in FY 2021.

Planned or Contemplated Changes

The only planned change is revision of the change-control process document to include mandatory screenings of RHINO software-change requests (SCRs). However, the RHLLW Disposal Facility is anticipating the receipt of activated metal waste from the ATR Complex and NRF to commence in FY 2022. Disposal of these waste streams is not considered a change, but involves the disposal of waste canisters not previously disposed of in vaults that have not yet received waste. In preparation, generator certification will be conducted in FY 2022, and operational readiness activities are scheduled at the RHLLW Disposal Facility. An evaluation of 3 years of baseline monitoring data will be conducted in FY 2022 with recommendations on future sampling.

No changes are planned or contemplated for facility design, construction, operations, 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.

CONTENTS

FIGURES

TABLES

ACRONYMS

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
ECAR	Engineering Calculations and Analysis Report
ED	effective dose
EPA	Environmental Protection Agency
FCF	Fuel Conditioning Facility
FE	facility evaluation
FY	fiscal year
HFEF	Hot Fuel Examination Facility
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology Center
IWTS	Integrated Waste Tracking Software
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
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NRF	Naval Reactors Facility
NSFH	Naval Spent Fuel Handling
ODAS	operating disposal-authorization statement
PA	performance assessment
PM	preventative maintenance
RH	remote handled
RHINO	Remote-Handled Low-Level Waste Disposal Facility Inventory Online
RSWF	Radioactive Scrap and Waste Facility

RWMB	radioactive-waste-management basis
SCR	software-change request
SD	standing directive
TRU	transuranic
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 2021

1. INTRODUCTION

The U.S. Department of Energy (DOE) requires the performance assessment (PA) (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 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 2021, 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 2021 annual summary report (ASR) determines and 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.

[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.

1.1 Site and Facility Background

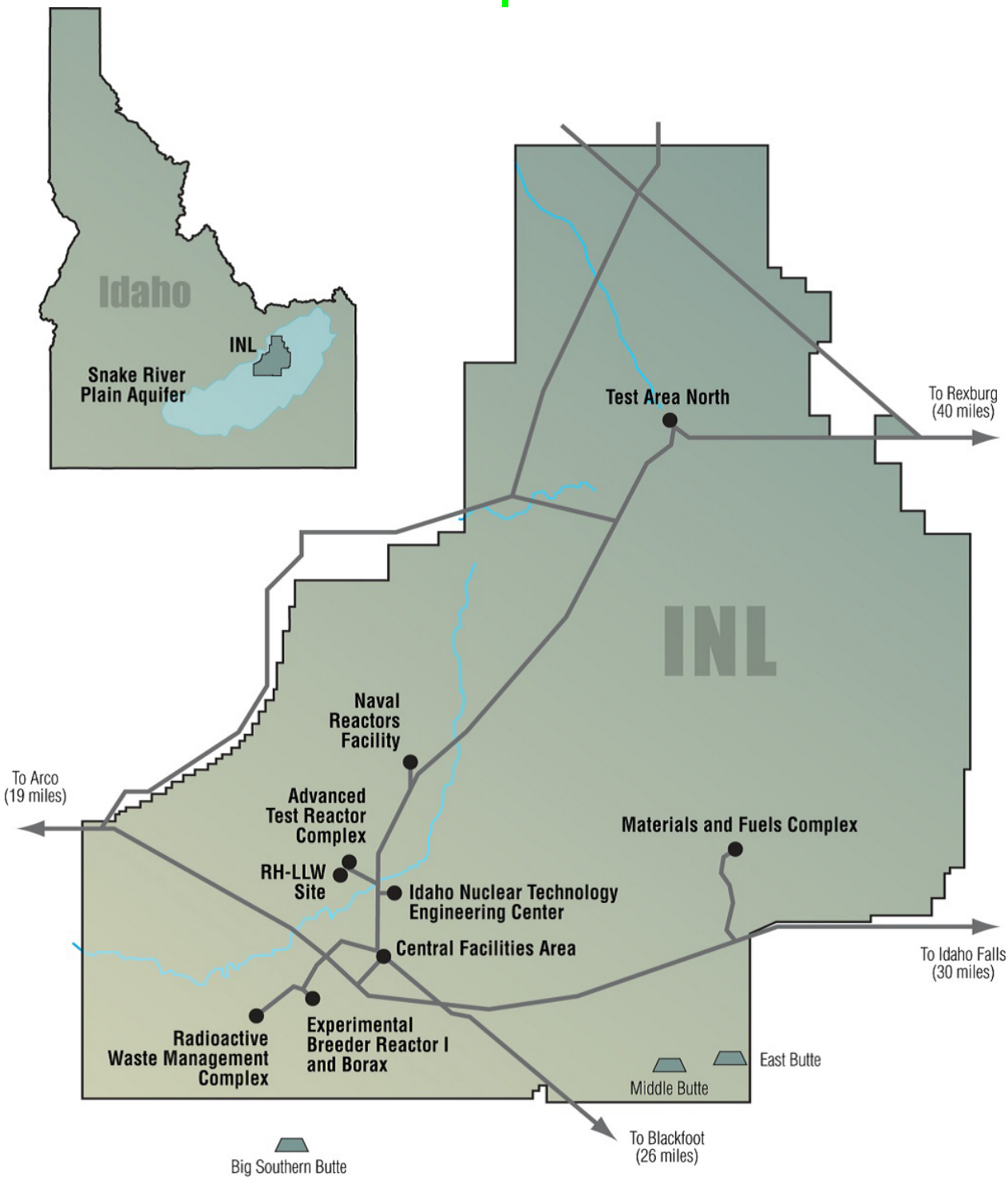

Figure 1. Map of INL Site showing the locations of major facilities including the RHLLW Disposal Facility.

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

Table 1. Waste cask/canister systems planned for disposal 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	Array 2 (LCC Vaults)
NRF	55-ton Scrap Cask/Canisters	Ion-Exchange Resins/Activated Metals	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[d]	Activated Metals	Array 2 (HFEF Vaults)
MFC	Hot Fuel Examination Facility (HFEF)-5 Cask/Canisters	Activated Metals/Debris	Array 2 (HFEF Vaults)

[d] During facility design and construction, ATR-canal waste was described as being handled using an HFEF-5-like cask/canister system. This system has been developed and designated the ATR-5 cask/canister system.

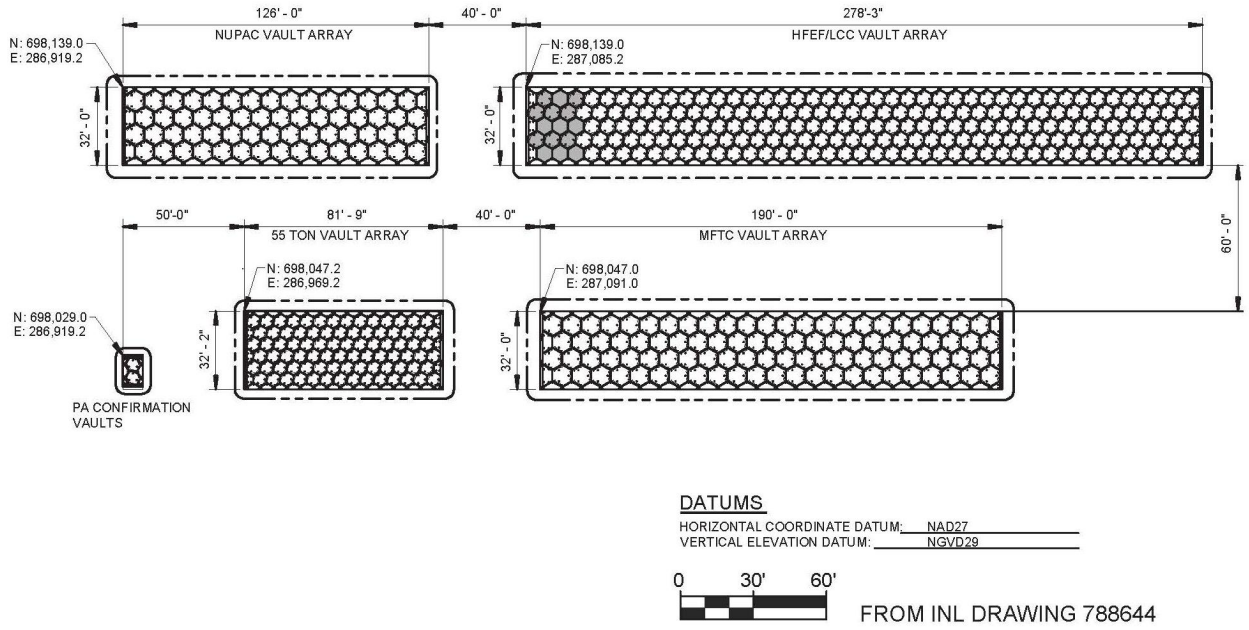

Figure 3. Horizontal layout of the disposal vault arrays at the RHLLW Disposal Facility.

1.2 Purpose and Scope

The purpose of this FY 2021 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 the report concludes FY 2021 RHLLW Disposal Facility operations were conducted within the bounds of the PA, CA, and ODAS. This ASR addresses RHLLW Disposal Facility operations for FY 2021 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 2021 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 2021

Section 3—Discussion of the cumulative effect of changes that occurred in FY 2021

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 2021 based on summary information presented in this report.

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

Sixteen waste canister disposals were performed in FY 2021 at the RHLLW Disposal Facility. This brings the total number of canister disposals to 45 by the end of FY 2021. There were no impacts to the RHLLW Disposal Facility PA, CA, ODAS, or RWMB as a result of changes in operations or other activities in FY 2021.

Other than an update of the PA/CA Maintenance Plan (PLN-3368) (see Table 2, UDQE-RHLLW-037), there were no updates to the PA, CA, ODAS, RWMB, or other technical-basis documents in FY 2021. The current revisions of the documents as of FY 2021 are as follows[e]:

- *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
- "Maintenance Plan for the Remote-Handled Low-Level Waste Disposal Facility Performance Assessment and Composite Analysis," PLN-3368, Revision 3
- "Monitoring Plan for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility," PLN-5501, Revision 2
- "Preliminary Closure Plan for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility," PLN-3370, Revision 0
- "Addendum to the Preliminary Closure Plan for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility," PLN-5503, Revision 0
- "Waste Acceptance Criteria for the Remote-Handled Low-Level Waste Disposal Facility," PLN-5446, Revision 1
- "DOE Order 435.1 Documentation Change Control Process for the RHLLW Disposal Facility," SD-52.1.4, 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 through the change-control process (SD-52.1.4).

As part of the process, several unreviewed disposal question screenings (UDQSs) and unreviewed disposal question evaluations (UDQEs) were performed to support operations in FY 2021. A summary of all UDQSs and UDQEs that were initiated and/or concluded during FY 2021 is provided in Table 2. All UDQS/UDQE forms completed and approved prior to FY 2021 are provided in Appendix A.

Work was performed on 13 UDQS/UDQEs in FY 2021, which included eight carried over from FY 2020. Of the 13, two were screened negative and approved, eight were screened positive requiring an evaluation, and three are still in the process of being screened. Of the eight that screened positive and required evaluations, seven of the evaluations were completed and approved, and one is still in progress.

[e] 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.

The seven evaluations that were completed and approved were negative, meaning the change, activity, or new information was determined to be within the bounds of the PA, CA, and ODAS. There were no positive evaluations; therefore, no special analyses are required. The need for special analyses or a determination of impacts to the PA, CA, ODAS, or RWMB, based on the four UDQS/UDQEs still in progress at the end of FY 2021, is to be determined and will be reported in the FY 2022 ASR.

Four of the seven UDQS/UDQEs that screened positive and required evaluation were for HFEF-5 canisters with radionuclide inventories flagged by the RHLLW Inventory Online (RHINO[f]) software. Prior to shipment, waste canisters details are entered into RHINO, which performs several checks to evaluate canisters for acceptance. RHINO compares the inventories against threshold values or action levels, or identifies radionuclides not considered in the PA (INL 2018). Exceedance of a threshold value or action level, or identification of a previously unanalyzed radionuclide by RHINO does not indicate a canister is unacceptable for disposal, but the inventory levels must be reviewed. Canister inventories flagged by RHINO are also reviewed to determine if the flagged inventories are anomalous or indicative of a change in waste generation rates. If after review, it is determined the inventory levels are within the bounds of the approved PA, the canister may be approved for disposal. In the case of the four canisters flagged by RHINO, the radionuclide inventories and accompanying dose impacts were expected to be very small or insignificant and with the bounds of the approved PA. It was recommended the canisters be accepted for disposal.

Of the four HFEF-5 waste canisters flagged by RHINO, two contained legacy waste and two contained non-legacy or new-generation waste.[g] The evaluation of the two new-generation waste canisters determined that inventories of some radionuclides were much greater than the projected inventories used for the PA. This is also true for the only other canister of new-generation waste placed at the facility (FY 2020). As a result, each canister of new-generation waste from MFC will continue to be monitored to determine if radionuclide inventories in the canister are an anomalous occurrence or indicative of a change in waste generation rates from those projected for the PA. If the trend continues, it may become necessary to re-evaluate the projected new-generation source term used for the PA.

In summary, it was determined no special analyses were required and there were no impacts to the PA, CA, ODAS, or RWMB based on the nine UDQS/UDQEs completed and approved in FY 2021. The need for special analyses or a determination of impacts to the PA, CA, ODAS, or RWMB based on the UDQS/UDQEs still in progress at the end of FY 2021 will be reported in the FY 2022 ASR.

[f] 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 Handle-LLW Inventory Online Database."

[g] Waste generated after 4/21/2015 is described in the PA as future-generation waste to distinguish it from legacy waste from the Radioactive Scrap and Waste Facility. In this report, this waste is referred to as new-generation or non-legacy waste.

Table 2. Unreviewed disposal question screens and evaluations performed during FY 2021.

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. Because the volume of shavings is small, the ATR-Canal Cleanout Project will retain the shavings until the issue is resolved.	Positive	In Progress	In Progress	TBD	TBD
UDQE-RHLLW-034	Canister MFC190345 radionuclide inventory flagged by RHINO for exceeding PA inventory checks	Waste canister MFC190345, an HFEF-5 canister from MFC containing new-generation activated metals and surface contamination, was flagged by RHINO[c] while performing PA checks as part of the acceptance review process. The impacts were determined to be very small or insignificant and within the bounds of the approved PA and the canister was deemed acceptable for disposal. No further action required.	Positive	Negative	Approved	None	None
UDQE-RHLLW-035	Unanalyzed PA radionuclides discovered after completion of SCR-RHINO-004	RHINO[c] software-change request (SCR)-RHINO-004 was implemented in FY 2020 to improve waste input and acceptance procedures in RHINO[c], have RHINO generate reports to assist in preparation of the ASR, and identify unanalyzed radionuclides. Unanalyzed radionuclides are radionuclides that were not considered during preparation of the PA for a specific waste generator, canister type, and waste form. Upon completion of SCR-RHINO-004, RHINO examined all previous disposals (29 canisters) for unanalyzed radionuclides and identified 15. The 15 unanalyzed radionuclides were evaluated for potential impacts to the conclusions of the PA. It was determined the unanalyzed radionuclides will have an insignificant impact on the conclusions of the PA. No further action required.	Positive	Negative	Approved	None	None

Table 2. (Continued.)

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-037	Proposed changes to the RHLLW Disposal Facility PA/CA Maintenance Plan (PLN-3368)	All proposed changes to technical-basis documents are evaluated through the change-control process to determine potential impacts to the PA and CA. Proposed changes to the PA/CA Maintenance Plan (PLN-3368) included elimination of unnecessary reviews conducted annually to support preparation of the ASR, updating land-use assumptions to be consistent with the recently updated INL Site land-use plan, and updating references and other minor errata. The evaluation determined the proposed changes do not affect the assumptions and/or conclusions of the PA/CA. No further action required.	Negative	N/A	Approved	None	None
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.	In Progress	In Progress	In Progress	TBD	TBD
UDQE-RHLLW-043	Damage discovered to the concrete lip of the upper riser of Vault E02 in Vault Array 2	Damage to the concrete lip of the upper riser of Vault E02 in Vault Array 2 was discovered during waste emplacement operations. Repairs are problematic because 10 of the 12 positions in the vault are already filled with waste canisters and personnel performing the repairs would be exposed to radiation. An evaluation determined the damage, if unrepaired, would have an insignificant impact on the conclusions of the PA and recommended repairs not be performed given potential radiation exposure. No further action required.	Positive	Negative	Approved	None	None

Table 2. (Continued.)

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-044	UDQE for SCR-RHINO-004	All RHINO[c] software-change requests are subject to the change-control process as identified in SD-52.1.4. 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 mostly cosmetic changes in the way that information is presented or involve extraction and presentation of data that were not previously extracted/presented by RHINO. It was determined 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	N/A	Approved	None	None
UDQE-RHLLW-045	Vault shield plugs exhibiting level 3 or greater damage identified during annual inspection	Vault shield plugs (VSPs) are inspected annually for damage. The 2020 inspection revealed Level 3 or greater damage to a single plug, VSP-E01 in Vault Array 2. Damage and repairs are managed using the change-control process. Repairs were completed and approved, and an evaluation determined the VSP is functional with no impacts to its safety function. No impacts to the conclusions of the PA are expected. No further action required.	Positive	Negative	Approved	None	None
UDQE-RHLLW-046	Canister MFC200361 radionuclide inventory flagged by RHINO during PA checks	Waste canister MFC200361, an HFEF-5 canister from MFC containing new-generation waste with activated metals, was flagged by RHINO while performing PA checks. Radionuclide inventories were evaluated and impacts were determined to be insignificant and within the bounds of the approved PA. The canister was deemed acceptable for disposal. No further action required.	Positive	Negative	Approved	None	None
UDQE-RHLLW-047	Canister SN-124 radionuclide inventory flagged by RHINO during PA checks	Waste canister SN-124, an HFEF-5 canister from MFC containing legacy waste with surface contamination, was flagged by RHINO while performing PA checks. Radionuclide inventories were evaluated and impacts were determined to be insignificant and within the bounds of the approved PA. The canister was deemed acceptable for disposal. No further action required.	Positive	Negative	Approved	None	None

Table 2. (Continued.)

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-048	Canister OWC003 radionuclide inventory flagged by RHINO during PA check	Waste canister OWC003, an HFEF-5 canister from MFC containing legacy waste with activated metal, was flagged by RHINO while performing PA checks. Radionuclide inventories were evaluated and impacts were determined to be insignificant and within the bounds of the approved PA. The canister was deemed acceptable for disposal. No further action required.	Positive	Negative	Approved	None	None
UDQE-RHLLW-049	CVAS exhibiting level 3 or greater damage identified during annual inspection	The HFEF CVAS is inspected annually for damage. The 2021 inspection identified level 3 or greater damage. The HFEF CVAS exhibited a crack >0.01 inches in width over 11.5 inches in length. Damage and repairs are managed using the change-control process. Repair is scheduled for FY 2022 and the UDQE will be completed after the repair is made and approved by a qualified inspector. An operability review (OPR 2021-0145, 2021), generated by condition CO 2021-1223 (2021), was completed at the time the damage was noted and the CVAS was deemed Operable by Engineering.	In Progress	In Progress	In Progress	TBD	TBD
UDQE-RHLLW-050	Vault shield plugs exhibiting level 3 or greater damage identified during annual inspection	Vault shield plugs are inspected annually for damage. The 2021 inspection revealed damage to three vault plugs: VSP-E01 and D02 in Vault Array 2 and the PA-South vault shield plug. The damage includes a chip/spall approximately 1-inch in depth on one vault and small cracks in the other two. Damage and repairs are managed using the change-control process. Repairs are scheduled for FY 2022 and the UDQE will be completed after the repairs are made and approved by a qualified inspector.	In Progress	In Progress	In Progress	TBD	TBD

N/A indicates an evaluation was not required due to a negative screen.
a. UDQES/UDQEs are presented sequentially without regard to status. Identification numbers missing from the sequence were completed in the previous FY.
b. "None" includes impact determination described as minimal, insignificant, not-discernable, etc.

2.2 Land-Use Plans for the INL Site

Land use at the INL Site is currently managed by management and operation contractor, Battelle Energy Alliance, LLC (BEA), for DOE Idaho Operations Office (DOE-ID) and is designated for government-controlled industrial use (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 Reactor (DOE-NR) programs managing naval spent fuel. Land use for the INL Site is further described in the INL/EXT-20-57515, *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 2017). The RHLLW Disposal Facility and associated long-term controls were incorporated into the updated CLUES report. The update is being reviewed for potential impacts to the PA, CA and closure plan.

A number of recent congressional actions,[h] DOE-ID site-use permits,[i] construction of new nuclear energy research infrastructure at INL, and DOE's interpretation of the definition of the statutory term *high-level radioactive waste*[j] 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 most likely will 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 2021, no changes are needed to ensure the continued adequacy of the CA with respect to land-use assumptions.

2.3 Waste-Acceptance Criteria

Only RH-LLW 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 issued in FY 2018, and no modifications to the WAC were made in FY 2021.

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h 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 accelerated 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, DOD, or NRC rules.

i Use Permit No. DE-NE7000065, Use Permit Authorized by USDOE to Utah Associated Municipal Power Systems (UAMPS) (2016); Use Permit No. DE-NE700105, Use Permit Authorized by USDOE to Oklo Inc (2019).

j Federal Register Notice 83 FR 50909, October 10, 2018, requested public comments on the *US DOE Interpretation of High-Level Radioactive Waste*; followed by Federal Register Supplemental Notice 84 FR 26835 (June 10, 2019) in response to the October 10, 2018 FR Notice. Re-classification of a HLW stream requires implementation of the NEPA process.

2.4 Impact of Future Disposals

Sixteen waste canister disposals were performed in FY 2021 at the RHLLW Disposal Facility. No changes in the waste forms are expected for future disposals. 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). However, the only waste streams currently approved for disposal are generated at MFC (see Section 4.1).

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. With one exception, no modifications have been made or are expected to be made to the inventory of the residual radioactive material that was used as a basis for the CA. The exception is the Idaho Nuclear Technology Center (INTEC) Calcined Solids Storage Facility. The PA and CA for this facility is being currently being reviewed by the LFRG. Once the reviews are complete (anticipated FY 2022) and the PA and CA approved, they will be reviewed to determine potential impacts on the RHLLW Disposal Facility CA.

PLN-3368 includes a requirement to evaluate the potential impact of published INL Site Comprehensive Environmental Response, Compensation and Liability Act (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). This evaluation will be included in the FY 2022 ASR.

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 (SD-52.1.4).

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 disposal 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 2021, no special-case disposals were required, and no special analyses were conducted.

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. The facility PA and CA will be updated if the facility is expanded. During

FY 2021, there were no changes in the design, construction, or operation of the RHLLW Disposal Facility.

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 *Conduct of RHLLW Disposal Facility Waste Generator Facility Evaluations* (MCP-4211). FEs are conducted to ensure each generator's waste certification program and waste streams are compliant with the WAC by evaluating and measuring the adequacy of processes and their implementation and identifying conditions adverse to quality.

A successful re-certification of the only currently approved waste generator was conducted in FY 2021 and the results are documented in ASMT 2021-0050. Waste shipments from both the ATR Complex and NRF are anticipated to begin in FY 2022. An initial FE will be conducted in FY 2022 to ensure both the ATR Complex and NRF's waste certification programs are compliant with the RHLLW WAC.

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 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 changes to DOE standards, orders, or other regulations from the above list in FY 2021 were updates to DOE Order 435.1 and DOE-STD-1196. DOE Order 435.1 was updated to acknowledge *Radioactive Waste Management Manual* (DOE Manual 435.1-1) had been updated, and *Implementation Guide for use with DOE Manual 435.1-1* (DOE Guide 435.1-1) was no longer an official document. Changes to DOE Manual 435.1-1 were primarily associated with high-level waste and do not impact the RHLLW Disposal Facility.

DOE-STD-1196 was updated in 2021 (DOE-STD-1196-2021) 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 was based on values from the previous standard (DOE-STD-1196-2011). The update will be reviewed in FY 2022 for potential impacts to the PA.

A summary of waste disposal records is presented and discussed in Section 4. Groundwater-pathway compliance and performance monitoring data is presented and discussed in Section 5. A review of on-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. Hydraulic drainage system-performance data are reviewed annually only to support lysimeter

sampling.

During review of the performance monitoring data in FY 2020, a higher-than-expected tritium sampling result from a lysimeter near Vault Array 2 was discovered. As a result, several actions were taken to provide additional information to understand the result. These actions were completed in FY 2021, and the actions and findings are documented in the white paper, *Evaluation of Elevated Tritium in Lysimeter Samples at the Remote-Handled Low-Level Waste Disposal Facility* (Sondrup 2022). The findings and subsequent recommendations are presented in Section 5.2.

2.9.2 Documentation Updates

Table 1 of PLN-3368 lists requirements for documentation updates, as necessary. PLN-3368 was revised in FY 2021 to eliminate unnecessary reviews conducted annually to support preparation of the ASR, update land-use assumptions to be consistent with the recently updated INL Site land-use plan, and update references and other minor errata. The revisions were evaluated and deemed minor and do not impact assumptions and conclusions of the PA and CA or impact the validity of the RWMB and ODAS (see Table 2, UDQE-RHLLW-037). Except for the PA/CA maintenance plan (PLN-3368), there were no updates to the PA, CA, or technical-basis documents in FY 2021. The only other technical-basis document to be revised since issuance of the ODAS is the monitoring plan (PLN-5501). This was addressed in the FY 2020 ASR.

There are no limitations or conditions of the ODAS to track, and there have been no special analyses prepared, nor are any needs for special analyses known as of publication of this ASR. A minor revision to the change-control process document (SD-52.1.4) will be completed early in FY 2022 (see Section 34).

Other document updates in progress include *Technical Basis for Environmental Monitoring and Surveillance at the INL Site* (DOE/ID-11485) and the *Idaho National Laboratory Environmental Monitoring Plan* (DOE/ID-10-11088). These documents will include monitoring activities associated with the RHLLW Disposal Facility. Both revisions are expected to be complete in FY 2022.

The *Idaho National Laboratory Comprehensive Land Use and Environmental Stewardship Report* (INL 2016) was updated in FY 2020, and the RHLLW Disposal Facility and associated long-term controls were added to the updated report, *INL Comprehensive Land Use and Environmental Stewardship (CLUES) Report Update* (INL 2020b). The update is being reviewed for potential impacts to the PA, CA, and closure plan. The evaluation will be included in the FY 2022 ASR.

2.9.3 Planned and As-Needed Maintenance Activities

Table 1 of the PA/CA maintenance plan 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 2021 inspection was performed under annual Work Order (WO) 308757 (2021). 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 were no indications of animals or nesting and burrowing. Some minor vegetation was present, which was either corrected on the spot or eradicated by maintenance personnel spraying weed control. In addition, 10 random locations throughout the vault yard near the vault arrays were tested for compaction. All but one location showed compaction measurements met or exceeded 95% criteria with only one location showing slightly less compaction from the design specification of 95% of maximum dry unit weight per ASTM D698. However, this reduced compaction measurement was determined to still be

acceptable for continued operations as it shows no degradation from the previous year's measurement.

A 3-year vault yard preventative maintenance WO was also performed during 2021 (WO 306180, 2021). The scope of this WO includes a topographic survey of the vault yard, and elevation measurements of the top of 10% of the vault shield plugs. No notable issues were identified from this preventative maintenance activity. The vault yard appears to have reasonably maintained its original surface elevation and general slopes.

Vault shield plugs are also inspected annually for damage. These activities are directed by MWO 257898 (2018) and were performed in 2021 under annual WO 310808 (2021). The scope of the annual inspection requires top surfaces of all vault shield plugs that contain waste, as well as the top surfaces of any empty vaults adjacent to those with waste emplaced in them, to be inspected. The repair work orders direct qualified individuals to perform repairs followed by documented inspections by a qualified quality inspector to ensure these corrective-maintenance actions were completed properly and the vault plug no longer exhibits issues that meet or exceed need-to-repair criteria. Two vault shield plugs, Array 2 vault shield plugs D2 and E2, were found to have damage exceeding the Level 3 criteria of the WO. Vault shield plug D2 had four cracks and E2 had one chip that were of issue. These damages were evaluated in OPR 2021-0163 (2021), which was generated from CO 2021-1387 (2021), to determine their functionality with respect to SAR-419 safety analysis requirements. The results of this evaluation showed both shield plugs can still perform their safety function. Additionally, both shield plugs were evaluated under UDQE-RHLLW-050 (see Table 2) for concerns relative to the PA/CA. The evaluation resulted in both shield plugs acceptability for continued use. Even though both evaluations showed both shield plugs acceptability for continued use, it is Engineering's posture to perform repairs under the routine repair WO to ensure the shield plugs can be expected to provide protection against water ingress into the steel reinforcement material and to result in no impact to long-term vault performance. As such, maintenance work request MWR-2021-4669 (2021) was submitted to initiate these repairs under the routine work order covering this work.

Table 1 of 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 2020 and the spring 2021. 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 work order packages:

- PM Radioactive Waste Management Complex Diversion Dam Semi-Annual Floodgate Inspection (WO Package 297458, 2020) performed September 2020
- PM Radioactive Waste Management Complex Diversion Dam Semi-Annual Floodgate Inspection (WO Package 304759, 2021) performed March 2021
- PM Experimental Breeder Reactor-II Semi-Annual Floodgate Inspection (WO Package 299199, 2020) performed October 2020
- PM Experimental Breeder Reactor-II Semi-Annual Floodgate Inspection (WO Package 306355,2021) performed April 2021
- PM Lost River Sinks Semi-Annual Floodgate Inspection (WO Package 299191, 2020) performed October 2020
- PM Lost River Sinks Semi-Annual Floodgate Inspection (WO Package 306373, 2021) performed April 2021
- PM Howe Semi-Annual Pole Line Road Floodgate Inspection (WO Package 299192, 2020) performed October 2020.

- PM Howe Semi-Annual Pole Line Road Floodgate Inspection (WO Package 306372, 2021) performed April 2021.

The PA/CA maintenance plan further requires an annual evaluation of the potential impacts of proposed new facilities with respect to the creation of perched water beneath the RHLLW Disposal Facility. Several projects at the nearby ATR Complex that were initiated, continued, or completed in FY 2021 were evaluated. These include the:

- Continued construction of an upgrade to the Nuclear Materials Inspection and Storage facility
- Completion and turnover of the new ATR Maintenance Support Building
- Continued construction of the new ATR Reactor Support Building, a general office building that will contain a cafeteria
- Completion and turnover of the new ATR Complex Security Building
- Completion and turnover of the potable water mains for the ATR Complex Utility Corridor Extension
- Continued upgrade of the ATR Complex Cold Waste pumps control system that conveys wastewater to the Cold Waste Ponds
- ATR Core Internals Changeout (CIC) VI
- Seepage testing of the ATR Complex sewage lagoons.

Except for the ATR CIC, wastewater generated from the projects consists of sanitary sewer wastewater discharged to lined treatment lagoons or storm runoff. Each of the building construction projects incorporate general storm-water management features such as swales, ponds, or shallow injection wells for runoff control. The largest contributor to the perched water body is the Cold Waste Ponds. The Cold Waste Pond upgrade improves the pump-controller system but does not impact flows to or function of the pond. While the ATR CIC VI contributed to a total Cold Waste Pond discharge greater than the previous FY, the total FY 2021 discharge was within both the historical operational discharges and the facility's wastewater reuse permit limit (report year November-October) issued by DEQ. 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. No corrective maintenance regarding either was required in FY 2021.

3. CUMULATIVE EFFECTS OF CHANGES

As described in Section 2, there were no changes identified in FY 2021 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), an annual FE (see Section 2.9.1) was conducted in FY 2021 to re-certify MFC's waste certification program and waste streams are compliant with the WAC. The FE was conducted according to MCP-4211 (2020) and documented in ASMT 2021-0050. As a result, current waste streams approved for shipment and disposal to the RHLLW Disposal Facility are:

- Activated metals in HFEF-5 canisters from MFC

- Surface-contaminated debris in HFEF-5 canisters from MFC
- Combined activated metals and surface-contaminated debris in HFEF-5 canisters from MFC.

Other waste streams and canister types will be approved as the generators are certified.

4.2 Waste Receipts

During FY 2021, sixteen waste canisters were received and disposed of in the RHLLW Disposal Facility. Table 3 contains information on these 16 canisters including waste form, disposal date and disposal location.

Table 3. Waste receipts and disposals in FY 2021.

Generator	Generator Canister ID No.	Container Type	Waste Form[a]	Shiptask No.	Waste Receipt Date	Disposal Date	Vault Array	Disposal Position
MFC	MFC190345	HFEF-5	Combined	RHLLW-MFC-21-001	12/2/2020	12/2/2021	HFEF	02-E03-3ba (Top)
MFC	OWC021	HFEF-5	AM	RHLLW-MFC-21-002	7/6/2021	7/7/2021	HFEF	02-E03-4a (Bottom)
MFC	SN-124	HFEF-5	SC	RHLLW-MFC-21-003	7/8/2021	7/12/2021	HFEF	02-E03-4b (Top)
MFC	OWC001	HFEF-5	Combined	RHLLW-MFC-21-004	7/13/2021	7/14/2021	HFEF	02-E03-5a (Bottom)
MFC	B-307	HFEF-5	AM	RHLLW-MFC-21-005	7/15/2021	7/19/2021	HFEF	02-E03-5b (Top)
MFC	OWC003	HFEF-5	AM	RHLLW-MFC-21-006	7/20/2021	7/21/2021	HFEF	02-E03-6a (Bottom)
MFC	SN-108	HFEF-5	AM	RHLLW-MFC-21-007	7/22/2021	7/26/2021	HFEF	02-E03-6b (Top)
MFC	SN-110	HFEF-5	Combined	RHLLW-MFC-21-008	7/27/2021	7/28/2021	HFEF	02-D01-1a (Bottom)
MFC	SN-137	HFEF-5	Combined	RHLLW-MFC-21-009	7/29/2021	8/2/2021	HFEF	02-D01-1b (Top)
MFC	SN-109	HFEF-5	AM	RHLLW-MFC-21-010	8/3/2021	8/4/2021	HFEF	02-D01-2a (Bottom)
MFC	OWC020	HFEF-5	AM	RHLLW-MFC-21-011	8/5/2021	8/9/2021	HFEF	02-D01-2b (Top)
MFC	SN-117	HFEF-5	AM	RHLLW-MFC-21-012	8/10/2021	8/11/2021	HFEF	02-D01-3a (Bottom)
MFC	SN-116	HFEF-5	Combined	RHLLW-MFC-21-013	8/12/2021	8/16/2021	HFEF	02-D01-3b (Top)
MFC	SN-99	HFEF-5	Combined	RHLLW-MFC-21-014	8/17/2021	8/18/2021	HFEF	02-D01-4a (Bottom)
MFC	SN-120	HFEF-5	AM	RHLLW-MFC-21-015	8/19/2021	8/23/2021	HFEF	02-D01-4b (Top)
MFC	MFC200361	HFEF-5	AM	RHLLW-MFC-21-016	9/22/2021	9/22/2021	HFEF	02-D01-5a (Bottom)

a. AM = Activated Metals, SC = Surface-Contaminated Debris, Combined = Activated Metals and Surface-Contaminated Debris

The HFEF vault array (Array 02) consists of 15 vaults with positions for 12 canisters in each vault, resulting in a total capacity of 180 canisters from MFC and ATR Complex. Nine of the 16 canisters placed in FY 2021 contained only activated metals, six contained combined activated metals and surface-contaminated debris, and one contained only surface-contaminated debris. Fourteen of the canisters were legacy waste canisters from the Radioactive Scrap and Waste Facility (RSWF), and two were new-generation (non-legacy) HFEF-5 canisters from the fuel conditioning facility (FCF) at MFC.

A summary of the canisters placed, and facility capacity are presented in Table 4. This contains the vault capacity, the percentage of vaults/positions and total vaults/positions filled through FY 2021. Table 5 contains a summary of the volume of canisters placed in the vaults.

Table 4. Vault capacity summary through FY 2021.

Array	Vault Type	Vault Description	Positions Filled FY 2021	Positions Filled Cumulative Through FY 2021	Empty Positions Remaining Through FY 2021	Total Positions	Percent Positions Filled Through FY 2021
01	NuPac	1 Hole (2 Levels)	0	0	120	120	0.0%
02	HFEF-5	6 Holes (2 Levels)	16	45	135	180	25.0%

	LCC	1 Hole (Single Storage)	0	0	195	195	0.0%
03	55-ton	1 Hole (2 Levels)	0	0	168	168	0.0%
04	Modified FTC	3 Holes (1 Level)	0	0	276	276	0.0%
		Facility Totals	16	45	894	939	4.8%

Table 5. Placed canister volume summary through FY 2021.

Array	Vault Type	Canister Type, Generator, Waste Form	Generator	Gross Volume (m^3) FY 2021	Cumulative Gross Volume (m^3) Through FY 2021
02	HFEF-5	HFEF-5 - MFC Activated Metals w/ lead plug	MFC	0.308	0.462
		HFEF-5 - MFC Activated Metals w/ steel plug	MFC	1.08	3.54
		HFEF-5 - MFC Combined w/ lead plug[a]	MFC	0.154	0.308
		HFEF-5 - MFC Combined w/ steel plug[a]	MFC	0.770	2.46
		HFEF-5 - MFC Surface Contaminated w/ steel plug	MFC	0.154	0.154
			Array Total	2.46	6.93
			Facility Totals	2.46	6.93

a. Waste form is combined activated metals and surface contaminated debris.

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 the 16 HFEF-5 waste canisters placed in FY 2021, there were 22 radionuclides reported in activated metals and 70 radionuclides reported as surface contamination. Ten radionuclides were reported as both activated metal and surface contamination. Radionuclide reporting requirements are documented in the WAC (PLN-5446).

Dose calculations and canister-acceptance checks were performed 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. Table 6 contains the inventory placed in FY 2021 and cumulative inventory for the groundwater-pathway radionuclides fully analyzed in the PA. These are recorded and presented by array, generator, and waste form. Two of the 14 radionuclides (Cl-36 and I-129) were not reported in any of the FY 2021 disposals.

Given the total number of HFEF-5 canisters placed through FY 2021 is 25% of the HFEF vault array capacity (Table 4), the cumulative inventory of this vault array as a percent of the PA inventory is approximately as expected or less than expected for all but two of 14 groundwater-pathway radionuclides fully analyzed in the PA (Np-237 [495%] and Pu-240 [176%], Table 6). The large percentages of Np-237 and Pu-240 are primarily the result of three new-generation (non-legacy) waste canisters from FCF at MFC. One of these canisters (MFC170305) was placed in FY 2020 and the other two (MFC190345 and MFC200361) were placed in FY 2021. All three canisters were flagged by RHINO for exceeding the 10% PA inventory threshold for Pu-240 for the specific generator/canister/waste form, and evaluated for disposal acceptance (see UDQE-RHLLW-032, UDQE-RHLLW-034, and UDQE-RHLLW-046). Two of the canisters were flagged for exceeding the 10% threshold for Np-237. These three canisters are also responsible for most of the U-235 and U-238 for this generator/canister/waste from.

Although the inventories of Np-237, Pu-240, U-235, and U-238 as surface contamination in these canisters exceed what is expected for this generator/canister/waste form according to the PA, the inventories are 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 (Section 4.3).

The apparent discrepancy between actual inventories and PA base-case inventories for new-generation waste is likely related to the generating facility at MFC and the waste type. The three canisters of new-generation waste at the RHLLW disposal facility were loaded at the FCF. Of the 23 waste canisters used to estimate the inventory of new-generation waste for the PA, 22 were loaded with waste from the Hot Fuel Examination Facility (HFEF) hot cell and one from FCF. These were the most recently loaded waste canisters at MFC prior to developing the source term for the PA. Although the cell waste at both HFEF and FCF are similar, there are some differences that could explain the discrepancy. For example, both facilities contain irradiated metals and EBR-II hardware, but HFEF contains more post-irradiation-examination research waste categorized as combination waste (activated metal and surface-contaminated debris). Because of this apparent discrepancy, the inventory projections of new-generation waste from MFC are being evaluated. This evaluation will begin in FY 2022.

Table 6. Radionuclide activities disposed of by array, generator and waste form through FY 2021 compared to inventory analyzed in the PA for the groundwater pathway.

Nuclide	Vault Array	Waste Generator	Waste Form[a]	FY-2021 Inventory (Ci)	Cumulative Inventory (Ci)	PA Inventory (Ci)[b]	Cumulative Inventory as % of PA Inventory
C-14	55-ton	NRF	A			4.78E+01	
			R			2.36E-02	
			S			8.09E-01	
	HFEF-5	ATR	A			2.36E+01	
		MFC	A	4.00E-01	5.00E-01	2.75E+00	18.2%
	Large Concept Cask	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			2.21E-02	
	HFEF-5	ATR	A			3.40E-06	
	Large Concept Cask	NRF	A			9.24E-02	
H-3	55-ton	NRF	A			6.12E+01	
			R			1.14E+00	
	HFEF-5	ATR	A			1.76E+03	
		MFC	A	3.86E-04	3.86E-04	1.21E+01	0.00%
			S	1.73E-05	1.73E-05	3.49E-05	49.7%
	Large Concept Cask	NRF	A			1.47E+02	
			R			2.61E+00	
	NuPac	ATR	R			1.09E-01	
I-129	55-ton	NRF	A			2.14E-06	
			R			5.52E-07	
			S			2.66E-06	
	HFEF-5	ATR	A			2.47E-15	
		MFC	S			4.40E-09	
	Large Concept Cask	NRF	A			5.87E-06	
			R			1.27E-06	

Table 6. (Continued.)

Nuclide	Vault Array	Waste Generator	Waste Form[a]	FY-2021 Inventory (Ci)	Cumulative Inventory (Ci)	PA Inventory (Ci)[b]	Cumulative Inventory as % of PA Inventory
			S			1.94E-05	
	Modified FTC	MFC	S			4.83E-04	
	NuPac	ATR	R			5.33E-02	
Mo-93	55-ton	NRF	A			2.11E-01	
	HFEF-5	ATR	A			5.41E-01	
		MFC	A	9.26E-01	1.04E+00	2.78E+00	37.3%
	Large Concept Cask	NRF	A			2.61E-01	
	Modified FTC	MFC	A			2.17E+01	
			S			3.19E-01	
Nb-94	55-ton	NRF	A			3.71E+00	
			R			6.16E-10	
			S			1.15E-02	
	HFEF-5	ATR	A			3.82E+01	
		MFC	A	1.17E-01	1.42E-01	1.11E+00	12.8%
	Large Concept Cask	NRF	A			8.31E+00	
			R			1.41E-09	
			S			1.46E-01	
	Modified FTC	MFC	A			4.74E+00	
			S			7.02E-02	
	NuPac	ATR	R			8.48E-01	
Ni-59	55-ton	NRF	A			5.83E+02	
			R			3.39E+00	
			S			3.16E-01	
	HFEF-5	ATR	A			1.90E+02	
		MFC	A	1.23E+00	1.67E+00	8.85E+00	18.9%
	Large Concept Cask	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			1.76E-06	
			R			4.49E-06	
			S			3.35E-09	
	HFEF-5	MFC	S	1.71E-07	3.40E-07	6.86E-08	495%
	Large Concept Cask	NRF	A			4.49E-06	
			R			1.03E-05	
			S			6.89E-08	
	Modified FTC	MFC	S			5.82E-04	
	NuPac	ATR	R			9.18E-05	
Pu-239	55-ton	NRF	A			6.60E-02	
			R			3.09E-05	
			S			7.04E-05	
	HFEF-5	MFC	S	6.97E-04	1.18E-03	1.56E-02	7.54%
	Large Concept Cask	NRF	A			1.47E-01	
			R			7.07E-05	
			S			3.78E-04	

Table 6. (Continued.)

Nuclide	Vault Array	Waste Generator	Waste Form[a]	FY-2021 Inventory (Ci)	Cumulative Inventory (Ci)	PA Inventory (Ci)[b]	Cumulative Inventory as % of PA Inventory
	Modified FTC	MFC	S			2.99E-01	
	NuPac	ATR	R			2.88E-02	
Pu-240	55-ton	NRF	A			5.67E-02	
			R			6.31E-05	
			S			6.22E-05	
	HFEF-5	MFC	S	5.72E-05	1.07E-04	6.11E-05	176%
	Large Concept Cask	NRF	A			1.15E-01	
			R			1.45E-04	
			S			3.13E-04	
	Modified FTC	MFC	S			1.85E-03	
	NuPac	ATR	R			1.81E-03	
Tc-99	55-ton	NRF	A			3.54E-02	
			R			1.69E-02	
			S			1.43E-03	
	HFEF-5	ATR	A			2.58E-02	
		MFC	A	9.23E-03	9.48E-03	0.00E+00[c]	NA[c]
			S	4.80E-02	5.84E-02	5.36E-01	10.9%
	Large Concept Cask	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			2.64E-05	
			R			8.28E-05	
			S			4.78E-07	
	HFEF-5	MFC	S	8.58E-06	1.61E-05	1.17E-04	13.7%
	Large Concept Cask	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			4.49E-07	
			R			1.11E-06	
			S			1.57E-10	
	HFEF-5	MFC	S	2.12E-07	5.80E-07	1.81E-06	32.0%
	Large Concept Cask	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	
U-238	55-ton	NRF	A			3.10E-05	
			R			5.13E-09	
			S			1.40E-08	
	HFEF-5	MFC	S	1.21E-07	2.44E-07	9.11E-07	26.8%
	Large Concept Cask	NRF	A			1.04E-04	
			R			1.18E-08	
			S			2.92E-08	

Table 6. (Continued.)

Nuclide	Vault Array	Waste Generator	Waste Form[a]	FY-2021 Inventory (Ci)	Cumulative Inventory (Ci)	PA Inventory (Ci)[b]	Cumulative Inventory as % of PA Inventory
	Modified FTC	MFC	S			7.40E-04	

a. Waste forms include A = activated metals, R = resin, S = surface contamination. Surface contamination may be on debris or activated metal components.

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). They are combined because both are treated the same for calculating the all-pathway PA dose.

c. 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.

Table 7 presents the FY 2021 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 is the highest percent of the vault-array action level at 2%. This is of no concern given the total number of HFEF-5 canisters placed through FY 2021 is 25% of the HFEF vault array capacity (Table 4).

Table 7. Radionuclide inventory of primary dose contributors to the chronic-intruder pathway through FY 2021.

Nuclide	Vault Array	FY-2021 Inventory (Ci)	Cumulative Inventory Through FY 2021 (Ci)	Vault Array Action Level[a] (Ci)	Cumulative Inventory Through FY 2021 as % of Vault Array Action Level
Co-60	55-ton			7.33E+05	
	HFEF-5	9.54E+02	7.59E+03	3.79E+06	0.20%
	Large Concept Cask			1.17E+06	
	Modified FTC			2.68E+04	
	NuPac			4.24E+03	
Cs-137	55-ton			1.27E+02	
	HFEF-5	9.08E-01	1.15E+00	6.12E+01	1.89%
	Large Concept Cask			2.76E+02	
	Modified FTC			1.69E+04	
	NuPac			1.14E+02	
Nb-94	55-ton			6.88E+01	
	HFEF-5	1.17E-01	1.42E-01	7.27E+02	0.02%
	Large Concept Cask			1.57E+02	
	Modified FTC			8.90E+01	
	NuPac			1.57E+01	
Ni-63	55-ton			1.36E+06	
	HFEF-5	7.17E+01	9.65E+01	4.68E+05	0.02%
	Large Concept Cask			2.11E+06	
	Modified FTC			8.64E+04	
	NuPac			6.29E+02	
Sr-90	55-ton			8.53E+01	
	HFEF-5	9.64E-01	1.28E+00	1.25E+02	1.03%
	Large Concept Cask			1.92E+02	
	Modified FTC			1.17E+04	
	NuPac			3.00E+02	

a. Vault array action levels (Engineering Calculations and Analysis Report (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.

The PA reported the projected radionuclide inventories from all waste generators. Disposal inventories for the 20-year facility life cycle were projected for each of the waste generators and compiled in ECAR-3940 (2018). This ECAR informed the source term used in the facility PA. No programmatic changes at the site have been identified, and no projected deviations from the facility source term (ECAR-3940) and the PA analysis are known or forecast as of this ASR. The total project radionuclide inventory remains bounded by the PA analysis.

4.4 Performance Objectives Tracking Using RHINO

The RHLLW Disposal Facility does not depend on the radionuclide sum-of-fractions rule[k] to determine compliance with performance objectives. Rather, the facility uses the RHINO software to calculate facility performance with each shipment. 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).

The reason the sum-of-fractions rule is not used to determine compliance is because, 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 surface-contaminated debris in an HFEF-5 canister in the HFEF vault array.

Table 8 summarizes the performance measures for all disposals in FY 2021 and cumulative disposals through FY 2021. As expected, the calculated dose and concentration performance measures for all canisters placed through FY 2021 are a very 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.

RHINO tracks contributions to the all-pathway dose by vault array, generator, and waste form. As other vault arrays are utilized in the future, this information will be presented in future ASRs. For now, the entire all-pathway dose is attributed to the MFC waste in the HFEF vault array. Although the FY 2021 waste and cumulative waste disposed of through FY 2021 consists of both activated metals and surface contamination, the dose was dominated by the surface contamination.

[k] 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 based on its limit derived from the PA. It is calculated by dividing each nuclides 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.

Table 8. Summary of facility performance through FY 2021.

Performance Objective or Measure	Performance Standard	Point of Assessment Location	Compliance Period			Post-Compliance Period		
			Maximum Based on FY-2021 Disposals	Maximum Based on Cumulative Disposals Through FY 2021	Cumulative Disposal Maximum as % of Standard	Maximum Based on FY-2021 Disposals	Maximum Based on Cumulative Disposals Through FY 2021	Cumulative Disposal Maximum as % of Standard
All-Pathway Dose	25 mrem/yr	100 m	3.92E-05	4.77E-05	0.0002%	2.28E-02	2.78E-02	0.11%
Air-Pathway Dose[a]	10 mrem/yr	100 m	4.84E-07[b]	6.05E-07[b]	0.0001%[b]	NA[c]	NA[c]	NA[c]
Intruder Dose	100 mrem/yr	Facility	6.63E-03	8.97E-03	0.009%	NA[c]	NA[c]	NA[c]
Beta-gamma DE[d]	4 mrem/yr	100 m	2.78E-05[e]	3.39E-05[e]	0.0008%[e]	1.62E-02[e]	1.97E-02[e]	0.49%[e]
Beta-gamma ED[d]	4 mrem/yr	100 m	1.52E-05[e]	1.85E-05[e]	0.0005%[e]	8.86E-03[e]	1.08E-02[e]	0.27%[e]
Gross alpha	15 pCi/L	100 m	1.77E-31	3.43E-31	0.00%	3.69E-07	7.22E-07	0.000005%
Ra-226/228	5 pCi/L	100 m	8.24E-34	1.54E-33	0.00%	7.69E-08	1.44E-07	0.000003%
Uranium Mass	30 ug/L	100 m	5.46E-29	1.18E-28	0.00%	1.04E-06	2.25E-06	0.00001%

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.
b. The air-pathway dose in the PA is due to C-14, H-3 and I-129. C-14 and H-3 were reported in the FY 2021 inventory (see Table 6).
c. Air-pathway and intruder doses peak during the compliance period. No doses are reported for the post-compliance period.
d. DE = dose equivalent, ED = effective dose.
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. Cl-36 and I-129 were not reported in FY 2021 or any other year.

5. MONITORING

Compliance and performance monitoring began in FY 2019 with commencement of operations of the facility and is conducted in accordance with 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 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 samplers is located immediately outside the facility fence south of the vault yard. Results are presented in annual site environmental reports for each calendar year and reviewed for this ASR. The most recent results, from Calendar Year 2020 (DOE-ID 2021), indicate gross alpha and gross beta were detected in concentrations consistent with historical measurements. Composited 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-1196-2011 2011).

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 308757 (2021) for Calendar Year 2021. Some moderate vegetation growth on a few areas of the vault-yard perimeter were found during the inspection, and the vegetation was sprayed and/or removed. No evidence of burrowing insects or animals was identified during the inspection.

The only other monitoring activities performed at the facility are annual visual inspections of the vault-yard road apron, the 3-year vault yard topographic survey and compaction measurements, and inspection of vault shield plugs for damage. The road-apron inspection showed typical rutting, settling, erosion, sedimentation, and uneven surfaces; however, all 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 vault shield plug top surfaces that contain waste to be inspected, as well as the top surfaces of empty adjacent vaults. The inspection found two vault shield plugs with cracks or chip/spall that required repair. Repairs are expected in early FY 2022 (see Section 2.9.3.1). Any damage and repairs (if necessary) are managed using the change-control process (SD-52.1.4). UDQEs associated with vault damage or repairs are presented in Section 2.1. Two vaults (see Figure 1 through 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 RHLLW Disposal Facility (see Figure 4). 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. However, the performance-monitoring action levels only apply after a 3-year period to establish background concentrations.

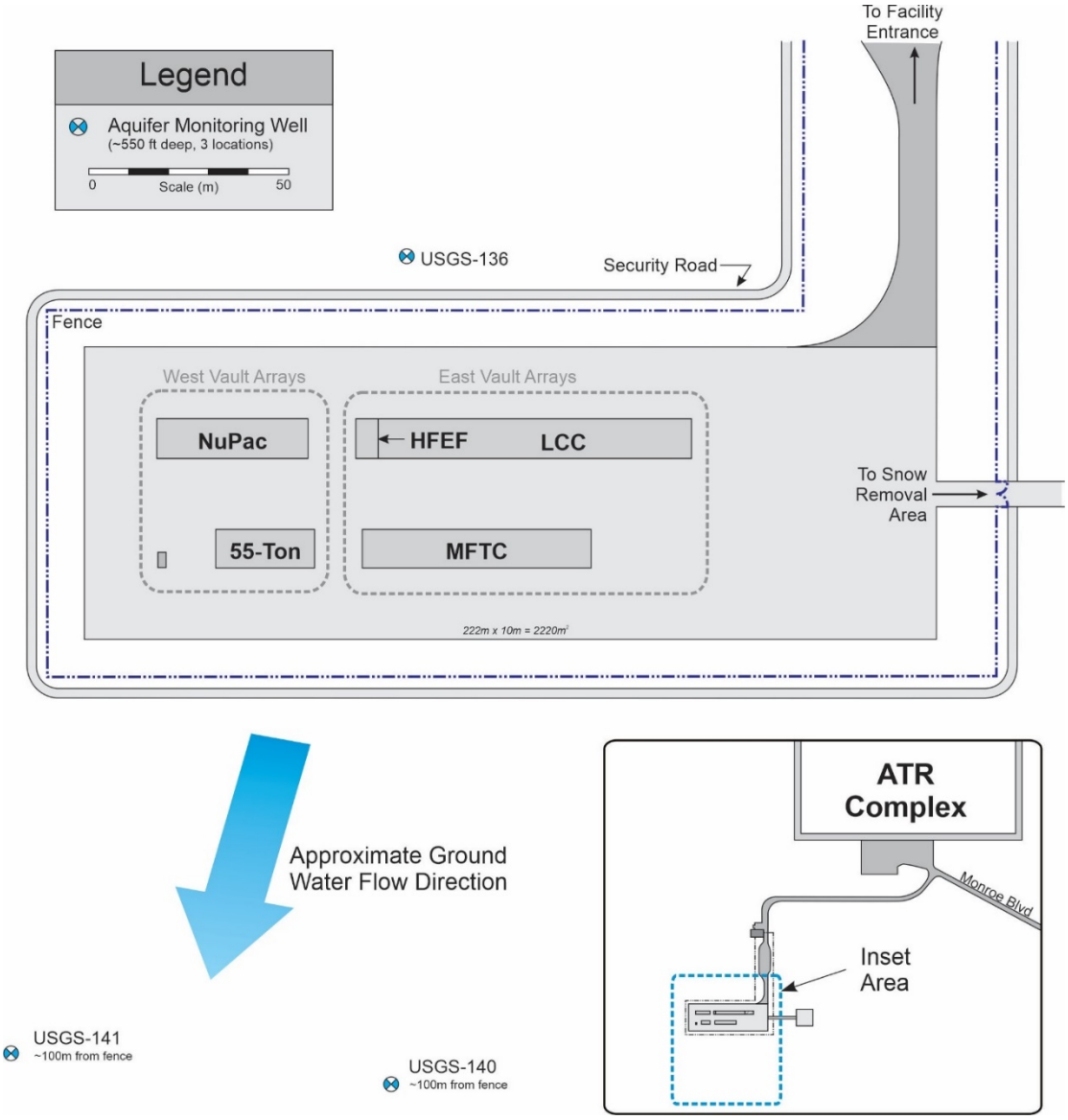

Figure 4. RHLLW Disposal Facility layout showing aquifer-monitoring well locations.

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 (i.e., 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.

Annual samples were collected from each of the three aquifer wells in April 2021. Results of the compliance monitoring are presented in Appendix B and summarized in Table 9. Tritium (H-3) was detected in all three aquifer wells. Gross beta was positively detected in all three wells, while gross alpha was detected only in USGS-141. 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) (see Appendix B).

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 5) 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.

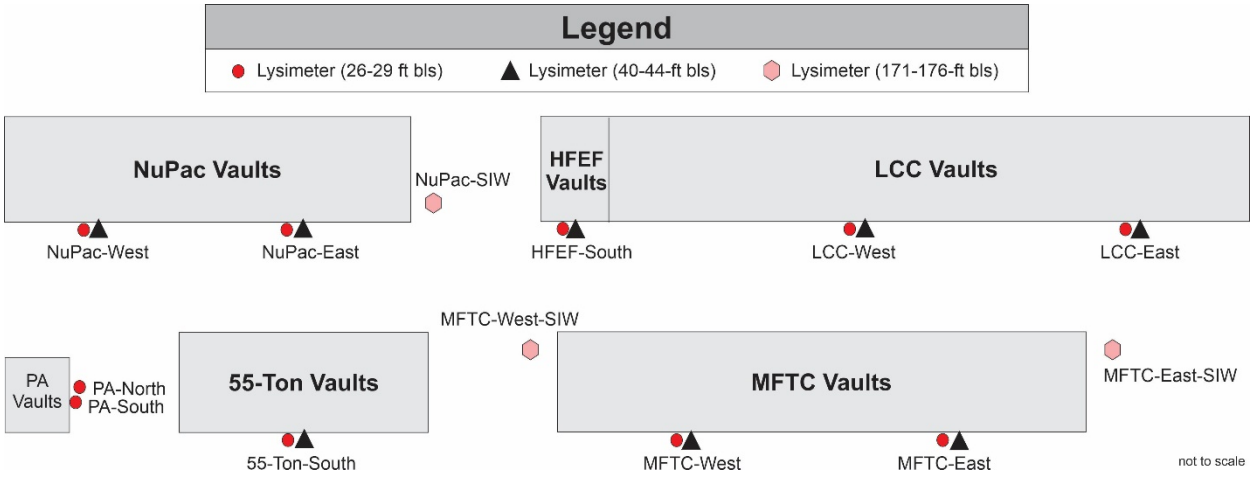

Figure 5. Plan view of the vault arrays showing the lysimeter locations.

FY 2019 began a 3-year period to establish background concentrations for all lysimeters. During this period, samples are 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, gross beta, C-14, I-129, H-3, and then Tc-99. After the 3-year baseline period, the monitoring plan specifies that annual sampling will be conducted only at lysimeters near vaults that have received waste, and samples will be analyzed only for 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 semi-annually (as soil water is available) and continue as long as action levels are exceeded. Semi-annual samples will be analyzed for target analytes H-3, C-14, Tc-99, and I-129, in addition to gross alpha and gross beta.

Data from the 3-year baseline period (FY 2019 through FY 2021) will be evaluated in FY 2022. This evaluation will be documented in a report with recommendations to either extend the baseline period or move to the next phase according to the monitoring plan (PLN-5501).

Routine annual lysimeter-sample collection for FY 2021 was performed in the spring (March 18 through May 20) similar to previous years. Multiple sample collections were performed to increase the total sample volume from each lysimeter in hopes of having enough porewater to analyze for the full suite of analytes. After each sample-collection event, vacuum was reapplied to the lysimeters and samples collected again after 1 or 2 weeks. This process was repeated until sufficient porewater was obtained, or until the amount of water recovered was trivial.

In FY 2021, all 10 of the lysimeters in the shallow-alluvium yielded water, and sufficient volume was collected from seven of the lysimeters for the full suite of analytes. Sufficient volume was collected from four lysimeters to perform duplicate analyses for one or two of the analytes.

In FY 2021, all eight lysimeters in the deep-alluvium yielded water, but the quantities were only enough to analyze for a few of the analytes. Five of the eight lysimeters yielded only a small amount of water (12 to 32 ml), so the samples were combined and the total volume (116 ml) was analyzed for tritium. All three of the deep lysimeters yielded water, but one (NuPac-SIW) produced only enough water to analyze for tritium. Another produced enough to analyze for gross alpha, gross beta, and tritium. The third yielded enough water for the full suite of analytes and three duplicate analyses.

Of the 10 shallow-alluvium lysimeter samples analyzed for gross alpha and gross beta, only four positively detected gross alpha, and three detected gross beta. This is down from the previous year where eight detected gross alpha and five detected gross beta. Gross alpha may have been detected in two other lysimeters and gross beta in another, but the results were qualified UJ in the validation report. A UJ qualifier indicates the radionuclide may or may not be present in the sample, and the result is considered highly questionable. For this report, all data qualified as U or UJ are not reported as positive detections.[1] None of the deep-alluvium lysimeter samples were analyzed for gross alpha or gross beta due to insufficient volume. The two samples from the sedimentary-interbed lysimeters analyzed for gross alpha and gross beta were positive for both. C-14, I-129, and Tc-99 were not detected in any of the lysimeter samples. Tritium was detected in seven of the 10 shallow lysimeters, three of the four deep lysimeter samples, and one of the three sedimentary-interbed lysimeters.

In addition to the routine annual lysimeter sampling in the spring, six lysimeters were sampled in the fall of 2020 and analyzed only for tritium. This “non-routine” sampling effort was conducted in response to an unexpectedly high tritium result in lysimeter HFEF-South in spring FY 2020 (see Section 5.2.1). These six lysimeters include HFEF-South and five others near HFEF-South.

All performance monitoring results for FY 2021 are presented in Appendix B and summarized in Table 10. All sample concentrations were less than action levels, with one exception. The gross-alpha result from the PA-North lysimeter sample (11.3 pCi/L) exceeded the action level of 10 pCi/L. This result is consistent with the previous 2 years that were also slightly above the action level for this lysimeter. The gross-alpha action level has only been exceeded in one other lysimeter sample and that was a combined sample from seven of the deep-alluvium lysimeters. Although some sample results exceed the performance-monitoring action level, the levels only truly apply after a 3-year period to establish background concentrations. According to the monitoring plan (PLN-5501), this lysimeter is not scheduled to be sampled after this year (the end of the 3-year baseline period), because no waste will be placed in the vault near this lysimeter. However, the data will be used to determine baseline conditions, and a review of the 3-year baseline data scheduled for FY 2022 will determine if additional monitoring of this lysimeter is necessary.

[1] 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.

Although action levels are only defined for gross alpha and gross beta, the tritium concentration in soil porewater from lysimeter HFEF-South exceeded the federal drinking water maximum contaminant level (MCL) of 20,000 pCi/L both in the fall of 2020 (37,300 pCi/L) and the spring of 2021 (34,100 pCi/L). The monitoring plan states that if gross alpha or gross beta action levels are exceeded, lysimeter samples will be analyzed for target analytes and the results will be compared to MCLs. The tritium results in FY 2021 were greater than the MCL but less than the 47,100 pCi/L result from spring 2020, and FY 2021 results exhibit a downward trend since that result (see Figure 6). The elevated tritium in lysimeter HFEF-South is discussed in Section 5.2.1.

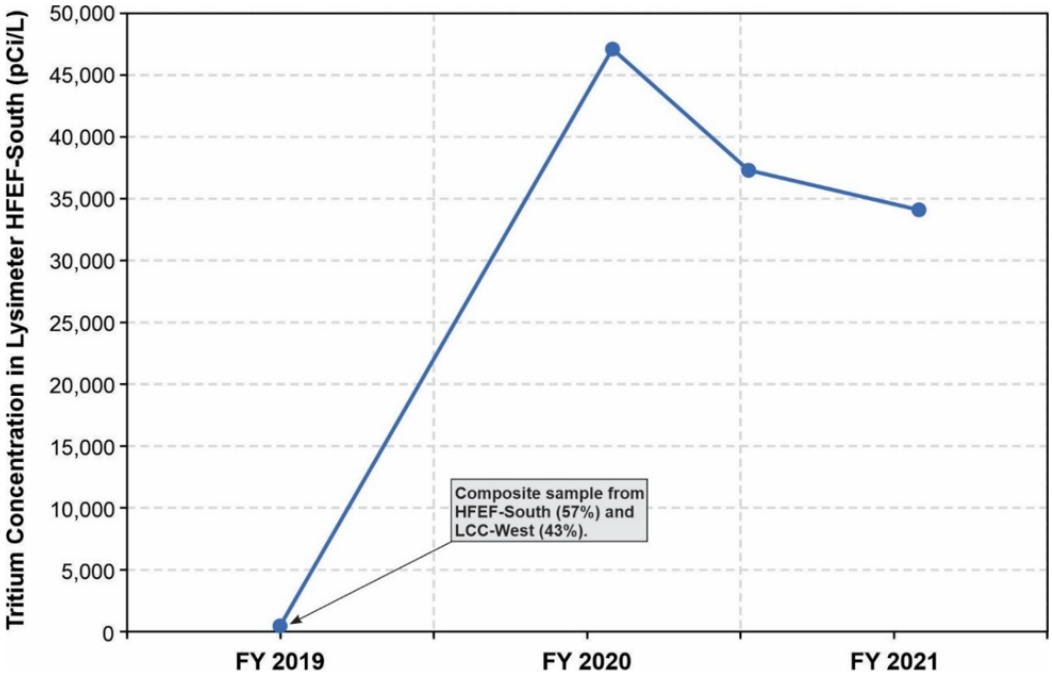

Figure 6. Tritium concentration time history in lysimeter HFEF-South.

5.2.1 Evaluation of Elevated Tritium in Lysimeter HFEF-South

As a result of the unexpectedly high tritium result in lysimeter HFEF-South in spring 2020, several actions were taken to better understand the result. All actions were documented in accordance with LWP-13840, "Issues Management." The actions and findings are documented in the white paper, *Evaluation of Elevated Tritium in Lysimeter Samples at the Remote-Handled Low-Level Waste Disposal Facility* (Sondrup 2022). Below is a summary of findings.

- The elevated tritium level in soil porewater collected from lysimeter HFEF-South is valid. Measurements from subsequent samples (fall 2020 and spring 2021) indicate the concentration is slowly decreasing.
- The source of the elevated concentration cannot be credibly traced to tritium in the perched water at the nearby ATR Complex, water used for facility construction and infiltration tests, or other natural or anthropogenic sources not related to the RHLLW Disposal Facility.
- The contents of waste containers placed at the facility is not a credible source of the elevated tritium. However, small amounts of tritium (well below established limits) present on the exteriors of some waste containers is a potential source and offers a plausible explanation for the elevated concentration.
- The current levels of tritium detected in soil-porewater samples from lysimeter HFEF-South represent an insignificant impact to the aquifer and health risk to the public.

Based on the evaluation findings, subsequent actions and recommendations were made. These include:

- The sampling frequency of six lysimeters was increased from annual to semi-annual. These lysimeters include HFEF-South, and five others nearby (HFEF-South-45, NuPac-East, LCC-West, LCC-West-45, and MFTC-West). The fall samples will be analyzed for tritium only. Tritium concentrations in porewater samples from HFEF-South collected since the original elevated concentration detection, confirm that semi-annual sampling is adequate (see Figure 6).
- Tritium monitoring of all lysimeters will continue at least annually after the 3-year baseline period even if screening levels for gross alpha and gross beta are not exceeded.
- Smears of the outside of waste containers will be analyzed for tritium if they are accessible and are not a high radiation worker exposure concern.
- All tritium concentrations will continue to the be tracked and reported in the RHLLW Disposal Facility ASRs to DOE-EM.
- Baseline tritium sampling results will be incorporated into the INL Annual Site Environmental Reports.

Table 9. Compliance monitoring summary for the RHLLW Disposal Facility in FY 2021.

Monitoring Location	Monitoring Type	Monitoring Results	Performance Objective Measure or Other Regulatory Limit	Action Level	Action Taken	PA/CA Impacts
RHLLW Disposal Facility Vicinity (Aquifer wells USGS-136, USGS-140, and USGS-141)	Groundwater (gross alpha, gross beta, and target analytes C-14, H-3, I-129 and Tc-99)	H-3 was detected in all three aquifer wells. Gross beta was positively detected in all three wells, while gross alpha was detected only in 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)	Aquifer Maximum Contaminant Levels	No actions taken. Annual sampling will continue as long as performance-monitoring actions levels are not exceeded after the 3-year baseline period (see Section 5.2).	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 2021.

Monitoring Location	Monitoring Purpose	Monitoring Results and Trends	PA Expected Behavior	Action Taken	PA/CA Impacts
Vadose zone lysimeters adjacent to and below the disposal vaults. Moisture content data reviewed to determine time to sample.	Provide data to establish baseline concentrations for future performance monitoring. Period to establish baseline is 3 years (2019-2021). Provide data to indicate potential radionuclide release from source zone and migration toward aquifer.	All 21 of the lysimeters yielded water, and 8 yielded sufficient water for the full suite of analytes. All sample concentrations were non-detects or less than action levels with one exception. The gross-alpha result for the PA-North lysimeter sample (11.3 pCi/L) is greater than the action level of 10 pCi/L. The HFEF-South lysimeter sample results for H-3 [37,300 pCi/L (fall 2020), 34,100 pCi/L (spring 2021)] exceed the drinking water MCL of 20,000 pCi/L but concentrations continue to decrease from the high value in spring 2020 (47,100 pCi/L). MCLs do not apply to porewater, but are used for comparison purposes only.	FY 2021 is the third year of a 3-year period to establish baseline concentrations for the facility. Because very little waste has been emplaced and only in one location, 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).	Continue with annual spring sampling except for the tritium monitoring in selected lysimeters conducted in the fall. The 3 years of baseline data will be evaluated in FY-2022 and any changes to the monitoring schedule or monitoring plan will be determined.	None. No changes to PA/CA results and conclusions.

CA = composite analysis
PA = performance assessment

6. RESEARCH AND DEVELOPMENT

No research and development activities were conducted at the RHLLW Disposal Facility in FY 2021 (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. The only planned change is a revision to a technical-basis document. Other activities listed are not considered changes, but are more accurately the commencement of anticipated activities associated with generation, shipment, receipt, and disposal of waste from the ATR Complex and NRF. The only other change involves more frequent sampling of selected lysimeters for tritium analysis that began in FY 2020 and continued in FY 2021. No changes are planned or contemplated for facility design, construction, operations, or closure.

The only planned change to a technical-basis document is revision of the change-control process document (SD-52.1.4). SD-52.1.4 was updated to include mandatory UDQSs of all RHINO SCRs consistent with the decision discussed in the FY 2019 ASR. SCRs completed previous to the change were evaluated in UDQE-RHLLW-042 (INL 2021), and UDQE-RHLLW-044 (see Table 2). Additionally, SD-52.1.4 is being changed from a sitewide standing directive (SD) to a facility administrative procedure document (ADM) at the request of the MFC associate laboratory director. This involves formatting changes and a new document number. The new document will be identified as RH-ADM-5214 and will be finalized in early FY 2022.

The RHLLW Disposal Facility is anticipating the receipt of activated metal waste from the ATR Complex and NRF to commence in FY 2022 (see Section 2.9.1). ATR Complex and NRF activated metal waste will be shipped in canisters that are modifications or upgrades compared to what was assumed in the PA. The modifications were discussed in last year's ASR and the design and fabrication of the new canisters is complete. Disposal of these waste streams is not considered a change, but involves the disposal of waste canisters not previously disposed of in vaults that have not yet received waste. In preparation, initial generator certification FEs for both the ATR Complex and NRF will be conducted in FY 2022, and operational readiness activities are scheduled at the RHLLW Disposal Facility.

As discussed in last year's ASR, selected lysimeters were sampled in the fall of 2020 and analyzed for tritium. This is in addition to planned annual sampling in response to an unexpectedly high tritium concentration in lysimeter HFEF-South in spring of 2020. In addition, data from all lysimeters collected during the 3-year baseline period (FY 2019 through FY 2021) will be evaluated in FY 2022. This evaluation will be documented in a report with recommendations to either extend the baseline period or move to the next phase. This is discussed in Section 5.

None of the planned changes discussed in the section are expected to impact the PA, CA, ODAS, or the RHLLW Disposal Facility design, operations, closure, research and development, or land use.

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

Planned or Contemplated Change	Change Basis	PA/CA Impact	Schedule
Revise Change-Control Process document SD-52.1.4	Decision to include mandatory screening of all RHINO SCRs in the change-control process. Management decision to change document from a standard directive (SD) to an administrative document (ADM).	None	FY 2022
ATR Complex waste generator certification	Anticipated commencement of shipment and disposal of activated metal waste stream from ATR Complex. Initial FE will be performed in accordance with MCP-4211 to certify ATR Complex as a generator of ATR-5 waste canisters containing activated metals. Operational readiness activities for receipt and disposal of ATR-5 waste canisters scheduled for FY 2022.	None	FY 2022
NRF waste generator certification	Anticipated commencement of shipment and disposal of activated metal waste stream from NRF. Initial FE will be performed in accordance with MCP-4211 to certify NRF as a generator of NRF 55-ton waste canisters containing activated metals. Operational readiness activities for receipt and disposal of NRF 55-ton waste canisters scheduled for FY 2022.	None	FY 2022
Lysimeter sample collection from selected lysimeters	Unexpectedly high tritium concentration in lysimeter HFEF-South. Continue increased frequency of lysimeter sample collection from selected lysimeters and analyze for tritium only. Evaluate three years of baseline samples for all lysimeters and make recommendations to extend the baseline period or move to the next phase according to the monitoring plan (PLN-5501).	The impact of the high tritium concentration was evaluated and the impact was determined to be insignificant.	FY 2022

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 2021.

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. Example of 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 & Date Completed	PA, CA, ODAS Impact
N/A[a]						

a. Not applicable for FY 2021.

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 2021 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 consistent with assumptions of the PA and CA (Section 4).
- Compliance and performance monitoring results indicate assumptions and conclusions of the PA and CA are appropriate (Section 5).
- One modification to a technical-basis document (PA/CA Maintenance Plan, PLN-3368) was performed in FY 2021, and a minor modification to the change-control process document (SD-52.1.4) will be completed early in FY 2022 (Section 7). None of these corrections or modifications are significant changes that would challenge the continued validity of the RWMB. Projected disposal operations indicate continued compliance with the RWMB (Section 2). The RWMB was submitted to DOE for review and approved by the Field Element Manager on December 11, 2020 (FY 2021). The next RWMB review is scheduled for early FY 2023.

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Appendix A

Fiscal Year 2021 Unreviewed Disposal Question Screens and Evaluations for the RHLLW Disposal Facility

Appendix A

Fiscal Year 2021 Unreviewed Disposal Question Screenings and Evaluations for the RHLLW Disposal Facility

This appendix includes copies of UDQSs and UDQEs that were completed and approved by the end of FY 2021. Evaluations that were initiated but not completed are listed as "in progress" in Table 2 of the ASR are not included here. Evaluations that were cancelled are also not included here. No special analyses were completed in FY 2021, and none are expected to be required based on current UDQSs/UDQEs in progress. The following evaluations are included herein:

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

UDQE Tracking No.: UDQE-RHLLW-034

Subject: RHINO Acceptance Check of Canister MFC190345, Flagged 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 MFC190345 is an HFEF-5 canister containing activated metal waste with surface contamination from MFC that was generated after 4/21/2015. This waste stream is described in the RHLLW Disposal Facility performance assessment (PA) as HFEF future generation waste. 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. Canister MFC190345 was flagged by RHINO based on the following inventory checks:

PA Check 1: PA Base Case Inventory Check by Generator/Canister/Waste Form

This check was flagged by RHINO because the cumulative inventory of four radionuclides (Ba-137m, Np-237, Pa-233 and Th-231) exceed levels analyzed in the PA for this generator, canister type and waste form. The cumulative inventory includes the inventory of placed plus proposed canisters. Of the four radionuclides, three (Ba-137m, Pa-233 and Th-231) were screened out during preparation of the PA as part of the three-phase screening process, and dose impacts from these radionuclides are not included in the PA all-pathway dose. The fourth radionuclide, Np-237, is a key radionuclide meaning it was not screened out during preparation of the PA and dose impacts are included in the PA all-pathway dose. Radionuclide inventories that result in or contribute to the cumulative inventory exceeding the inventory levels analyzed in the PA (see INL/EXT-18-45184) must be reviewed to determine if the dose impacts are within the bounds of the approved PA.

PA Check 2: Administrative 10% Canister Inventory Check (Key Radionuclides Only)

This flag was checked by RHINO because the canister inventory of two key radionuclides (Np-237 and Pu-240) exceed the 10% threshold levels of the inventory analyzed in the PA for this generator, canister type and waste form. 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). If the 10% threshold is exceeded, the inventory is reviewed to determine if the canister radionuclide inventories are anomalous occurrences or indicative of a change in waste generation rates.

PA Check 3: Unanalyzed/Not Exempt Radionuclide Check

This check was flagged by RHINO because the canister inventory contains a reportable radionuclide (Nb-93m) that was not reported in the PA for the specific generator, canister type and waste form (see WAC, PLN-5446, Appendix B tables) and is not exempt (see WAC, PLN-5446, Table 1). A radionuclide is reportable if the half-life is greater than 1 year and the inventory is greater than 1% of the total canister inventory. Unanalyzed or non-exempt radionuclides are not accepted for disposal without additional evaluation per SD-52.1.4.

According to INL/EXT-18-45184 and the RHLLW WAC (PLN-5446), the radionuclide inventory of any canister that causes the cumulative inventory for a specific generator, canister type and waste form to exceed the inventory analyzed in the PA, must be reviewed according to SD-52.1.4 to determine if the cumulative inventory is within the bounds of the approved PA. Additionally, any canister inventory levels that exceed canister 10% threshold levels must be reviewed to determine if the canister inventory is an anomalous occurrence or indicative of a change in waste generation rates. Exceedance of threshold values does not indicate a canister is unacceptable for disposal but

requires the inventory levels be reviewed. If after review, it is determined the inventory levels (both canister and cumulative) are within the bounds of the approved PA, the 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: Canister MFC190345 contains radionuclides whose inventory levels exceed canister inventory threshold levels analyzed in the PA for a specific generator, canister type and waste form. The canister also contains radionuclides whose inventories cause the cumulative inventory for the specific generator, canister type and waste form to exceed the cumulative inventory analyzed in the PA, or result in an increase from a level that already exceeded the cumulative inventory analyzed in the PA. And lastly, the canister contains a radionuclide not analyzed in the PA. According to INL/EXT-18-45184 and the RHLLW WAC (PLN-5446), the exceedances must be evaluated to determine if the inventory levels that exceed threshold levels are an anomalous occurrence or indicative of a change in waste generation rates, and the cumulative inventory and the inventory of any unanalyzed radionuclides is within the bounds of the approved PA. A UDQE 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

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	Jonathan Jacobson	11/23/2020
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
J Mayer	J Mayer	11/23/2020
Print/Type Name Approver/NFM	Signature Approver/NFM	Date

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.

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

Explanation

The three PA inventory checks performed and flagged by RHINO on waste canister MFC190345 were evaluated as part of this UDQE. The flagged checks are highlighted yellow on the RHINO output shown in Figure 1 and the detailed results from each check are shown at the lower part of the figure. Checks shown as 9 and 10 in Figure 1 are the same check but the results for key and non-key radionuclides are shown in separate rows. The evaluations of each of these checks are described below.

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	8.5244E-006	1	mrem/yr	Compliance	11/18/2020
	Yes	All Pathways Dose	4.9652E-003	12.5	mrem/yr	Post Compliance	11/18/2020
2	Yes	Beta-Gamma DE	6.0545E-006	0.16	mrem/yr	Compliance	11/18/2020
	Yes	Beta-Gamma DE	3.5248E-003	2.4	mrem/yr	Post Compliance	11/18/2020
3	Yes	Ra-226/228	8.2049E-034	0.2	pCi/L	Compliance	11/18/2020
	Yes	Ra-226/228	7.6675E-008	2.5	pCi/L	Post Compliance	11/18/2020
4	Yes	Gross Alpha	1.8713E-031	0.6	pCi/L	Compliance	11/18/2020
	Yes	Gross Alpha	3.9856E-007	7.5	pCi/L	Post Compliance	11/18/2020
5	Yes	Beta-Gamma ED	3.3125E-006	0.16	mrem/yr	Compliance	11/18/2020
	Yes	Beta-Gamma ED	1.9285E-003	2	mrem/yr	Post Compliance	11/18/2020
6	Yes	Uranium	7.0627E-029	1.2	ug/L	Compliance	11/18/2020
	Yes	Uranium	1.3380E-006	15	ug/L	Post Compliance	11/18/2020
7	Yes	Intruder	2.4724E-003	20	mrem/yr	Compliance	11/18/2020
8	Yes	Air Pathway	1.2068E-007	0.4	mrem/yr	Compliance	11/18/2020
9	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	-			Compliance	11/18/2020
10	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-			Compliance	11/18/2020
11	No	Administrative 10% Canister Inventory Check (Key Radionuclides)	-			Compliance	11/18/2020
12	No	Unanalyzed/Not Exempt Nuclides Check	-			Compliance	11/18/2020
13	Yes	Canister Action Levels Check	-			Compliance	11/18/2020

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	Cumlative PA Amount (Ci)	Limit Inv (Ci)	Canister Contribution (Ci)
Ba-137m [Details]	S	HFEF-5 Can	MFC	2	East	2.6276E-001	1.3503E-002	3.0800E-002
Np-237 [Details]	S	HFEF-5 Can	MFC	2	East	1.8989E-007	6.8565E-008	2.1100E-008
Pa-233 [Details]	S	HFEF-5 Can	MFC	2	East	1.6892E-007	2.0675E-017	2.1000E-010
Th-231 [Details]	S	HFEF-5 Can	MFC	2	East	3.9415E-007	4.7750E-011	2.6100E-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)
Np-237	S	MFC	HFEF-5 Can	2	2.1100E-008	6.8565E-008	6.8565E-009
Pu-240	S	MFC	HFEF-5 Can	2	7.0500E-006	6.1053E-005	6.1053E-006

12. PA Unanalyzed Nuclides (With a half-life > 1 year and more than 1% of canister activity) (Canister Specific)

Nuclide	Form	Generator	Array	Amount (Ci)	Half Life (y)	%
Nb-93m	A	MFC	2	1.1000E-001	1.6100E+001	1.465

Figure 1. PA Check output screen from RHINO for waste canister MFC190345.

PA Check 1: PA Base Case Inventory Check by Generator/Canister/Waste Form

This check was flagged by RHINO because the cumulative inventory of four radionuclides (Ba-137m, Np-237, Pa-233 and Th-231) exceed levels analyzed in the performance assessment (PA, DOE/ID-11421) for this generator, canister type and waste form (see Checks 9 and 10 in Figure 1). The cumulative inventory includes the inventory of placed plus proposed canisters. Radionuclide inventories that result in or contribute to the cumulative inventory exceeding the inventory levels analyzed in the PA (see INL/EXT-18-45184) must be reviewed to determine if the dose impacts are within the bounds of the approved PA.

The evaluation determined three of the four radionuclides (Ba-137m, Pa-233 and Th-231) were screened from the groundwater pathway analysis because their respective half-lives are all less than 1 year. According to the PA, a radionuclide with a one-year half life would have 9.3E-10 times its original activity after 30 years, the

approximate time it would take a non-sorbing tracer to migrate from land surface to the aquifer. Therefore, the Ba-137m, Pa-233 and Th-231 inventories in canister MFC190345 will have an insignificant impact on the PA all pathway dose and the inventories are within the bounds of the approved PA.

The fourth radionuclide, Np-237, is a key radionuclide meaning it was not screened out during preparation of the PA and dose impacts are included in the PA all-pathway dose. Table 1 compares the proposed cumulative inventory of Np-237 as surface contamination to other PA inventories. The cumulative Np-237 inventory in the RHLLW Disposal Facility after disposal of canister MFC190345 would be 1.9E-07 Ci (Column 6) for this generator (MFC legacy and future generation), canister type (HFEF-5) and waste form (surface contamination). This exceeds the PA inventory (6.86E-08 Ci, Column 7) for this generator, canister type and waste form. This however is expected because canister MFC170305, an HFEF-5 future-generation waste canister placed in the facility on 11/21/2019, contained more Np-237 as surface contamination than was analyzed in the PA (1.49E-07 Ci) (see ECAR-4033 and UDQE-RHLLW-032). Therefore, all future HFEF-5 canisters from MFC that report Np-237 will be flagged by RHINO for exceeding the PA inventory.

Table 1. Np-237 inventory summary for PA Check 1.

1	2	3	4	5	6	7	8	9
Radionuclide	Generator	Canister Type	Waste Form	Canister MFC190345 Inventory[a] (Ci)	Projected Cumulative RHLLW Facility Inventory (Placed + Proposed Canister MFC190345)[a] (Ci)	PA Inventory (MFC HFEF-5 Canisters)[a] (Ci)	PA Inventory (All Generators, Canisters, as Surface Contamination)[b] (Ci)	PA Inventory (All Generators, Canisters, Waste Forms)[b] (Ci)
Np-237	MFC	HFEF-5	Surface	2.11E-08	1.90E-07	6.86E-08	5.82E-04	6.95E-04

a. Includes legacy (before 4/21/15) and future generation (after 4/21/15) waste.
b. Table 2-14, RHLLW Performance Assessment (DOE/ID-11421).

Table 1 shows the projected cumulative inventory of Np-237 (1.90E-07 Ci, Column 6) is only 0.033% of the total Np-237 surface contamination in all waste streams (5.82E-04 Ci, Column 8) and 0.027% of the total Np-237 in all waste forms analyzed in the PA (6.95E-04 Ci, Column 9). Based on this the proposed dose increase should be minimal. This is evidenced by the proposed PA all pathways dose for the compliance period shown in row 1 of Figure 1. The proposed dose would be 8.52E-06 mrem/year and 4.97E-03 mrem/yr for the post-compliance period after disposal of MFC190345. These values are significantly less than the PA limit of 25 mrem/yr from DOE Order 435.1-1. Based on this, the Np-237 inventory in canister MFC190345 has a minimal impact on the PA all pathway dose and the inventory is within the bounds of the approved PA.

PA Check 2: Administrative 10% Canister Inventory Check (Key Radionuclides Only)

This flag was checked by RHINO because the canister inventory of two key radionuclides (Np-237 and Pu-240) exceed the 10% threshold levels of the inventory analyzed in the PA for this generator, canister type and waste form. 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). If the 10% threshold is exceeded, the inventory is reviewed to determine if the canister radionuclide inventories are anomalous occurrences or indicative of a change in waste generation rates.

Np-237—The activity of Np-237 in waste canister MFC190345 is 2.11E-08 Ci and thus greater than the 10% threshold level for this generator, canister type and waste form (6.86E-09 Ci, INL/EXT-18-45184). Canister MFC190345 is only the second canister of future-generation waste from MFC submitted for disposal. The first canister, MFC170305, was placed on 11/21/2019 and contained an estimated 1.49E-07 Ci Np-237 as surface contamination which is also greater than the 10% threshold level. So while the Np-237 in canister MFC190345 is not anomalous when compared to the other HFEF-5 future-generation waste canisters, both canisters contain Np-237 at levels that are elevated from what was analyzed in the PA.

Pu-240—The activity of Pu-240 in waste canister MFC190345 is 7.05E-06 Ci and is slightly greater than the 10% threshold level for this generator, canister type and waste form (6.11E-06 Ci combined for legacy and future waste, INL/EXT-18-45184). Canister MFC190345 is only the second canister of future-generation waste from MFC submitted for disposal. The first canister, MFC170305, was placed on 11/21/2019 and contained an estimated 4.99E-05 Ci Pu-240 as surface contamination which is also greater than the 10% threshold level. So, while the Pu-240 in canister MFC190345 is not anomalous when compared to the other HFEF-5 future-generation waste canisters, both canisters contain Pu-240 at levels that can be considered elevated from what was analyzed in the PA.

It is likely the Np-237 and Pu-240 inventories in canister MFC190345 were flagged by RHINO because the canister was loaded with waste from the Fuel Conditioning Facility at MFC. Of the 23 waste canisters used to estimate the inventory of future-generated (non-legacy) waste for the PA, 22 of the 23 were loaded with waste from the Hot-Fuel Examination Facility (HFEF) and only 1 was loaded with waste from FCF. Nevertheless, the Np-237 and Pu-240 inventories in canister MFC190345 are consistent with canister MFC170305 (also from FCF) and do not represent a significant increase in the facility inventory.

Table 2 compares the Np-237 and Pu-240 surface contamination inventories in canister MFC190345 (Column 2) to the total PA inventories in MFC HFEF-5 canisters (Column 3) and to the inventories for the entire facility (Column 5). The MFC190345 inventories are less than the MFC inventories in legacy and future generation waste from MFC in HFEF-5 canisters (Column 4) and significantly less (<, 1%) than the total PA inventory for all generators (Column 6).

Table 2. Np-237 and Pu-240 inventory summary for PA Check 2.

1	2	3	4	5	6
Radionuclide	Canister MFC190345 Inventory (Ci)	PA Inventory (MFC, HFEF-5 Canisters) (Ci)	Canister MFC190345 Inventory as % of PA Inventory for MFC HFEF-5 Canisters	PA Inventory (All Generators, All Canisters) (Ci)	Canister MFC190345 Inventory as % of PA Inventory for All Generators and Canisters
Np-237	2.11E-08	6.87E-08	30.7%	5.82E-04	0.004%
Pu-240	7.05E-06	6.10E-05	11.6%	2.28E-03	0.31%

a. Includes Legacy and Future Generation waste

Based on this information the inventories of Np-237 and Pu-240 in MFC190345 do not appear to be anomalous occurrences or indicative of a change in waste generation rates and are within the bounds of the approved PA.

PA Check 3: Unanalyzed/Not Exempt Radionuclide Check

This check was flagged by RHINO because the canister inventory contains Nb-93m, a reportable radionuclide that was not reported in the PA for the specific generator, canister type and waste form (see WAC, PLN-5446, Appendix B tables), and is also not exempt according to the WAC (PLN-5446, Table 1). A radionuclide is reportable if the half-life is greater than 1 year and the inventory is greater than 1% of the total canister inventory. Unanalyzed or non-exempt radionuclides are not accepted for disposal without additional evaluation per SD-52.1.4

The reported Nb-93m activity in activated metal in canister MFC190345 is 0.11 Ci which is 1.46% of the total canister activity. Nb-93m has a half-life of 16.1 years which is relatively short compared to the compliance period. Additionally, the canister inventory is only 0.022% of the total Nb-93m in activated metal considered in the PA (494 Ci, DOE/ID-11421 Table 2-14). Because Nb-93m was screened from the PA groundwater pathway and the activity in the canister is small compared to the activity reported for the PA, the dose impact is insignificant and within the bounds of the approved PA. Because the activity is relatively small and this is only the second canister of future-generation waste from MFC, it is not necessarily indicative of a change in waste generation rates.

Summary— The radionuclide activities in canister MFC190345 have been evaluated and the dose impacts are expected to be very small or insignificant and within the bounds of the approved PA. While the presence of some radionuclides in the waste canister may be anomalous and/or different from assumed in the PA, their presence is not necessarily indicative of a change in waste generation rates. This will be examined as additional waste canisters of HFEF-5 future-generation waste canisters are considered for disposal. Based on this evaluation, this canister is deemed acceptable for disposal.

Print/Type Name	Signature	Date
Jonathan Jacobson Originator/FDS	Jonathan Jacobson Originator/FDS	11/23/2020
Allen Prather System Engineer/SE	A. R. Prather System Engineer/SE	11/23/20
Jeff Sondrup PA/CA SME	Jeff Sondrup PA/CA SME	11/23/20
Amy Cox Waste Management/WMP	Amy M Cox Waste Management/WMP	11/24/2020
James Mayer Nuclear Facility Manger/NFM	JAMES MAYER (Affiliate) Digitally signed by JAMES MAYER (Affiliate) Date: 2020.11.24 09:32:12 -07'00' Nuclear Facility Manger/NFM	11/24/2020

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

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

UDQE Tracking No.: UDQE-RHLLW-035

Subject: Unanalyzed PA nuclides discovered after completion of SCR-RHINO-004

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 (RHLLW) Inventory Online (RHINO) database is a software application developed to assist the RHLLW Disposal Facility in accepting, managing, and tracking receipt of waste. All RHINO Software Change Requests (SCRs) are managed using the change-control process. All 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.

SCR-RHINO-004 was completed and approved on 10/13/2020. Changes made to RHINO by SCR-RHINO-004 were evaluated in UDQE-RHLLW-044. Those changes screened negative and UDQE-RHLLW-044 was approved on 11/5/2020. One of the changes made to RHINO as part of SCR-RHINO-004 was to identify radionuclides not included in the PA base-case inventory for a particular generator, container type and waste form. These are referred to as unanalyzed radionuclides. 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 SD-52.1.4, "RHLLW Disposal Facility DOE O 435.1 Documentation Change Control."

Upon completion of SCR-RHINO-004, all previous disposals (29 containers) were analyzed by RHINO for unanalyzed radionuclides. According to RHINO, there were 15 radionuclides that were not analyzed in the PA (see Table 1 below). Because the unanalyzed radionuclides are a potential change to what was considered in the PA, the purpose of this UDQE is to evaluate these previously disposed of unanalyzed radionuclides to determine the potential impact on the conclusions of the PA. Unanalyzed radionuclides identified after this will be evaluated by individual containers as they are submitted for acceptance.

Table 1. Unanalyzed radionuclides and inventories identified by RHINO in the first 29 containers disposed of at the RHLLW disposal facility.

Unanalyzed PA Nuclides							
Nuclide	**Name**	**Half Life**	**Form**	**Gen**	**Array**	**Vault Type**	**Amount (Ci)**
Be-10	Beryllium	1.5100E+006	A	MFC	Array 02	HFEF-5 Can	1.0700E-008
K-40	Potassium	1.2500E+009	A	MFC	Array 02	HFEF-5 Can	7.0000E-028
Na-22	Sodium	2.6000E+000	A	MFC	Array 02	HFEF-5 Can	1.6500E-019
Nb-92	Niobium	3.4900E+007	A	MFC	Array 02	HFEF-5 Can	9.9100E-007
Nb-93m	Niobium	1.6100E+001	A	MFC	Array 02	HFEF-5 Can	1.9692E-001
Pa-231	Protactinium	3.2600E+004	S	MFC	Array 02	HFEF-5 Can	9.2994E-011
Ra-228	Radium	5.7400E+000	S	MFC	Array 02	HFEF-5 Can	3.1435E-023
Rh-102m	Rhodium	2.9000E+000	A	MFC	Array 02	HFEF-5 Can	1.7300E-012
Si-32	Silicon	1.5300E+002	A	MFC	Array 02	HFEF-5 Can	8.8400E-007
Sr-90	Strontium	2.8900E+001	A	MFC	Array 02	HFEF-5 Can	9.1700E-015
Tc-98	Technetium	4.2100E+006	A	MFC	Array 02	HFEF-5 Can	1.8300E-009
Tc-99	Technetium	2.1100E+005	A	MFC	Array 02	HFEF-5 Can	7.5450E-003
Th-228	Thorium	1.9100E+000	S	MFC	Array 02	HFEF-5 Can	2.6375E-023
Th-232	Thorium	1.4000E+010	S	MFC	Array 02	HFEF-5 Can	4.8206E-023
Zr-93	Zirconium	1.5300E+006	A	MFC	Array 02	HFEF-5 Can	2.2740E-007

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:

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: The RHINO unanalyzed radionuclide check is based on generator, waste form and container type. A radionuclide identified as unanalyzed for a particular generator may or may not have been submitted by a different generator for consideration in the PA. And because the PA screening did not consider generator, waste form or container type, the radionuclide may have been considered in the PA. However, the inventory may be different than what was considered in the PA. Therefore, the unanalyzed radionuclides identified by RHINO and their inventories should be evaluated for impact to the 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:

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:

Need to evaluate the list of previously disposed of unanalyzed radionuclides to determine potential impacts to the conclusions of the PA.

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	Jonathan Jacobson	6/2/2021
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
James Mayer	J Mayer	6/2/2021
Print/Type Name Approver/NFM	Signature Approver/NFM	Date

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:

Table 2 contains the unanalyzed radionuclides and inventories for the 29 containers previously disposed of at the RHLLW disposal facility as identified by RHINO. The last column of the table also explains why the radionuclide is not a concern from a PA groundwater pathway perspective. These findings are summarized below.

Groundwater Pathway Evaluation for Unanalyzed Radionuclides

Of the 15 radionuclides identified, only two (Na-22, Rh-102m) were not listed in the PA base case inventory. Due to the short half lives (2.6 years, 2.9 years) and the small amounts of activity (1.64E-19 Ci, 1.73E-12 Ci), these radionuclides are not groundwater pathway concerns and there is no impact to the conclusions of the PA (DOE-ID 2018). In addition, the radionuclide activities are small enough that they are not reportable according to the WAC (Section 2.1). The lowest

activity container of the 29 containers placed is 14 Ci (Container MFC170305). Based on this, radionuclides not included in Table A-13 with an activity less than 0.14 Ci do not have to be reported. Based on this, Nb-93m with a total inventory of 0.197 Ci is the only radionuclide that is potentially reportable. Nevertheless, the other radionuclides were examined for their potential impact to the PA as discussed below.

Of the 13 other radionuclides, 12 (Tc-99 excluded) were eliminated during the PA Phase II or Phase III groundwater pathway screening. The total inventory of nine of the 12 radionuclides (Be-10, K-40, Nb-93m, Pa-231, Ra-228, Sr-90, Th-228, Th-232, Zr-93) in the 29 containers is less than 0.1% the PA base case inventory and in most cases much less than 0.1%. These inventory ratios are highlighted green in Table 2. Based on this, these radionuclides are not groundwater pathway concerns and there is no impact to the conclusions of the PA.

The total inventory for three of the 12 radionuclides eliminated during PA screening is greater than 0.1% of the PA base case inventory and the inventory of one of the three radionuclides (Si-32) is greater than the PA base case inventory. These inventory ratios are highlighted yellow in Table 2. Although the total inventory in the 29 containers of these three radionuclides is a higher fraction of the PA inventory, a comparison of inventory ratios and the screening dose to inventory ratio from the PA shows that these inventories also would have been screened out in the PA. Therefore, these radionuclides are not groundwater pathway concerns and there is no impact to the conclusions of the PA.

The remaining radionuclide, Tc-99, is reportable according to the WAC (Section 2.1, Table A-13), but was identified as unanalyzed because it is not in WAC Table B-4 (legacy waste) or B-5 (future-generation waste) as an activated metal, only as surface contamination. However, Tc-99 is listed in the PA base case inventory as an activated metal in the ATR waste stream destined for the HFEF vault array. Therefore, the dose contribution calculated by RHINO is included in the all-pathway dose. Thus, there is no concerns with this being reported as an unanalyzed radionuclide.

Intruder Pathway Evaluation for Unanalyzed Radionuclides

None of the unanalyzed radionuclides were included in the top 5 intruder dose contributors in the PA, Nevertheless, the unanalyzed radionuclides were evaluated to determine their potential impact on the PA intruder dose calculations. This was done by calculating the intruder doses for the inventory of unanalyzed radionuclides in the 29 containers. This evaluation was performed using the dose-to-source ratios from the PA (ECAR-2073 Rev 2). The results shown in Table 3 show the total maximum acute dose from all unanalyzed radionuclides is 7.04E-08 mrem and the total chronic dose from all unanalyzed radionuclides is 4.4E-05 mrem/yr. These doses are an insignificant fraction of the total doses in the PA (3.19 mrem, Acute; 5.42 mrem/yr, Chronic). Based on these results, the unanalyzed radionuclides will have an insignificant impact on the conclusions of the PA.

Summary

Based on an evaluation of unanalyzed radionuclides identified in the first 29 containers placed at the RHLLW disposal facility for dose potential to both the groundwater and intruder pathways, it was determined the radionuclides and inventories will have an insignificant impact on the conclusions of the PA. Therefore, no further action is required.

Table 2. Groundwater pathway evaluation of unanalyzed radionuclides in the 29 containers previously disposed of at the RHLLW disposal facility.

Nuclide	Half-Life (yr)	Waste Form	Gene-rator	Unanalyzed Inventory (Ci)	PA Total Base Case Inventory (Ci)	Ratio Unanalyzed Inventory to PA Total Inventory	PA Ground-water Screening Phase Eliminated	Explanation
Be-10	1.51E+06	A	MFC	1.07E-08	1.58E-04	6.77E-05[a]	II	Radionuclide eliminated during the PA screening and the unanalyzed activity is much less than 0.1% of PA base case inventory for all generators. Therefore, there is no impact to the conclusions of the PA.
K-40	1.25E+09	A	MFC	7.00E-28	5.06E-04	1.38E-24[a]	III	Radionuclide eliminated during the PA screening and the unanalyzed activity is much less than 0.1% of PA base case inventory for all generators. Therefore, there is no impact to the conclusions of the PA.
Na-22	2.60E+00	A	MFC	1.65E-19	None	NA	NA	Na-22 was not reported in the PA base case inventory. However, the activity and half-life (2.56 years) of Na-22 preclude this from being a groundwater concern. According to the PA, the transit time through the vadose zone for a non-sorbing tracer is 30 years based on an average INL sediment thickness and a conservative infiltration rate. After 30 years, Na-22 would have 0.0003 times its original activity or 5.55E-23 Ci. This is significantly less than the WAC reporting level for each of the 29 placed containers.
Nb-92	3.49E+07	A	MFC	9.91E-07	4.43E-06	2.24E-01[b]	III	The Phase III screening dose from Nb-92 in the PA base case inventory is approximately 1.3E+06 times less than the PA screening value (0.4 mrem/yr). Because the unanalyzed inventory is 4 times less than the PA screening inventory, and because the Phase III screening process is conservative, the unanalyzed Nb-92 inventory will not impact the conclusions of the PA.
Nb-93m	1.61E+01	A	MFC	1.97E-01	570	3.45E-04[a]	III	Radionuclide eliminated during the PA screening and the unanalyzed activity is much less than 0.1% of PA base case inventory for all generators. Therefore, there is no impact to the conclusions of the PA.
Pa-231	3.26E+04	S	MFC	9.30E-11	6.68E-06	1.39E-05[a]	III	Radionuclide eliminated during the PA screening and the unanalyzed activity is much less than 0.1% of PA base case inventory for all generators. Therefore, there is no impact to the conclusions of the PA.
Ra-228	5.74E+00	S	MFC	3.14E-23	2.28E-07	1.38E-16[a]	II	Radionuclide eliminated during the PA screening and the unanalyzed activity is much less than 0.1% of PA base case inventory for all generators. Therefore, there is no impact to the conclusions of the PA.
Rh-102m	2.90E+00	A	MFC	1.73E-12	None	NA	NA	Rh-102m was not reported in the PA base case inventory. However, the activity and half-life (2.9 years) of Rh-102m preclude this from being a groundwater concern. According to the PA, the transit time through the vadose zone for a non-sorbing tracer is 30 years based on an average INL sediment thickness and a conservative infiltration rate. After 30 years, Rh-102m would have 0.0008 times its original activity or 1.33E-15 Ci. This is significantly less than the minimum WAC reporting level for each of the 29 placed containers.
Si-32	1.53E+02	A	MFC	8.84E-07	3.28E-07	2.70[b]	II	The Phase II screening dose from Si-32 in the PA base case inventory is approximately 21 times less than the PA screening value (0.4 mrem/yr). Because the unanalyzed inventory is only 2.7 times the PA screening inventory, and because the

								Phase II screening process is very conservative, the unanalyzed Si-32 inventory will not impact the conclusions of the PA.
Sr-90	2.89E+01	A	MFC	9.17E-15	673	1.36E-17[a]	III	Radionuclide eliminated during the PA screening and the unanalyzed activity is much less than 0.1% of PA base case inventory for all generators. Therefore, there is no impact to the conclusions of the PA.
Tc-98	4.21E+06	A	MFC	1.83E-09	1.23E-07	1.49E-02[b]	II	The Phase II screening dose from Tc-98 in the PA is approximately 19 times less than the PA screening value (0.4 mrem/yr). Because the unanalyzed inventory is 67 times less than the PA screening inventory, and because the Phase II screening process is very conservative, the unanalyzed Tc-98 inventory will not impact the conclusions of the PA.
Tc-99	2.11E+05	A	MFC	7.55E-03	5.24	1.44E-03[c]	Not screened. Retained for full analysis in PA	Tc-99 is reported as unanalyzed because it is not in WAC Table B-4 (legacy waste) or B-5 (future-generation waste) as an activated metal, only as surface contamination. However, Tc-99 is listed in the PA base case inventory as an activated metal in the ATR waste stream destined for the HFEF vault array. Therefore, the dose contribution calculated by RHINO is included in the all-pathway dose.
Th-228	1.91E+00	S	MFC	2.64E-23	2.02E-04	1.31E-19[a]	III	Radionuclide eliminated during the PA screening and the unanalyzed activity is much less than 0.1% of PA base case inventory for all generators. Therefore, there is no impact to the conclusions of the PA.
Th-232	1.40E+10	S	MFC	4.82E-23	2.48E-07	1.94E-16[a]	II	Radionuclide eliminated during the PA screening and the unanalyzed activity is much less than 0.1% of PA base case inventory for all generators. Therefore, there is no impact to the conclusions of the PA.
Zr-93	1.53E+06	A	MFC	2.27E-07	22.2	1.02E-08[a]	III	Radionuclide eliminated during the PA screening and the unanalyzed activity is much less than 0.1% of PA base case inventory for all generators. Therefore, there is no impact to the conclusions of the PA.

a. Green shaded cells indicate inventory of unanalyzed radionuclides less than 0.1% of PA base case inventory. Radionuclide eliminated during PA screening.
b. Yellow shaded cells indicate inventory of unanalyzed radionuclides greater than 0.1% of PA base case inventory. Radionuclide eliminated during PA screening.
c. Red shaded cells indicate inventory of unanalyzed radionuclides greater than 0.1% of PA base case inventory. Radionuclide not eliminated during PA screening.

Table 3. Intruder pathway evaluation results for unanalyzed radionuclides and inventories in the 29 containers previously disposed of at the RHLLW disposal facility.

Nuclide	Unanalyzed Inventory (Ci)	Acute DSR 100 years[a]	Acute Dose 100 at years (mrem)	Chronic DSR 100 years[a]	Chronic Dose at 100 years (mrem/yr)
Be-10	1.07E-08	NA	NA	NA	NA
K-40	7.00E-28	3.75E-03	2.31E-30	1.06E+00	4.67E-30
Na-22	1.65E-19	NA	NA	NA	NA
Nb-92	9.91E-07	3.64E-02	3.17E-08	4.73E+00	2.95E-08
Nb-93m	1.97E-01	2.78E-08	4.82E-09	5.69E-06	7.06E-09
Pa-231	9.30E-11	4.01E-02	3.28E-12	2.84E+00	1.66E-12
Ra-228	3.14E-23	NA	NA	NA	NA
Rh-102m	1.73E-12	NA	NA	NA	NA
Si-32	8.84E-07	NA	NA	NA	NA
Sr-90	9.17E-15	4.90E-05	3.95E-19	2.22E-01	1.28E-17
Tc-98	1.83E-09	NA	NA	NA	NA
Tc-99	7.55E-03	5.09E-06	3.38E-08	9.25E-01	4.40E-05
Th-228	2.64E-23	5.80E-18	1.35E-40	7.40E-16	1.23E-40
Th-232	4.82E-23	NA	NA	NA	NA
Zr-93	2.27E-07	7.00E-06	1.40E-12	7.20E-04	1.03E-12
		Total Dose	**7.04E-08**	Total Dose	**4.40E-05**

DSR = Dose to Source Ratio. The maximum occurs at 100 years post closure.
NA = radionuclide not included in PA intruder analysis. Only radionuclides failing the Phase II groundwater screening were included in the PA intruder analysis.

References

DOE-ID, 2018, *Performance Assessment for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility*, DOE/ID-11421, Revision 2, U.S. Department of Energy, Idaho Operations Office, 2018.

WAC, PLN-5446, 2018, "Waste Acceptance Criteria for the Remote-Handled Low-Level Waste Disposal Facility," Revision 1, Idaho National Laboratory, March 2018.

ECAR-2073, 2018, "Inadvertent Intruder Analysis for the INL Remote-Handled Low-Level Waste Disposal Facility Performance Assessment," Revision 1, Idaho National Laboratory, January 2018.

Jonathan Jacobson	Jonathan Jacobson	6/21/2021
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
R.D. Brown	R.D. Brown	6/22/21
Print/Type Name System Engineer/SE	Signature System Engineer/SE	Date
A. Jeff Sondrup	Jeff Sondrup	9/27/21
Print/Type Name PA/CA SME	Signature PA/CA SME	Date
Amy M. Cox	Amy M. Cox	2021.09.27
Print/Type Name Waste Management/WMP	Signature Waste Management/WMP	Date
Tim Arsenault	Tim Arsenault	09/28/2021
Print/Type Name Nuclear Facility Manger/NFM	Signature Nuclear Facility Manger/NFM	Date

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

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

UDQE Tracking No.: UDQE-RHLLW-037

Subject: Proposed change to the RHLLW Disposal Facility PA/CA Maintenance Plan (PLN-3368)

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 (formerly SD-52.1.4), Section 3.1 requires a mandatory Unreviewed Disposal Question Screening (UDQS) for any proposed change to DOE Order 435.1 documentation. The PA/CA Maintenance Plan (PLN-3368) is one of the documents listed that requires a mandatory screening. 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 PA or CA.

The proposed changes to the PLN-3368 include:

- Elimination of the annual activity to evaluate changes to 40 CFR 61 Subpart H (NESHAPs) and Subpart Q (radon) to support preparation of the annual summary report (ASR). Per the facility Air Permit Applicability Determination (APAD-18-001r1), the facility is not required to report rad emissions for NESHAP evaluation, therefore there is no need to evaluate changes to 40 CFR 61, Subpart H or Subpart Q. Radon emissions will continue to be estimated per DOE O 435.1 requirements.
- Elimination of the annual activity to review concrete performance data to support preparation of the annual summary report (ASR). Per the facility monitoring plan (PLN-5501r2), concrete performance data is not collected nor are there plans to collect it, thus there is no need to evaluate the data. This activity should have been eliminated after issuance of revision 1 of PLN-5501 prior to issuance of the DAS but was overlooked. This will be revisited if at some point in the future the monitoring plan is revised to include collection of concrete performance data.
- Updating the Land-Use Assumptions section to be consistent with the revised INL Comprehensive Land Use and Environmental Stewardship (CLUES) Report (INL 2020). The CLUES report was updated in 2020 to officially recognize the RHLLW disposal facility as one of the INL Site areas that will remain under federal control indefinitely. The CLUES report further explains that upon closure the RH-LLW disposal facility will require long-term surveillance, maintenance, monitoring, and institutional controls to enforce land use restrictions and ensure the closure concept meets performance objectives. Updating the CLUES document to include the RHLLW disposal facility information was identified in PLN-3368 as a maintenance activity to take place in 2019 when the CLUES document was scheduled to be updated. Therefore, the changes to the CLUES document related to the RHLLW disposal facility were understood at the time the DAS was issued and are now included in the updated CLUES document.
- Updating references and correcting miscellaneous editorial errata that were missed during preparation of the last revision.

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:

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:

After a review of the changes with respect to the screening questions above, it has been determined that none of the proposed changes has the potential to affect the assumptions and/or conclusions of the PA or CA. Because the changes do not have the potential to affect the assumptions and/or conclusions of the PA or CA, a screening is not mandatory according to RH-ADM-5214; however, the information provided here to make this determination will serve as the screening and is documented here to provide justification. Based on this determination, it is recommended the UDQS screen negative and no further evaluation is required.

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 ☐

A. Jeff Sondrup	Jeff Sondrup	9/30/21
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Tim Arsenault	Tim Arsenault	09/30/2021
Print/Type Name Approver/NFM	Signature Approver/NFM	Date

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:

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

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

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

UDQE Tracking No.: UDQE-RHLLW-043

Subject: Damage discover to the upper vault Riser in Array#: 2 Position E02

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:

On June 22, 2020 during waste emplacement operations and rotating the CVAS from position 4 to position 5 it was discovered that there was damage to the upper rise in vault array 2, vault E02. The lower and upper risers of all vaults are not safety significant components per SAR-419; only the vault shield plug (VSP) and CVAS are safety significant and no damage was identified on either component.

The design attributes of the vault system that are assumed in the RHLLW performance Assessment/Composite Analysis (PA/CA) include durability and structural capabilities of the vault system. Damaged components have the potential to impact these areas of concern by a reduction in shielding, incorrect fit that may increase water ingress and structural degradation that may affect strength or durability of the vault.

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: NA

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: The design attributes of the vault system that are assumed in the RHLLW performance Assessment/Composite Analysis (PA/CA) include durability and structural capabilities of the vault system. Damaged components have the potential to impact these areas of concern by a reduction in shielding, incorrect fit that may increase water ingress and structural degradation that may affect strength or durability of the vault.

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	Jonathan Jacobson	9/27/2021
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Tim Arsenault	Tim Arsenault	09/28/2021
Print/Type Name Approver/NFM	Signature Approver/NFM	Date

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: NOTE: The following is the determination from J. A. Sondrup; SME for the PA/CA.
The fabrication and installation specifications (SPC-1857 and SPC-1910) would classify this as level-3 damage and require a CAR and most likely a repair. Corrective actions would be based on potential impact in the areas of shielding, structural, fit, and durability. Although I have not performed any calculations, I assume the shielding, structural and fit concerns would not be a serious issue if no repair were made due to the nature and size of the damaged area. Regarding durability, since the damage does not extend the full height of the riser tongue, there is no impact to water ingress potential. The damage does however result in a decrease of cement cover over the rebar which could impact the durability of the container in the damaged area. For the groundwater pathway, the PA estimates the vault system and, in particular, the concrete vault components are not expected to fail during the 1,000-year compliance period as a result of mechanical or chemical degradation. I expect the damage to this

vault if unrepaired would have an insignificant impact on the results of conclusions of PA for the following reasons:

- There is no exposed rebar apparent from the photos, thus the impact of early or enhanced corrosion of the rebar due to loss of cement cover will still be delayed (just not as much as if there were no damage) and limited to the damaged area.
- The damaged area would only impact a relatively small area of a single vault. The PA base case assumed final cover failure (which is controlled primarily by vault durability) begins at 500 years after closure and be complete at the end of the 1,000 year compliance period. Additionally, several sensitivity and uncertainty cases examined early failure of the cover, all of them much more severe than could be brought on by early structural failure of a single vault or a portion of a single vault. In each case, the PA still met regulatory standards.

If there were no waste in the vaults, I would recommend the damage be repaired. But given that repairing the damage would result in radiation exposure to personnel performing the repair and impacts to the PA would be insignificant without the repair, I recommend the repairs not be done. I do however recommend loose spalled material be knocked or swept into the pea gravel between vaults so as to not interfere with the fit of the shield plug or CVAS. Material less than 2 inched tall could be left on the flat area between partition voids or swept into the filled vault.

In addition, Functionality Review OPR 2020-0097 was complete and approved with similar determination and justification.

Jonathan Jacobson	Jonathan Jacobson	9/28/2021
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
	A. R. Prather	9/28/21
Print/Type Name System Engineer/SE	Signature System Engineer/SE	Date
A. Jeff Sondrup	Jeff Sondrup	9/28/21
Print/Type Name PA/CA SME	Signature PA/CA SME	Date
Amy M. Cox	Amy M. Cox	2021.09.28
Print/Type Name Waste Management/WMP	Signature Waste Management/WMP	Date
Tim Arsenault	Tim Arsenault	12/15/2021
Print/Type Name Nuclear Facility Manger/NFM	Signature Nuclear Facility Manger/NFM	Date

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

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

UDQE Tracking No.: UDQE-RHLLW-044

Subject: UDQE for SCR-RHINO-04 on Remote Handled Low-Level Disposal Facility Inventory Online (RHINO)

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:

As identified in the Annual Summary Report (ASR) for the Remote Handled Low-Level Waste Disposal Facility-FY 2019 (INL/EXT-20-57199), 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 SD-52.1.4. "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.

SCR-RHINO-004 Detailed Description of Change

1. Have RHINO generate reports necessary for reporting requirement for the PA/CA, the Annual Summary Report and any other additional reporting requirements. Also need to make the PA configurable

   - Report total gross and net volume of waste disposed of by array, generator and waste form for the current FY and cumulative disposals (to date).
   - Report vaults filled for current FY and cumulative disposals (to date) and capacity used/remaining.
   - Report radionuclide waste inventory disposed of by array, generator and waste form for current FY and cumulative disposals (to date) and report cumulative as percentage of PA inventory.
   - Report total all-pathway dose by array, generator and waste form for current FY and cumulative disposals (to date) for both compliance period and post-compliance period.
   - Report the following facility performance measures (all-pathway dose, air-pathway dose, chronic intruder dose, beta-gamma DE, beta-gamma ED, gross alpha concentration, Ra-226/228 concentration and uranium mass concentration) for current FY and cumulative disposals for both compliance period and post-compliance period and % of standard for cumulative.

2. Separate the PA inventory limit check into two separate PA checks:

   - The first check should compare the cumulative (placed plus pending canisters) inventory against the PA base case inventory by waste form only as found in Table 16 of ECAR-3940. This test should be performed for all reportable radionuclides in the canister inventory that are not on the exempt list (WAC Table 1) and not identified as "unanalyzed" by a separate check. The title of this test should be "PA Base Case Inventory Check by Waste Form (All Radionuclides)." For all exceedances, a list of details should be provided that includes: the radionuclide, cumulative inventory and waste form (for placed plus pending canisters), the PA base case inventory by waste form (Table 16, ECAR-3940), and percent exceedance. This information needs be presented only for the exceedance by waste form.

   - The second check should compare the cumulative (placed plus pending canisters) inventory against the PA base case inventory by generator, waste form and canister type as found in the penultimate column of Table 18 of INL/EXT-18-45184. This test should be performed only for the 18 "key" radionuclides found in Table 18. The title of this test should "PA Base Case Inventory Check by Generator/Waste

From/Canister (Key Radionuclides)." For all exceedances a list of details should be provided that includes: the radionuclide, cumulative inventory by generator, waste form and canister type (for placed plus pending canisters), the PA base case inventory by generator, waste form, and canister type, and percent exceedance. This information needs be presented only for the exceedance by generator, waste form and canister type.

3. Change the title of the canister PA inventory check from "Canister 10% Inventory Limit" to "Administrative 10% Canister Inventory Check by Generator/Waste Form/Canister (Key Radionuclides)." This is for the check where the radionuclide inventory for the pending canister is compared to the last column of Table 18 of INL/EXT-18-45184 and should only be done for the 18 "key" radionuclide found in Table 18. Also, please check to make sure that for all exceedances a list of details is provided that includes: radionuclide, canister inventory by generator, waste form and canister type, 10% of PA base case inventory by generator, waste form, and canister type, and percent exceedance.

4. RHINO needs to add a field so generators with combined waste form need to enter the % volume of activated metal and surface contaminated debris.

5. Per PLN-5446 RHLLW WAC, Appendix B tables, RHINO must identify radionuclides by generator, canister type and waste form that were not analyzed in the PA inventory.

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:

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 changes made to RHINO were mostly cosmetic changes in the way that information is presented or involve extraction and presentation of data that were not previously extracted/presented by RHINO. There is no new information being generated by RHINO that was not or could not have been extracted or generated previously. None of the changes involve a change to the PA or impact the conclusions of the PA. Furthermore, none of the changes involve inputs to the PA or involve errors or omissions from the PA. Additionally, none of these changes necessitate changes to the WAC, Closure Plan, CA or PA/CA Maintenance Plan.

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	Jonathan Jacobson	11/05/2020
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
J. Mayer	JAMES MAYER (Affiliate) Digitally signed by JAMES MAYER (Affiliate) Date: 2020.11.05 10:19:25 -07'00'	11/5/2020
Print/Type Name Approver/NFM	Signature Approver/NFM	Date

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:

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

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

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

UDQE Tracking No.: UDQE-RHLLW-045

Subject: 2020 12 M Vault Shield Plug Inspection with Level 3 or Greater Damage Identified

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:
As required by PLN-3368: "Maintenance Plan for the Remote-Handled Low-Level Waste Disposal Facility Performance Assessment and Composite Analysis", the 12-month B21-632 HFEF Vault Shield Plug (VSP) inspection was performed on 7/29/2020. The "System Design Description-Remote-Handled Low-Level Waste Disposal Vault System (SDD-410)" requires inspection (and subsequent repair, if necessary) of concrete damage to be performed using criteria carried forward from facility design to operations. The criteria used during vault fabrication are documented in SPC-1857 and during vault installation in SPC-1910. Inspection criteria employed during vault fabrication included identification of concrete defects introduced during the vault fabrication process (i.e., bug holes, honeycombing, air bubble marks, cracking and seals offset) in addition to Level 1, Level 2, and Level 3 damage (e.g., spalling) to components occurring after the vault components were fabricated. During vault installation, the inspection criteria were reduced to include only the Level 1, Level 2, and Level 3 post-fabrication cracking and spalling damage (see SPC-1910) using the performance measures provided in SPC-1857. SDD-410 and SD-52.1.4: "DOE Order 435.1 Documentation Change Control Process for the RH-LLW Disposal Facility", require inspection and repair of any new Level 3 post-fabrication cracking and spalling damage using the criteria and procedures specified in SPC-1910 and carried forward into SDD-410. Level 3 damage is of importance since it has the potential to impact the functional performance of the vault shield plugs.

This UDQE is being prepared and evaluated because the annual inspection performed under WO 295706 identified a new Level 3 defect on the HFEF Array 2 position E1 VSP as follows:
The VSP currently installed in the Array 2, E1 position exhibited a chip at the top corner that is approximately 4" long by approximately 4" wide by 1-1/16" in depth. This defect is being evaluated in this UDQE to ensure it is repaired and inspected per the requirements of SDD-410 using the procedures approved in SPC-1910 and implemented in Model Work Order (MWO) 258119.

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: Level 3 damage has the potential to impact the long-term performance of the VSP. The concrete vaults provide structural protection to the stainless-steel canisters and provide structural support of the final engineered cover.

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: NA

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:

The design attributes of the vault system that are assumed in the RHLLW performance Assessment/Composite Analysis (PA/CA) include durability and structural capabilities of the vault system. Damaged components have the potential to impact these areas of concern by a reduction in shielding, incorrect fit that may increase water ingress and structural degradation that may affect strength or durability of the vault.

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	Jonathan Jacobson	9/27/2021
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Tim Arsenault	Tim Arsenault	09/27/2021
Print/Type Name Approver/NFM	Signature Approver/NFM	Date

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:

SPC-1857 identifies Level 1, Level 2 and Level 3 damage and defect types. Level 1 and Level 2 damage and defects have been determined to pose an insignificant impact to long-term vault performance (i.e., shielding, weight bearing, and long-term vault performance) if left unrepaired. Level 3 damage (i.e., new cracks, chipping and spalling) has been determined to pose a potential performance risk.

The annual inspection WO 295706 requires the VSPs to be visually inspected for cracks, chipping, and spalling of the concrete top surface per the preventative maintenance program. As required by the annual WO, the inspection was performed and identified one Level 3 damaged area on the HFEF Array 2 Position E1 VSP as noted in the description section of this UDQE. The attached inspection form (FRM-2539) contains a photograph and measurement details of the damaged area for evaluation.

Evaluation of Damage:

Damages on the HFEF VSP: This chip/spall will be repaired using approved materials and re-inspected as required in SDD-410. This damage appears to be similar to the spalls/chips evaluated in document, "Assessment of the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility Vault Concrete Data (INL/EXT-17-42239)." As evaluated in INL/EXT-17-42239, given the damage origin and dimensions, the damage would not be expected to impact long-term vault performance. However, as required by SDD-410, the damage will be repaired using approved repair material (see SPC-1910; Jet Set Complete) per WO 299411 and re-inspected. As with defects repaired during vault fabrication, this repair is expected to provide protection against water ingress into the steel reinforcement material and to result in no impact to long-term vault performance. Additionally, Labway Operability Review OPR 2020-0129 was completed to determine if the damage could impact the safety/functional performance of the VSP per SAR-419. This completed and approved review resulted in the determination that the VSP is still functional with no impact to its safety function.

For all repairs, the requirements of SDD-410 and shown in SPC-1910, Section 2.2 and 2.3 will be followed as implemented in the work order. The repairs will be made by using routine repair WO 299411 and be performed by trained personnel. Once the repair is made, the VSP will be re-inspected by the qualified inspector and documented in the repair work order.

Print/Type Name	Signature	Date
Jonathan Jacobson Originator/FDS	Jonathan Jacobson Originator/FDS	9/28/2021
 System Engineer/SE	A. R. Prather System Engineer/SE	9/28/21
A. Jeff Sondrup PA/CA SME	Jeff Sondrup PA/CA SME	9/28/21
Amy M. Cox Waste Management/WMP	Amy M. Cox Waste Management/WMP	2021.09.28
Tim Arsenault Nuclear Facility Manger/NFM	Tim Arsenault Nuclear Facility Manger/NFM	12/16/2021

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

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

UDQE Tracking No.: UDQE-RHLLW-046

Subject: RHINO Acceptance Check of Canister MFC200361, Flagged 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 MFC200361 is an HFEF-5 canister containing activated metal waste from MFC that was generated after 4/21/2015. This waste stream is described in the RHLLW Disposal Facility performance assessment (PA) as HFEF future generation waste to distinguish it from legacy waste. 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 MFC200361 was flagged by RHINO based on the following inventory checks:

PA Check 1: PA Base Case Inventory Check by Generator/Canister/Waste Form

This check was flagged by RHINO because the cumulative inventory of five radionuclides (Ba-137m, Np-237, Pa-233, Pu-240 and Th-231) exceed performance assessment (PA) base-case inventories for this generator, canister type and waste form. The cumulative inventory includes the inventory of all placed canisters, plus the proposed canister. Of the five radionuclides, three (Ba-137m, Pa-233 and Th-231) were screened out during preparation of the PA as part of the three-phase screening process, and dose impacts from these radionuclides are not included in the PA all-pathway dose. The other two radionuclides, Np-237 and Pu-240, are "key" radionuclides meaning they were not screened out during preparation of the PA and dose impacts are included in the PA all-pathway dose. According to INL/EXT-18-45184 (2018), the cumulative radionuclide inventory for each generator/canister/waste form must not exceed the PA base case inventories in Table 18. If this occurs, the cumulative inventory is evaluated to determine if the inventory and accompanying dose is within the bounds of the PA.

PA Check 2: Administrative 10% Canister Inventory Check (Key Radionuclides Only)

This flag was checked by RHINO because the canister inventory of four key radionuclides (Np-237, Pu-240, U-235 and U-238) exceed the 10% threshold levels of the base-case inventory levels 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 activity 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.

Exceedance of threshold values does not indicate a canister is unacceptable for disposal but requires the inventory levels be reviewed. If after review, it is determined the inventory levels (both canister and cumulative) are within the bounds of the approved PA, the 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: Canister MFC200361 contains radionuclides whose inventories cause the cumulative inventory for the specific generator, canister type and waste form to exceed the cumulative base-case inventory analyzed in the PA, or result in an increase from a level that already exceeded the cumulative base-case inventory analyzed in the PA. The canister also contains radionuclides whose inventory levels exceed canister inventory threshold levels analyzed in the PA for a specific generator, canister type and waste form. According to INL/EXT-18-45184 (2018), the cumulative radionuclide inventory for each generator/canister/waste form must not exceed the PA base case inventories in Table 18. If this occurs, the cumulative inventory is evaluated to determine if the inventory and accompanying dose is within the bounds of the PA. A UDQE is recommended to address both 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

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	Jonathan Jacobson	9/2/2021
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Tim Arsenault	Tim Arsenault	9/8/2021
Print/Type Name Approver/NFM	Signature Approver/NFM	Date

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.

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

Explanation

The two PA inventory checks flagged by RHINO on waste canister MFC200361 are highlighted yellow on the RHINO output shown in Figure 1 and the detailed results from each check are shown at the lower part of the figure. PA checks numbered 9 and 10 in Figure 1 are the same check but the results for key and non-key radionuclides are shown in separate rows. Evaluations of each of these flagged checks is included below.

Canister Details MFC200361

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	4.7698E-005	1	mrem/yr	Compliance	8/30/2021
	Yes	All Pathways Dose	2.7776E-002	12.5	mrem/yr	Post Compliance	8/30/2021
2	Yes	Beta-Gamma DE	3.3878E-005	0.16	mrem/yr	Compliance	8/30/2021
	Yes	Beta-Gamma DE	1.9718E-002	2.4	mrem/yr	Post Compliance	8/30/2021
3	Yes	Ra-226/228	1.5424E-033	0.2	pCi/L	Compliance	8/30/2021
	Yes	Ra-226/228	1.4411E-007	2.5	pCi/L	Post Compliance	8/30/2021
4	Yes	Gross Alpha	3.4270E-031	0.6	pCi/L	Compliance	8/30/2021
	Yes	Gross Alpha	7.2217E-007	7.5	pCi/L	Post Compliance	8/30/2021
5	Yes	Beta-Gamma ED	1.8535E-005	0.16	mrem/yr	Compliance	8/30/2021
	Yes	Beta-Gamma ED	1.0788E-002	2	mrem/yr	Post Compliance	8/30/2021
6	Yes	Uranium	1.1847E-028	1.2	ug/L	Compliance	8/30/2021
	Yes	Uranium	2.2471E-006	15	ug/L	Post Compliance	8/30/2021
7	Yes	Intruder	8.9662E-003	20	mrem/yr	Compliance	8/30/2021
8	Yes	Air Pathway	6.0457E-007	0.4	mrem/yr	Compliance	8/30/2021
9	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	-			Compliance	8/30/2021
10	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-			Compliance	8/30/2021
11	No	Administrative 10% Canister Inventory Check (Key Radionuclides)	-			Compliance	8/30/2021
12	Yes	Unanalyzed/Not Exempt Nuclides Check	-			Compliance	8/30/2021
13	Yes	Canister Action Levels Check	-			Compliance	8/30/2021

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	Cumlative PA Amount (Ci)	Limit Inv (Ci)	Canister Contribution (Ci)
Ba-137m [Details]	S	HFEF-5 Can	MFC	2	East	1.0921E+000	1.3503E-002	2.1962E-001
Np-237 [Details]	S	HFEF-5 Can	MFC	2	East	3.3968E-007	6.8565E-008	1.4959E-007
Pa-233 [Details]	S	HFEF-5 Can	MFC	2	East	3.1870E-007	2.0675E-017	1.4959E-007
Pu-240 [Details]	S	HFEF-5 Can	MFC	2	East	1.0716E-004	6.1053E-005	5.0183E-005
Th-231 [Details]	S	HFEF-5 Can	MFC	2	East	5.7982E-007	4.7750E-011	1.8567E-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)	Threshold (Ci)
Np-237	S	MFC	HFEF-5 Can	2	1.4959E-007	6.8565E-008	6.8565E-009
Pu-240	S	MFC	HFEF-5 Can	2	5.0183E-005	6.1053E-005	6.1053E-006
U-235	S	MFC	HFEF-5 Can	2	1.8567E-007	1.8102E-006	1.8102E-007
U-238	S	MFC	HFEF-5 Can	2	1.0610E-007	9.1146E-007	9.1146E-008

Figure 1. PA Check output screen from RHINO for waste canister MFC200361.

PA Check 1: PA Base Case Inventory Check by Generator/Canister/Waste Form

This check was flagged by RHINO because the cumulative inventory of five radionuclides (Ba-137m, Np-237, Pa-233, Pu-240 and Th-231) exceed the PA base-case inventories for this generator/canister/waste form (DOE/ID-11421) (see Figure 1, Column 1, Numbers 9 and 10). The cumulative inventory includes the inventory of all placed canisters, plus the proposed canister MFC200361. According to INL/EXT-18-45184 (2018), the cumulative radionuclide inventory for each generator/canister/waste form must not exceed the PA base case inventories in Table 18. If this occurs, the cumulative inventory is evaluated to determine if the inventory is within the bounds of the PA.

Three of the five radionuclides (Ba-137m, Pa-233 and Th-231) will have an insignificant impact on the PA all-pathway dose and the inventories are within the bounds of the approved PA because their half-lives are less than one year. Radionuclides with half-lives less than one year were screened from the groundwater and intruder pathway analyses in the PA because their impact on the all-pathway dose and the intruder dose would be inconsequential. According to the PA, a radionuclide with a one-year half-life would have 9.3E-10 times its original activity after 30 years, the approximate time it would take a non-sorbing tracer to migrate from land surface to the aquifer. In the future, it is recommended that radionuclides with a half-life less than one year not be subject to review.

The other two radionuclides identified, Np-237 and Pu-240, are key radionuclides meaning they were not screened out during preparation of the PA and dose impacts are included in the PA all-pathway dose. Table 1 compares the proposed cumulative inventory of Np-237 and Pu-240 as surface contamination to other PA inventories. Even before disposal of canister MFC200361, the cumulative Np-237 inventory in the RHLLW disposal facility already exceeds the PA base-case inventory for this generator/canister/waste form. Thus, the Np-237 inventory in canister MFC200361 would only add to this exceedance. The Pu-240 inventory in canister MFC200361 would cause the cumulative inventory to exceed the PA base-case inventory for this generator/canister/waste form.

It is allowable for the proposed cumulative inventory for a specific generator/canister/waste form to exceed the PA base-case inventory so long as the impact of the proposed cumulative inventory is within the bounds of the PA. This is demonstrated by: 1) comparing the projected cumulative inventories for the specific generator/canister/waste form to the total facility PA base-case inventories for the specific waste form (surface contamination) and to the total facility PA base-case inventories for all waste forms, and 2) comparing projected dose and concentration impacts to the performance objectives impacts (Figure 1, Column 1, Numbers 1-7). For Np-237, the projected cumulative inventory for MFC/HFEF-5 canisters/surface contamination (3.4E-07 Ci, Table 1, Column 3) is only 0.058% of the total Np-237 surface contamination in all PA waste streams (5.82E-04 Ci, Table 1, Columns 5 and 6) and 0.049% of the total Np-237 in all waste forms and waste streams (6.95E-04 Ci, Table 1, Columns 7 and 8). For Pu-240, the projected cumulative inventory (1.07E-04 Ci, Table 1, Column 3) is only 4.7% of the total Pu-240 surface contamination in all PA waste streams (2.28E-03 Ci, Table 1, Columns 5 and 6) and only 0.061% of the total Pu-240 in all waste forms and waste streams analyzed in the PA (1.76E-01 Ci, Columns 7 and 8). Based on these low percentages, the impact on performance objectives is expected to be minimal. This is evidenced by the projected all-pathway dose being 4.77E-05 mrem/yr after disposal of canister MFC200361 (see Figure 1, row 1) which is significantly less than the PA limit of 25 mrem/yr from DOE Order 435.1-1.

Table 1. Np-237 and Pu-240 inventory summary for PA Check 1.

1	2	3	4	5	6	7	8
	Surface Contamination					All Waste Forms	
Radionuclide	Canister MFC200361 Inventory (Ci)	Projected Cumulative Inventory (MFC, HFEF-5 Canisters)[a] (Ci)	PA Base-Case Inventory (MFC, HFEF-5 Canisters)[a] (Ci)	PA Base-Case Inventory (All Generators & Canisters) (Ci)	Projected Cumulative Inventory as % of PA Base Case Inventory (All Generators & Canisters)	PA Base-Case Inventory (All Generators, Canisters) (Ci)	Projected Cumulative Inventory as % of PA Base Case Inventory (All Generators & Canisters)
Np-237	1.50E-07	3.40E-07	6.86E-08	5.82E-04	0.058%	6.95E-04	0.049%
Pu-240	5.02E-05	1.07E-04	6.11E-05	2.28E-03	4.700%	1.76E-01	0.061%

a. Includes legacy (before 4/21/15) and future generation (after 4/21/15) waste (see INL/EXT-18-45184). However, there was no Np-237 listed in future generation waste in the PA base-case inventory.
b. Table 2-14, RHLLW Performance Assessment (DOE/ID-11421).

PA Check 2: Administrative 10% Canister Inventory Check (Key Radionuclides Only)

This flag was checked by RHINO because the inventories of four key radionuclides (Np-237, Pu-240, U-235 and U-238) in canister MFC200361 exceed the 10% canister threshold levels analyzed in the PA for this generator/canister/waste form. 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). If the 10% threshold is exceeded, the inventory is reviewed to determine if the canister radionuclide inventories are anomalous occurrences or indicative of a change in waste generation rates.

Table 2 contains a summary of the radionuclide inventories in canister MFC200361 compared to PA base-case inventories for: 1) the specific generator/canister/waste form, and 2) all generators, canister types and waste forms. Column 4 shows that all canister inventories are greater than 10% of the PA base-case inventories for the specific generator/canister/waste form. Np-237 is much greater at 218% while U-235 and U-238 are barely greater at 10.3% and 11.6% respectively. Canister MFC200361 is only the third canister of new-generation (non-legacy) waste from MFC submitted for disposal. The surface contamination inventories of all four radionuclides flagged by this check in the previous two canisters (MFC170305 and MFC190345) were also greater than the 10% threshold level. So, while the inventories in canister MFC200361 are not anomalous when compared to the other HFEF-5 new-generation waste canisters, all three canisters contain radionuclides at elevated levels from what was analyzed in the PA.

Although the inventories of Np-237, Pu-240, U-235 and U-238 in canister MFC200361 as surface contamination are greater than the 10% threshold levels, they are still small compared to the total PA inventories for all generators and canisters (0.005 to 2.2%, Column 6). This explains why the projected all-pathway dose remains low (4.8E-05 mrem/yr for the compliance period, see Figure 1, Row 1) and within the bounds of the PA.

Table 2. Radionuclide inventory summary for PA Check 2[a].

1	2	3	4	5	6
Radionuclide	Canister MFC200361 Inventory (Ci)	Total PA Inventory (MFC, HFEF-5 Canisters)[b] (Ci)	Canister Inventory as % of PA Inventory for MFC HFEF-5 Canisters)	Total PA Inventory (All Generators, All Canisters) (Ci)[c]	Canister Inventory as % of PA Inventory for all Generators and Canisters
Np-237	1.50E-07	6.86E-08	218%	5.82E-04	0.026%
Pu-240	5.02E-05	6.11E-05	82.1%	2.28E-03	2.20%
U-235	1.86E-07	1.81E-06	10.3%	3.70E-03	0.005%
U-238	1.06E-07	9.11E-07	11.6%	7.41E-04	0.014%

a. All inventory values are for surface contamination.
b. Includes legacy (before 4/21/15) and new-generation (after 4/21/15) waste (see INL/EXT-18-45184).
c. Table 2-14, RHLLW Performance Assessment (DOE/ID-11421).

The discrepancy between new-generation canister inventories and PA base-case inventories is likely related to the generating facility at MFC and the waste type. The three canisters of new-generation waste at the RHLLW disposal facility (2 placed, 1 proposed) were loaded at the Fuel Conditioning Facility (FCF) at MFC. Of the 23 waste canisters used to estimate the inventory of new-generation waste for the PA, 22 were loaded with waste from the Hot-Fuel Examination Facility (HFEF) hot cell. These were the most recently loaded waste canisters at MFC prior to developing the source term for the PA. Although the cell waste at both HFEF and FCF are similar, there are some differences that could explain the discrepancy. For example, both facilities contain irradiated metals and EBR-II hardware, but HFEF contains more post-irradiation-examination research waste categorized as combination waste (activated metal and surface contaminated debris).

Summary— The radionuclide activities in canister MFC200361 have been evaluated and the dose impacts are expected to be very small or insignificant and within the bounds of the approved PA. It is recommended the canister be accepted for disposal and inventories of new-generation waste from HFEF and FCF continue to be

monitored based on the differences identified in this UDQE. This will be done as the canisters are flagged by RHINO.

Jonathan Jacobson	Jonathan Jacobson	9/8/2021
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Allen R. Prather	A. R. Prather	9/8/21
Print/Type Name System Engineer/SE	Signature System Engineer/SE	Date
A. Jeff Sondrup	Jeff Sondrup	9/8/2021
Print/Type Name PA/CA SME	Signature PA/CA SME	Date
Amy M. Cox	Amy M. Cox	2021.09.09
Print/Type Name Waste Management/WMP	Signature Waste Management/WMP	Date
Tim Arsenault	Tim Arsenault	09/09/2021
Print/Type Name Nuclear Facility Manger/NFM	Signature Nuclear Facility Manger/NFM	Date

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

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

UDQE Tracking No.: UDQE-RHLLW-047

Subject: Canister SN-124 radionuclide inventory 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, details of each waste canister are entered into the Remote-Handled Low-Level Waste (RHLLW) Inventory Online (RHINO) software which performs several checks to evaluate the canister for acceptance. Waste canister SN-124, a legacy HFEF-5 canister (generated prior to 4/21/2015) containing surface contaminated debris/trash was flagged by RHINO for the following:

- The inventories of radionuclides Ba-137m, Np-237, Pa-233, and Th-231 in the canister would cause an exceedance of, or contribute to an existing exceedance of the performance assessment (PA) base case inventories for the specific generator, canister type, and waste form.
- The inventories of key radionuclides Co-60, Cs-137, and H-3 in the proposed canister are greater than 10% of the total base case activities for the specific generator, canister type and waste form.
- The inventory of Cs-137 in the canister is greater than the canister action level based on the chronic intrusion scenario in the PA.

According to INL/EXT-18-45184 (2018), the inventory of any canister that causes or contributes to an exceedance of these threshold values must be reviewed according to SD-52.1.4 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. Exceedance of the threshold activities does not indicate the canister is unacceptable but dictates the activity levels must be reviewed.

Also according to PLN-5446 Section 2.3 Radionuclide Limits and Action Levels, action levels have been established based on the chronic inadvertent intruder pathway analyzed in the facility Performance Assessment. If a specific canister exceeds the action levels presented in Table 2. An evaluation must be conducted in accordance with SD-52.1.4

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: Canister SN-124 was flagged by RHINO while performing PA checks during acceptance testing. According to INL/EXT-18-45184 (2018), the canister must be evaluated 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.

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	Jonathan Jacobson	7/7/2021
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Larry Evens	Larry Evens	7/7/2021
Print/Type Name Approver/NFM	Signature Approver/NFM	Date

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.

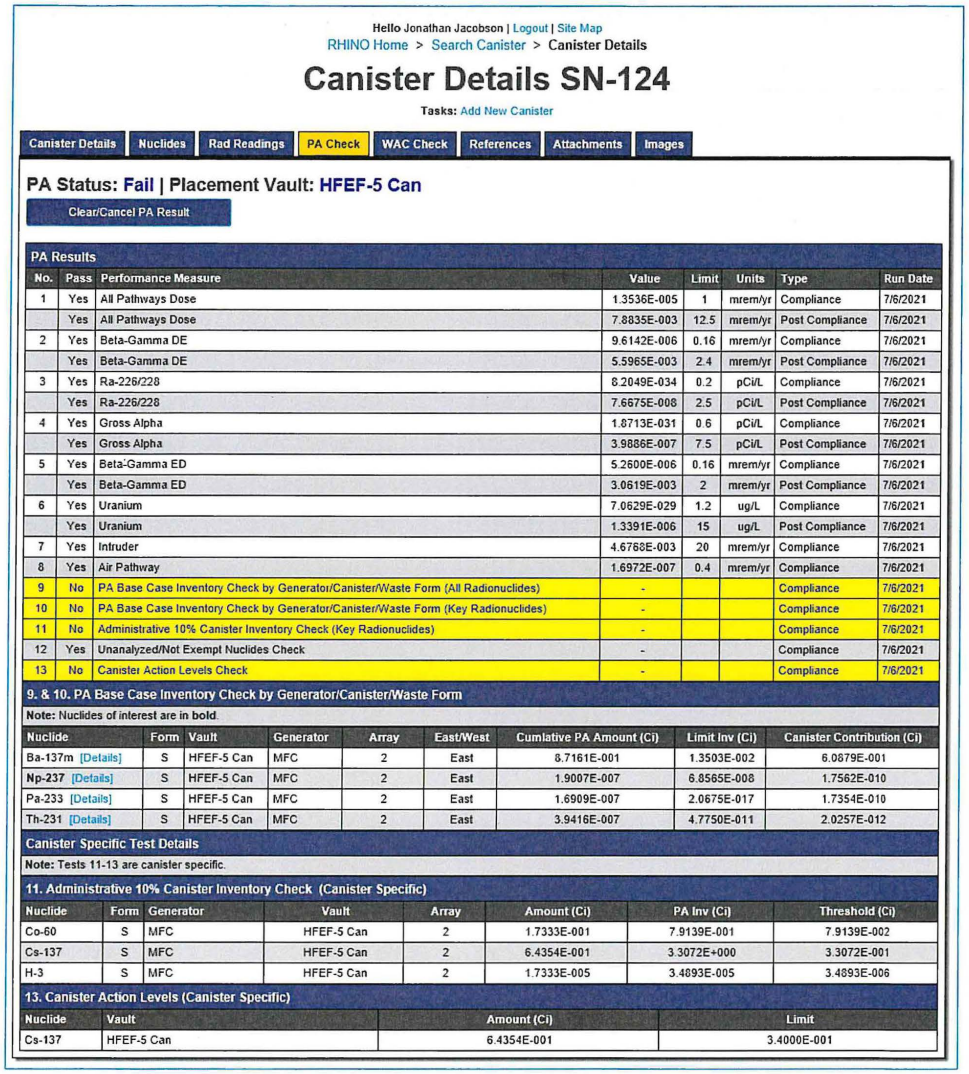
5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

   Yes ☐ No ☒

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

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

Explanation
Figure 1 shows the Canister Details page of RHINO and the results of the PA checks. The failed checks highlighted in yellow are evaluated as part of this UDQE.



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

Canister Details SN-124

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	1.3536E-005	1	mrem/yr	Compliance	7/6/2021
	Yes	All Pathways Dose	7.8835E-003	12.5	mrem/yr	Post Compliance	7/6/2021
2	Yes	Beta-Gamma DE	9.6142E-006	0.16	mrem/yr	Compliance	7/6/2021
	Yes	Beta-Gamma DE	5.5965E-003	2.4	mrem/yr	Post Compliance	7/6/2021
3	Yes	Ra-226/228	8.2049E-034	0.2	pCi/L	Compliance	7/6/2021
	Yes	Ra-226/228	7.6675E-008	2.5	pCi/L	Post Compliance	7/6/2021
4	Yes	Gross Alpha	1.8713E-031	0.6	pCi/L	Compliance	7/6/2021
	Yes	Gross Alpha	3.9886E-007	7.5	pCi/L	Post Compliance	7/6/2021
5	Yes	Beta-Gamma ED	5.2600E-006	0.16	mrem/yr	Compliance	7/6/2021
	Yes	Beta-Gamma ED	3.0619E-003	2	mrem/yr	Post Compliance	7/6/2021
6	Yes	Uranium	7.0629E-029	1.2	ug/L	Compliance	7/6/2021
	Yes	Uranium	1.3391E-006	15	ug/L	Post Compliance	7/6/2021
7	Yes	Intruder	4.6768E-003	20	mrem/yr	Compliance	7/6/2021
8	Yes	Air Pathway	1.6972E-007	0.4	mrem/yr	Compliance	7/6/2021
9	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	-			Compliance	7/6/2021
10	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-			Compliance	7/6/2021
11	No	Administrative 10% Canister Inventory Check (Key Radionuclides)	-			Compliance	7/6/2021
12	Yes	Unanalyzed/Not Exempt Nuclides Check	-			Compliance	7/6/2021
13	No	Canister Action Levels Check	-			Compliance	7/6/2021

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	8.7161E-001	1.3503E-002	6.0879E-001
Np-237 [Details]	S	HFEF-5 Can	MFC	2	East	1.9007E-007	6.8565E-008	1.7562E-010
Pa-233 [Details]	S	HFEF-5 Can	MFC	2	East	1.6909E-007	2.0675E-017	1.7354E-010
Th-231 [Details]	S	HFEF-5 Can	MFC	2	East	3.9416E-007	4.7750E-011	2.0257E-012

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)
Co-60	S	MFC	HFEF-5 Can	2	1.7333E-001	7.9139E-001	7.9139E-002
Cs-137	S	MFC	HFEF-5 Can	2	6.4354E-001	3.3072E+000	3.3072E-001
H-3	S	MFC	HFEF-5 Can	2	1.7333E-005	3.4893E-005	3.4893E-006

13. Canister Action Levels (Canister Specific)

Nuclide	Vault	Amount (Ci)	Limit
Cs-137	HFEF-5 Can	6.4354E-001	3.4000E-001

Figure 1. Canister Details page of RHINO and the results of the PA checks for canister SN-124.

Evaluation of Failed PA Checks 9 and 10

According to PA checks 9 and 10 performed by RHINO, the inventories of radionuclides Ba-137m, Np-237, Pa-233, and Th-231 in the canister would cause an exceedance of, or contribute to an existing exceedance of the PA base case inventories for the specific generator, canister type, and waste form. In this case, the cumulative inventory of each of these radionuclides in all previously placed canisters already exceeds the PA base case inventory for the specific generator, canister type and waste form. Therefore, the activity of these radionuclides in canister SN-124 only adds to the exceedances.

Since Ba-137m, Pa-233, and Th-231 all have half-lives less than 1 year, the inventory of these radionuclides will have an insignificant impact on the groundwater pathway and the PA and are not considered further. As for Np-237, the inventory in canister SN-124 (1.76E-10 Ci) is less than the PA base case inventory of Np-237 (6.86E-08 Ci, ECAR-3940, Table 8) by more than 2 orders of magnitude for this generator, canister type and waste form. Furthermore, the canister inventory of Np-237 is more than 6 orders of magnitude less than the total surface contaminated activity considered in the PA (5.82E-04 Ci, ECAR-3940, Table 16). Thus, the impact of the Np-237 on the PA will be small as evidenced by the All Pathways Dose value of 1.35E-05 mrem/yr during the compliance period (see Figure 1) following placement of this canister.

Evaluation of Failed PA Check 11

According to RHINO, the inventories of key radionuclides Co-60, Cs-137, and H-3 in the proposed canister are greater than 10% of the total base case activities for the specific generator, canister type and waste form. Co-60 and Cs-137 are key radionuclides for the intruder pathway and not the groundwater pathway in the PA. Tritium (H-3) is a key radionuclide for both the groundwater and air pathway in the PA.

Since Co-60 and Cs-137 are intruder pathway concerns, the waste form is not important, and the total inventory is all that matters. The inventory of Co-60 in canister SN-124 (0.173 Ci) is 0.0006% of the total Co-60 inventory for the PA base case. The inventory of Cs-137 in canister SN-124 (0.644 Ci) is 0.007% of the total Cs-137 inventory for the PA base case. So, while the inventories may exceed 10% of the generator/canister/waste-form specific inventory, they are not significant when compared to the total PA base case inventory and will have a minimal impact on the PA. However, the amount of Co-60 and Cs-137 as surface contamination is quite different from the 30 HFEF-5 canister placed-to-date in the RHLLW disposal facility. The average Co-60 and Cs-137 activities in the 30 previously placed canisters is 2.5E-06 Ci/can and 9.26E-03 Ci/can respectively. Therefore, the inventories in canister SN-124 represent a change from the previous canisters. This may be because canister SN-124 contains surface contaminated trash/debris only and all of the previous canisters contained activated metals or combined activated metals and surface contaminated trash/debris. This could explain the somewhat anomalous inventories of these radionuclides.

As stated previously, H-3 is key radionuclide for both the groundwater and air pathway in the PA. The groundwater and air pathway analysis in the PA credited waste form. Although the surface contaminated activity of H-3 in canister SN-124 (1.73E-05 Ci) is 50% of the total H-3 surface contaminated activity in the PA base case (3.49E-05 Ci), H-3 was a very minor contributor to the PA groundwater dose and air pathway dose (see PA, DOE/ID-11421, Table 4-3 [groundwater] and Table 2-24 [air]). Furthermore, the H-3 activity in canister SN-124 is only 0.000001% of the total H-3 in the PA base case. Based on this, the H-3 in canister SN-124 will have an insignificant impact on the PA.

Evaluation of Failed PA Check 13

According to RHINO, the Cs-137 inventory in canister SN-124 (0.644 Ci) is greater than the canister action level in the WAC (0.34 Ci/can, PLN-5446, Table 2). The canister action levels are based on the more conservative chronic intruder scenario and can be viewed as radionuclide thresholds for each vault array. In this case, the vault array is the HFEF array. As stated in the evaluation of PA Check 11, the Cs-137 inventory in canister SN-124 is higher than previously placed canisters. The average Cs-137 concentration in the 30 previously placed HFEF-5 canisters is 0.0093 Ci/can (0.278 Ci/30 cans). If canister SN-124 is included, the average concentration is 0.0297 Ci/can [(0.278 Ci + 0.644 Ci)/31 cans]. So, although the Cs-137 inventory in canister Sn-124 is higher than the action level, the action levels are based on average of all canisters in the vault array and the average with canister SN-124 is still much less than

the action level. Therefore, the Cs-137 activity in canister SN-124 will not impact the PA intruder dose. The intruder dose in Figure 1 (4.68E-03 mrem/yr) which includes the impact of canister SN-124 is further evidence that this is the case.

Summary

Canister SN-124 was flagged by RHINO because the inventory/activity exceeded or contributed to the exceedance of multiple PA checks. A review of the information available indicates the radionuclide inventory of canister SN-124 will have an insignificant impact on the PA and there is nothing to indicate the activities in this container are incorrect or that there is a change in waste generation rates. Therefore, the canister is recommended acceptable for disposal.

References

DOE/ID-11421, 2018, Performance Assessment for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility, Revision 2, U.S. Department of Energy Idaho Operations Office, February 2018.

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.

ECAR-5446, 2021, Radiological Source Term Determination for Containers Having Unique IDs B-307, OWC001, OWC003, OWC020, OWC021, SN-99, SN-108, SN-109, SN-110, SN-116, SN-117, SN-120, SN-124, and SN-137, Idaho National Laboratory, June 2021.

INL/EXT-18-45184, 2018, Methods, Implementation, and Testing to Support Determination of Performance Assessment Compliance for the RHLLW Disposal Facility WAC, Idaho National Laboratory, June 2018.

Jonathan Jacobson	Jonathan Jacobson	7/7/2021
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
A. R. Prather	A. R. Prather	7/7/21
Print/Type Name System Engineer/SE	Signature System Engineer/SE	Date
A. Jeffrey Sondrup	Jeff Sondrup	7/7/2021
Print/Type Name PA/CA SME	Signature PA/CA SME	Date
Amy M. Cox	Amy M. Cox	2021.07.07
Print/Type Name Waste Management/WMP	Signature Waste Management/WMP	Date
Larry Evens	Larry Evens	7/8/2021
Print/Type Name Nuclear Facility Manger/NFM	Signature Nuclear Facility Manger/NFM	Date

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

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

UDQE Tracking No.: UDQE-RHLLW-048

Subject: Canister OWC003 radionuclide inventory 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, details of each waste canister are entered into the Remote-Handled Low-Level Waste (RHLLW) Inventory Online (RHINO) software which performs several checks to evaluate the canister for acceptance. Waste canister OWC003, a legacy (generated prior to 4/21/2015) HFEF-5 canister from MFC containing activated metal waste components was flagged by RHINO for the following:

- The PA Base Case inventory check by Generator/Canister/Waste form (All Radionuclides/Key Radionuclides) failed because previous emplacements resulted in the PA inventory being exceeded for four radionuclides (Ba-137m, Np-237, Pa-233, and Th-231). Because of these previous exceedances, each new canister will fail this same check. This canister contains 1.82E-04 curies of Ba-137m that contribute to the exceedance of the PA base case inventories for specific generator, canister type, and waste form.

- The inventories of key radionuclide Mo-93 in the proposed canister is greater than 10% of the total base case activity for the specific generator, canister type and waste form.

According to INL/EXT-18-45184 (2018), the inventory of any canister that causes or contributes to an exceedance of these threshold values must be reviewed according to SD-52.1.4 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. Exceedance of the threshold activities does not indicate the canister is unacceptable but dictates the activity levels must be reviewed.

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: Canister OWC003 was flagged by RHINO while performing PA checks during acceptance testing. According to INL/EXT-18-45184 (2018), the canister must be evaluated 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.

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	Jonathan Jacobson	7/20/2021
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Tim Arsenault	Tim Arsenault	07/20/2021
Print/Type Name Approver/NFM	Signature Approver/NFM	Date

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.

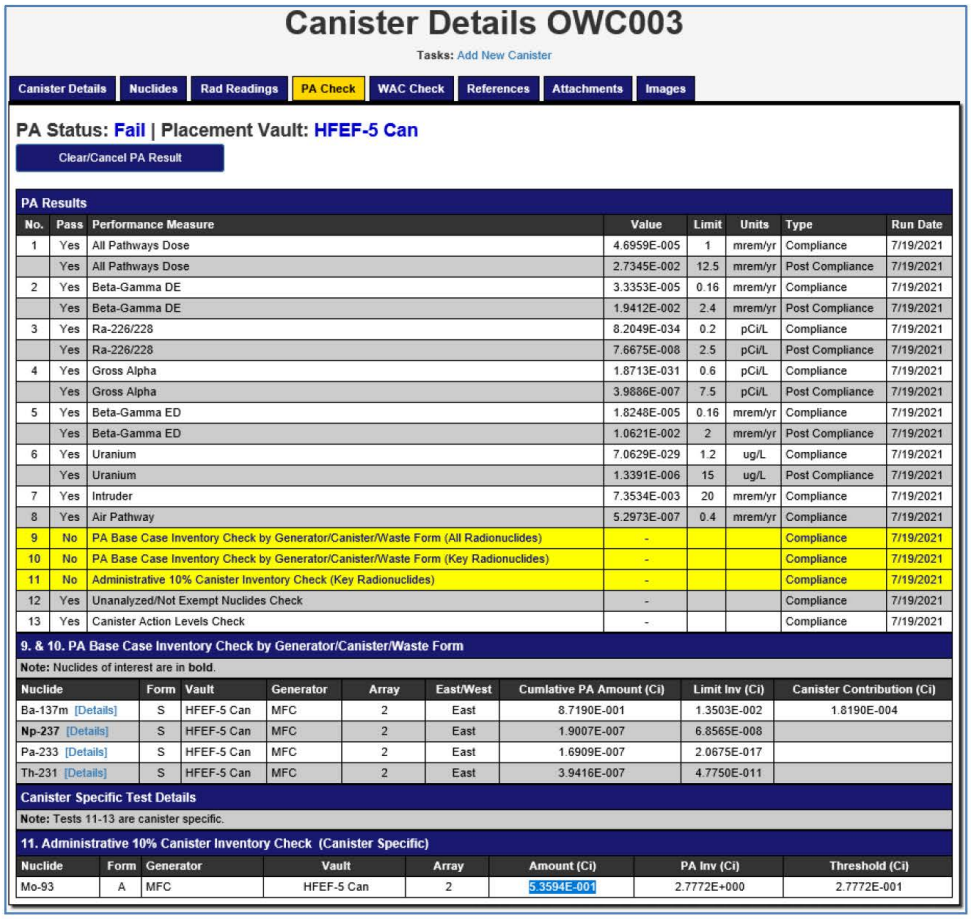
5. *Does the proposed activity/new information/discovery have the potential to result in a significant change impacting the ability of the disposal facility to meet the performance objectives of DOE Order 435.1 or alter conditions of the DAS and require a special analysis?*

   Yes ☐ No ☒

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

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

Explanation
Figure 1 shows the Canister Details page of RHINO and the results of the PA checks. The failed checks highlighted in yellow are evaluated as part of this UDQE.



Canister Details OWC003

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	4.6959E-005	1	mrem/yr	Compliance	7/19/2021
	Yes	All Pathways Dose	2.7345E-002	12.5	mrem/yr	Post Compliance	7/19/2021
2	Yes	Beta-Gamma DE	3.3353E-005	0.16	mrem/yr	Compliance	7/19/2021
	Yes	Beta-Gamma DE	1.9412E-002	2.4	mrem/yr	Post Compliance	7/19/2021
3	Yes	Ra-226/228	8.2049E-034	0.2	pCi/L	Compliance	7/19/2021
	Yes	Ra-226/228	7.6675E-008	2.5	pCi/L	Post Compliance	7/19/2021
4	Yes	Gross Alpha	1.8713E-031	0.6	pCi/L	Compliance	7/19/2021
	Yes	Gross Alpha	3.9886E-007	7.5	pCi/L	Post Compliance	7/19/2021
5	Yes	Beta-Gamma ED	1.8248E-005	0.16	mrem/yr	Compliance	7/19/2021
	Yes	Beta-Gamma ED	1.0621E-002	2	mrem/yr	Post Compliance	7/19/2021
6	Yes	Uranium	7.0629E-029	1.2	ug/L	Compliance	7/19/2021
	Yes	Uranium	1.3391E-006	15	ug/L	Post Compliance	7/19/2021
7	Yes	Intruder	7.3534E-003	20	mrem/yr	Compliance	7/19/2021
8	Yes	Air Pathway	5.2973E-007	0.4	mrem/yr	Compliance	7/19/2021
9	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (All Radionuclides)	-			Compliance	7/19/2021
10	No	PA Base Case Inventory Check by Generator/Canister/Waste Form (Key Radionuclides)	-			Compliance	7/19/2021
11	No	Administrative 10% Canister Inventory Check (Key Radionuclides)	-			Compliance	7/19/2021
12	Yes	Unanalyzed/Not Exempt Nuclides Check	-			Compliance	7/19/2021
13	Yes	Canister Action Levels Check	-			Compliance	7/19/2021

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	8.7190E-001	1.3503E-002	1.8190E-004
Np-237 [Details]	S	HFEF-5 Can	MFC	2	East	1.9007E-007	6.8565E-008	
Pa-233 [Details]	S	HFEF-5 Can	MFC	2	East	1.6909E-007	2.0675E-017	
Th-231 [Details]	S	HFEF-5 Can	MFC	2	East	3.9416E-007	4.7750E-011	

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)
Mo-93	A	MFC	HFEF-5 Can	2	5.3594E-001	2.7772E+000	2.7772E-001

Figure 1. Canister Details page of RHINO and the results of the PA checks for canister OWC003.

Evaluation of Failed PA Checks 9 and 10

According to PA checks 9 and 10 performed by RHINO, the inventories of radionuclides Ba-137m, Np-237, Pa-233, and Th-231 (ECAR-5546) exceed the performance assessment (PA) base case inventories for the specific generator, canister type, and waste form. In this case, the canister contains only Ba-137m. Exceedance of the PA base case inventory for the other radionuclides (Np-237, Pa-233 and Th-231) is due to canisters previously approved for acceptance and determined to be within the bounds of the PA.

Ba-137m was screened from the groundwater pathway evaluation in the PA due to a short half-life (DOE/ID-11421 2018). Because the half-life of Ba-137m is less than 1 year, the Ba-137m inventory will have an insignificant impact on the groundwater pathway PA dose.

Evaluation of Failed PA Check 11

OWC003 is an HFEF-5 canister from MFC that contains activated metal waste. Canister OWC003 contains 0.536 Ci of Mo-93, a key radionuclide for the groundwater pathway in the PA. According to RHINO, the Mo-93 inventory in canister OWC003 (0.536 Ci) is greater than 10% of the PA total base case activity for the specific generator, canister type and waste form (0.278 Ci) (see Figure 1). However, according to inventory records (supplemental information for ECAR-3940) the original estimated inventory of Mo-93 in canister OWC003, decayed to April 2020, the assumed operations start date in the PA, was 1.57 Ci. Because this is greater than 10% of the PA base case inventory, the exceedance is to be expected. And although the current Mo-93 inventory in canister OWC003 is less than the original projected inventory, it is still more than 10% of the PA base case inventory and was flagged by RHINO accordingly. Nevertheless, the Mo-93 inventory in canister OWC003 is within the bounds of the PA and does not represent an increase in waste generation rates.

According to RHINO, the projected all-pathways dose after including canister OWC003 is 4.70E-05 mrem/yr (see Figure 1). While this is well within the bounds of the PA, it does represent an increase of 2.06E-05 mrem/yr in the all-pathways dose from all previous canisters. This is likely because the original inventory of canister OWC003 contained a high percentage of the total inventory of several radionuclides for this waste form including C-14, Fe-55, Mo-93, Nb-94, Ni-59 and Ni-63. Therefore, it is not surprising that the dose contribution of this canister for this generator, canister type and waste form is higher than other canisters. Nevertheless, the dose is within the bounds of the PA.

Summary

Canister OWC003 was flagged by RHINO because the inventory/activity of some radionuclides exceeded or contributed to the exceedance of PA inventory checks. A review of the information available indicates the radionuclide inventory of canister OWC003 will not have a significant impact on the PA and there is nothing to indicate the activities in this container are incorrect or that there is a change in waste generation rates. Therefore, the canister is recommended acceptable for disposal.

References

DOE/ID-11421, 2018, Performance Assessment for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility, Revision 2, U.S. Department of Energy Idaho Operations Office, February 2018.

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.

ECAR-5546, 2021, Radiological Source Term Determination for Containers Having Unique IDs B-307, OWC001, OWC003, OWC020, OWC021, SN-99, SN-108, SN-109, SN-110, SN-116, SN-117, SN-120, SN-124, and SN-137, Idaho National Laboratory, June 2021.

INL/EXT-18-45184, 2018, Methods, Implementation, and Testing to Support Determination of Performance Assessment Compliance for the RHLLW Disposal Facility WAC, Idaho National Laboratory, June 2018.

Jonathan Jacobson	Jonathan Jacobson	7/20/2021
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
A. R. Prather	A. R. Prather	7/20/21
Print/Type Name System Engineer/SE	Signature System Engineer/SE	Date
A. Jeff Sondrup	Jeff Sondrup	7/20/2021
Print/Type Name PA/CA SME	Signature PA/CA SME	Date
Amy M. Cox	Amy M. Cox	2021.07.20
Print/Type Name Waste Management/WMP	Signature Waste Management/WMP	Date
Tim Arsenault	Tim Arsenault	07/20/2021
Print/Type Name Nuclear Facility Manger/NFM	Signature Nuclear Facility Manger/NFM	Date

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

Appendix B

Compliance and Performance Monitoring Data for the RHLLW Disposal Facility

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 2021 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: BEA01-3011-01, Work Order: 541292
- Limitations and Validation Report: AR0015_BEA01-3011-01_LVR for Idaho National Laboratory
- Lab Data Report for Sample Data Group: BEA01-3018-01, Work Order: 541033
- Limitations and Validation Report: AR0014_BEA01-3018-01_LVR for Idaho National Laboratory.

Lysimeter sample results are documented in the following reports:

- Lab Data Report for Sample Data Group: BEA01-2979-05, Work Order: 544201
- Radioanalytical Limitations and Validation Report: AR0012_BEA01-2079-05_LVR for Idaho National Laboratory
- Lab Data Report for Sample Data Group: BEA01-2980-02, Work Order: 545489
- Radioanalytical Limitations and Validation Report AR0016_BEA01-2980-02_LVR_REV01 for Idaho National Laboratory
- Lab Data Report for Sample Data Group: BEA01-2982-01, Work Order: 541681
- Radioanalytical Limitations and Validation Report AR0013_BEA01-2982-01_LVR_REV01 for Idaho National Laboratory.

All aquifer and lysimeter results are uploaded and stored 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 2021.
- Table B-2. Average groundwater concentrations in RHLLW Disposal Facility compliance monitoring wells for FY 2021.
- Table B-3. Average tritium concentration in groundwater in RHLLW Disposal Facility compliance monitoring wells (FY 2019-2021). Data is shown graphically in Figure B-1.
- Table B-4. Summary of RHLLW Disposal Facility lysimeter sampling results for FY 2021.
- Figure B-1. Average tritium concentration in groundwater in RHLLW Disposal Facility compliance monitoring wells (FY 2019-2021).

Table B-1. Aquifer sampling results for RHLLW Disposal Facility compliance monitoring wells for FY 2021.

Constituent	Result Type	Date Collected	Concentration (pCi/L)	Uncertainty	Validation Qualifier
Well USGS-136					
Gross alpha	Original	04/15/21	0.937	0.317	UJ
Gross beta	Original	04/15/21	2.14	0.26	
C-14	Original	04/15/21	-12.9	10.5	U
H-3	Original	04/15/21	916	149	
I-129	Original	04/15/21	9.27	8.72	U
Tc-99	Original	04/15/21	-0.196	0.174	U
Well USGS-140					
Gross alpha	Original	04/19/21	0.489	0.315	U
	Field Duplicate	04/19/21	0.528	0.27	U
Gross beta	Original	04/19/21	2.47	0.26	
	Field Duplicate	04/19/21	2.3	0.254	
C-14	Original	04/19/21	7.01	10.9	U
	Field Duplicate	04/19/21	-3.08	10.7	U
H-3	Original	04/19/21	624	126	
	Field Duplicate	04/19/21	853	143	
I-129	Original	04/19/21	-1.24	8.26	U
	Field Duplicate	04/19/21	-2.15	7.45	U
Tc-99	Original	04/19/21	0.0291	0.152	U
	Field Duplicate	04/19/21	-0.0226	0.0985	U
Well USGS-141					
Gross alpha	Original	04/19/21	1.06	0.337	
Gross beta	Original	04/19/21	1.65	0.254	
C-14	Original	04/19/21	-5.16	10.6	U
H-3	Original	04/19/21	608	125	
I-129	Original	04/19/21	11.7	8.07	U
Tc-99	Original	04/19/21	-0.115	0.166	U

U = Analyte was analyzed for but not detected above the minimum detectable activity. Results should not be used.
UJ = Analyte may or may not be present and the result is considered highly questionable. Results should not be used.
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.

Table B-2. Average groundwater concentrations in RHLLW Disposal Facility compliance monitoring wells for FY 2021.

Well	Average Sample Result (pCi/L)[a]					
	Gross alpha	Gross beta	C-14	H-3	I-129	Tc-99
USGS-136	U	2.14	U	916	U	U
USGS-140	U	2.39	U	739	U	U
USGS-141	1.06	1.65	U	608	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

U = Analyte was analyzed for but not detected above the minimum detectable activity.
UJ = Analyte may or may not be present and the result is considered highly questionable.
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 (see Table B-1).
ND = Non-detect

a. Average values do not include U- or UJ-qualified data. Average values include duplicate sample data if the analyte was detected in both the original and duplicate samples.
b. Action levels are maximum contaminant levels (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 EPA Radionuclides Rule 66 FR 76708. Other MCLs are based on a 4 mrem/year critical organ dose for beta/photon emitters.
c. *Assessment of Aquifer Baseline Conditions at the INL RHLLW Disposal Facility* (INL 2017).

Table B-3. Average tritium concentration in groundwater in RHLLW Disposal Facility compliance monitoring wells (FY 2019-2021). 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
USGS-140	10/1/2018	1490
	4/30/2019	1060
	4/28/2020	964
	4/19/2021	739
USGS-141	10/1/2018	1140
	4/30/2019	1520
	4/28/2020	815
	4/19/2021	608

a. Average values include duplicate sample data if the analyte was detected in both the original and duplicate samples.

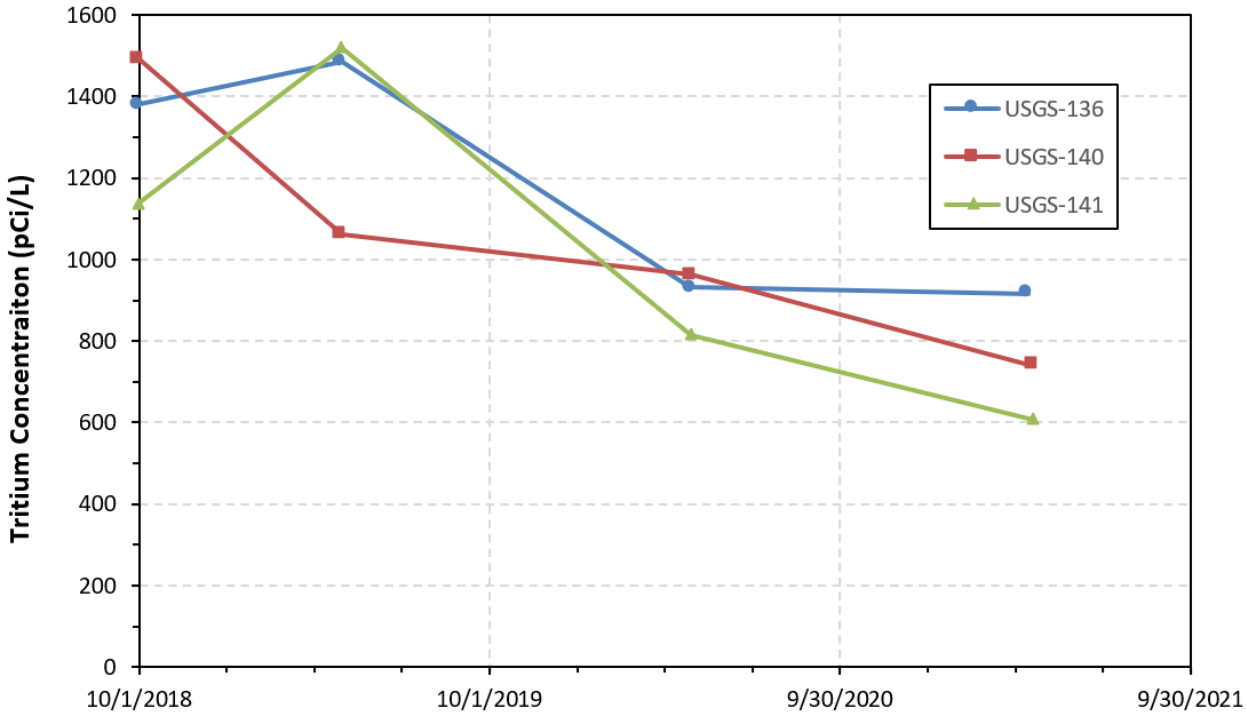


Figure B-1. Average tritium concentration in groundwater in RHLLW Disposal Facility compliance monitoring wells (FY 2019-2021).

Table B-4. Summary of RHLLW Disposal Facility lysimeter sampling results for FY 2021.

Lysimeter	Total Sample Volume (mL)	Sample Result (pCi/L)						
		Gross alpha	Gross beta	C-14	H-3 fall[f]	H-3 spring	I-129	Tc-99
Shallow-Alluvium Lysimeters (26–29 ft below land surface)								
PA-North	1022[b]	**11.3**	UJ	U		893	U	U
PA-North (Dup)		---	---	---		652	U	---
PA-South	324	UJ	6.36	---		1080	---	---
NuPac-West	672[a]	U	U	U		346	U	U
NuPac-East	542[a]	U	3.44	U	UJ	612	U	U
55-ton-South	1038[b]	UJ	U	U		U	U	U
55-ton-South (Dup)		---	---	U		U	---	---
HFEF-South	370	2.12	U	---	37,300	34,100	---	U
LCC-West	288	3.93	7.93	---	646	860	---	---
LCC-East	564[a]	U	U	U		U	U	U
MFTC-West	812[b]	U	U	U	U	UJ	U	U
MFTC-West (Dup)		---	---	---		U	---	---
MFTC-East	808[b]	1.88	U	U		255	U	U
MFTC-East (Dup)		---	---	---		UJ	---	---
Deep-Alluvium Lysimeters (40–43 ft below land surface)								
HFEF-South-45	108	---	---	---	U	442	---	---
LCC-West-45	146	---	---	---	670	701	---	U
LCC-East-45	60	---	---	---		U	---	---
Nupac-West-45	22[c]	---	---	---		474	---	---
Nupac-East-45	32[c]							
55-Ton-South-45	12[c]							
MFTC-West-45	28[c]							
MFTC-East-45	22[c]							
Sedimentary-Interbed Lysimeters (170–176 ft below land surface)								
NuPac-SIW	54	---	---	---		U	---	---
MFTC-West-SIW	264	4.36	8.08	---		335	---	---
MFTC-East-SIW	1076[b]	2.2	2.07	U		U	U	U
MFTC-East-SIW (Dup)		UJ	UJ	---		U	---	---
Action Level or MCL[e]		10[d]	40[d]	2000[e]	20,000[e]		1[e]	900[e]

a. Sample volume sufficient for full suite of analytes.
b. Sample volume sufficient for full suite of analytes and duplicates (Dup) of some analytes.
c. Sample volumes from five lysimeters combined into single sample volume (116 ml) for analysis.
d. Action levels (PLN-5501) are only defined for gross alpha and gross beta.
e. Federal drinking water maximum contaminant levels (MCLs) are not action levels and do not apply to lysimeter samples. They are provided for comparison and informational purposes only.
f. Samples collected in the fall are from a limited set of 6 lysimeters and only analyzed for tritium. Tritium analysis only requires about 50 ml and the sample volumes collected in the fall are not included in the volumes in column 2.
--- Indicates sample volume was insufficient for analysis. A blank cell shaded gray indicates no attempt was made to collect a sample.
U = Radionuclide is not considered to be present in the sample. Sample result is not included.
UJ = Radionuclide may or may not be present in the sample and the sample result (not included) is considered highly questionable.
J = Radionuclide is considered present in the sample, but the sample result (included) is questionable.
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.
BOLD font indicates result above action level (see footnote d).