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Annual Summary Report for the Remote-Handled Low-Level Waste Disposal Facility—FY 2020

March 2021

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Idaho National Laboratory

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EXECUTIVE SUMMARY

This Fiscal Year (FY) 2020 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 Change 1, "Radioactive Waste Management."

In FY 2020, 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. Fifteen total waste-canister shipments were received at the RHLLW Disposal Facility, and 15 total waste canisters were emplaced.

Except for the monitoring plan (PLN-5501), there were no updates to the PA, CA, ODAS, radioactive-waste-management basis (RWMB) or other technical basis documents in FY 2020. The update of PLN-5501 is discussed in Sections 2.1 and 2.9. 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 2
- "Monitoring Plan for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility," PLN-5501, Revision 2

[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.

- "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.

Ongoing Activities

In FY 2020, 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 2020 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 17 potential changes in FY 2020. 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 2020 were activated metals and surface-contaminated debris in Hot Fuel Examination Facility (HFEF)-5 canisters from the Materials and Fuels Complex (MFC). A total of 15 HFEF-5 waste canisters were shipped to the facility and disposed of in the HFEF vault array in FY 2020. Twenty-nine total HFEF-5 canisters from MFC have been received and disposed of at RHLLW Disposal Facility. This leaves space for 151 additional canisters of this type. No other vault arrays received waste, and the facility is at 3.1% 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, RHINO[b] (TFR-981 2018). In the 15 waste canisters placed in FY 2020 there were 18 radionuclides reported in activated metals and 62 radionuclides reported as surface contamination. Of those, 11 of the 14 radionuclides fully analyzed in

[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 PA for the groundwater (all-pathway) dose were 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, only C-14 was reported. Radionuclides reported that contribute to the PA beta-gamma dose equivalent, or the beta-gamma effective dose include C-14, Mo-93, Nb-94, Ni-59, and Tc-99.

Facility performance was also calculated and tracked using RHINO. The calculated maximum dose and concentration performance measures from the 15 waste canisters disposed of in FY 2020 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 2020 road-apron inspection showed some 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. The vault inspection revealed one damaged vault shield-plug surface. The damage is relatively minor, and the shield plug is scheduled for repair early in FY 2021. 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 2020 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 was detected in all three aquifer wells, while gross alpha and gross beta were positively detected in two 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 2017b).

Performance monitoring was conducted by collecting and analyzing soil-water 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). Sampling was conducted in the spring on several occasions in order to extract enough water for analysis of the full suite of analytes. In general, sample collection from the lysimeters was much more successful in FY 2020; the result of increased attempts to obtain water and procedural changes for sampling the sedimentary interbed lysimeters.

All sample results were less than action levels with three exceptions: two samples slightly exceeded the gross alpha action level of 10 pCi/L. A duplicate of one of the samples was less than the action level. The other exceedance was an unexpectedly high detection of tritium (H-3) at more than twice the action level of 20,000 pCi/L. As a result, several actions were initiated to provide additional

information to understand the H-3 result, including reanalysis of the original sample and additional sampling. Although some results and assessments were available at the time this report was prepared, several are ongoing, and the results will be presented in the next ASR after all actions are concluded and the assessment is complete. All actions will be documented in accordance with LWP-13840, “Issues Management.”

Design, Operations, and Closure Conditions

During FY 2020, 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 2020.

Planned or Contemplated Changes

Planned changes to technical-basis documents include minor revisions to the PA/CA Maintenance Plan (PLN-3368), the WAC (PLN-5546), and the change control process document (SD-52.1.4). A review of the PA/CA maintenance plan indicated some required evaluations and reviews should be removed or explained in more detail and the plan is currently being reviewed for other possible changes prior to revision. The WAC is also being evaluated for potential revisions that include recommendations for process improvement identified during operations, and a recommendation to re-evaluate the radionuclide-reporting requirements to ensure they are consistent with PA assumptions. SD-52.1.4 is being revised to include mandatory screenings (UDQSs) of all RHINO SCRs consistent with the decision discussed in the FY 2019 ASR.

Other changes include the new Advanced Test Reactor (ATR)-5 waste canister for disposal of activated metals from ATR, and the new 55-ton scrap canister for disposal of activated metal and resin waste from the Naval Reactors Facility. The canister designs are consistent with or expected to exceed the performance of PA assumptions. Design changes that may impact the PA or the ability to meet WAC continue to be evaluated through the change-control process. So far, none of the changes identified is expected to impact the PA, CA, ODAS, or the RHLLW Disposal Facility design, operations, closure, research and development, or land use.

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
CLUES	Comprehensive Land Use and Environmental Stewardship
CVAS	Cask to Vault Adapter System
DOE	Department of Energy
ECAR	Engineering Calculations and Analysis Report
EPA	Environmental Protection Agency
FE	facility evaluation
HFEF	Hot Fuel Examination Facility
INL	Idaho National Laboratory
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
RWMB	radioactive-waste-management basis
SCR	software-change request
TRU	transuranic
UDQE	unreviewed disposal question evaluation
UDQS	unreviewed disposal question screening
WAC	waste acceptance criteria
WO	work order

Annual Summary Report for the Remote-Handled Low-Level Waste Disposal Facility—FY 2020

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 2, "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 2020, 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 2020 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 2018a) to meet the DOE Order 435.1, Change 1, "Radioactive Waste Management," performance objectives for the RH-LLW Disposal Facility. Annual review of the adequacy of the PA and CA at the RH-LLW Disposal Facility ensures that conclusions of the analyses remain valid, in accordance with requirements of DOE Order 435.1, Change 1.

1.1 Site and Facility Background

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

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

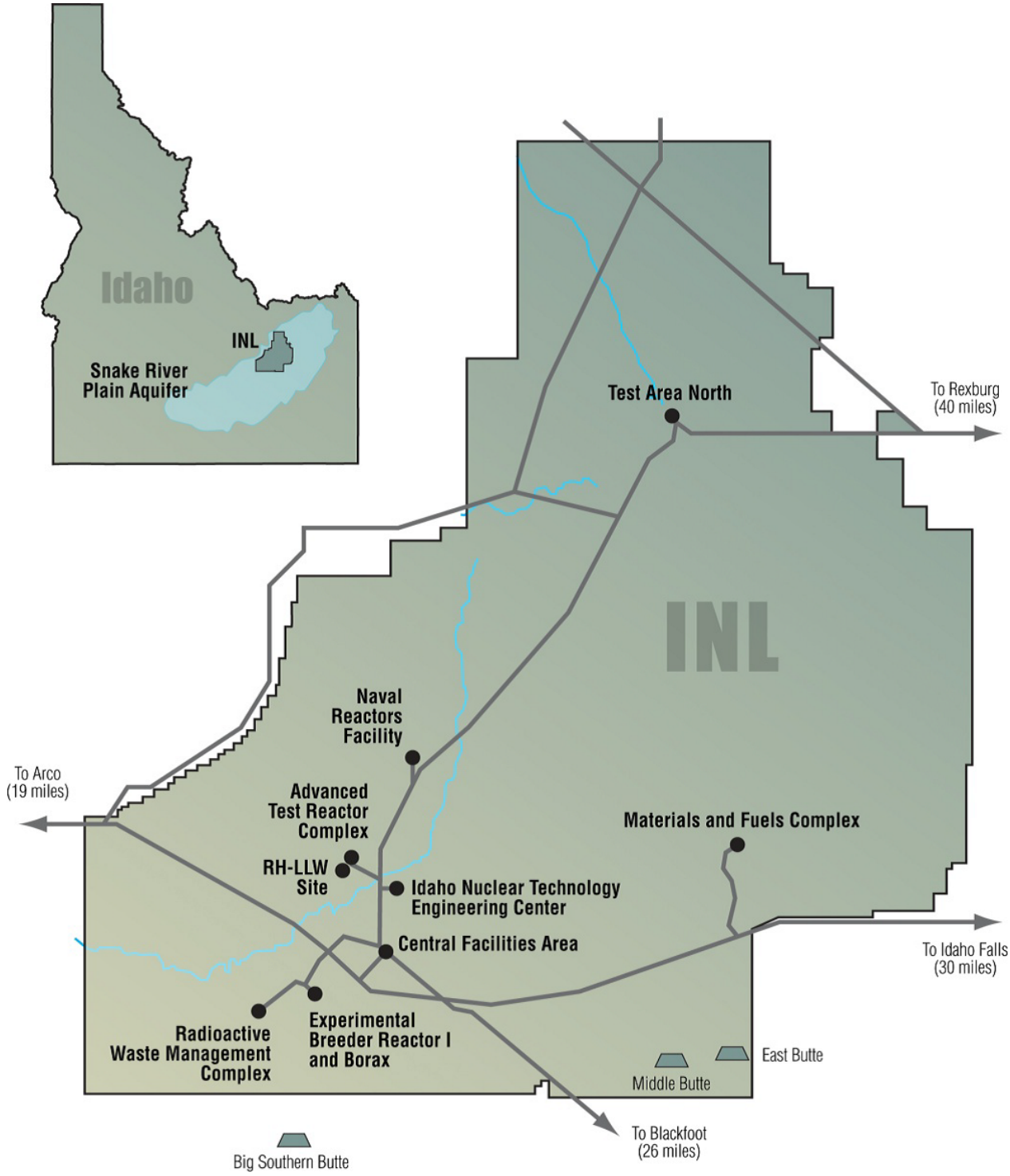

Figure 1-1. Map of INL Site showing the locations of major facilities including the RHLLW Disposal Facility.

Figure 1-2. RHLLW Disposal Facility showing administration and maintenance building (background) and vault yard (foreground). The Advanced Test Reactor Complex is in the far background.

Table 1-1. 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 is now in development and has been designated as the ATR-5 cask/canister system.

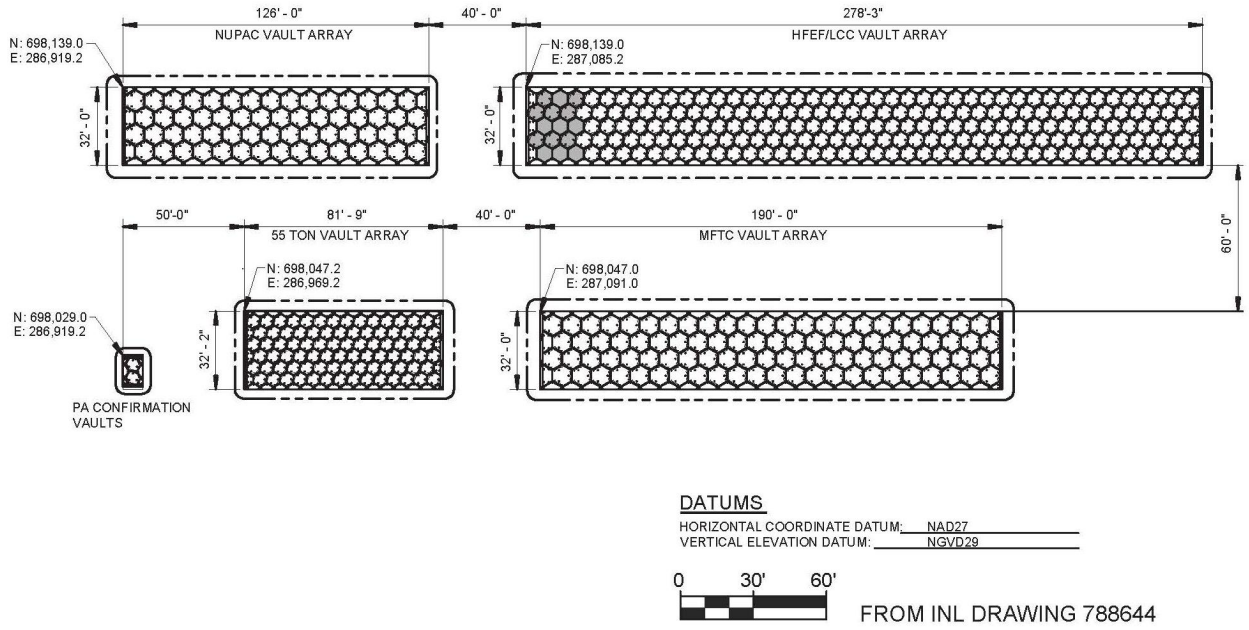

Figure 1-3. Horizontal layout of the disposal vault arrays at the RHLLW Disposal Facility.

1.2 Purpose and Scope

The purpose of this FY 2020 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 2020 RHLLW Disposal Facility operations were conducted within the bounds of the PA, CA, and ODAS. This ASR addresses RHLLW Disposal Facility operations for FY 2020 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 2020 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 2020

Section 3—Discussion of the cumulative effect of changes that occurred in FY 2020

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 2020 based on summary information presented in this report.

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

A total of 15 waste canister disposals were performed in FY 2020 at the RHLLW Disposal Facility. This brings the total number of canister disposals to 29 by the end of FY 2020. 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 2020. No new information or new activities were identified in FY 2020 that might change assumptions and conclusions of the PA, CA, ODAS, or RWMB. Issues that could impact assumptions and conclusions include land-use plans, the waste acceptance criteria (WAC), future disposals, changes to the disposed of inventory, and final closure plans. Supporting information for potential issues that might change assumptions and conclusions of the PA, CA, ODAS, or RWMB is discussed in the following subsections and Section 4, Waste Receipts.

Except for the monitoring plan (PLN-5501), there were no updates to the PA, CA, ODAS, RWMB or other technical basis documents in FY 2020. The update of PLN-5501 is discussed in Sections 2.1 and 2.9. 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 2
- "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 2020. A summary of all UDQSs and UDQEs that were initiated and/or concluded during FY 2020 is provided in Table 2-1. All UDQS/UDQE forms completed and approved prior to FY 2021 are provided in Appendix A.

[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.

Work was performed on 17 UDQS/UDQEs in FY 2020, and that included three carried over from FY 2019. Of the 17, one was cancelled, three were screened negative and approved, six were screened positive requiring an evaluation, and seven were still in the screening process at the end of FY 2020. Of the six that screened positive and required evaluations, five of the evaluations were completed and approved, and one is still in progress. The five evaluations that were 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 seven UDQSs and one UDQE still in progress at the end of FY 2020, is to be determined and will be reported in the FY 2021 ASR.

Technical evaluations were conducted and documented for two of the UDQEs. Technical evaluation TEV-4037 was conducted for UDQE-RHLLW-033, "Spatial Interference between NSFH waste cask/Cask to Vault Adapter System (CVAS) and Power Pedestal/Monitoring Wells," to determine the potential interference between a proposed waste cask and two sets of monitoring wells and power pedestals near the edge of Vault Array 2 (LCC Vaults). The RHLLW Disposal Facility was designed and constructed prior to design of the NRF Naval Spent Fuel Handling (NSFH) waste cask and the NSFH design team identified the potential interference. The evaluation found that the monitoring well risers do not interfere with the current cask/CVAS design, but the clearance is close, and it may be necessary to temporarily unbolt the instrument boxes from the monitoring well risers during canister emplacement. TEV-4037 recommends revisiting the design once the cask/CVAS is complete and present on site. Once on site, operations personnel can determine whether the clearance between the monitoring well and CVAS is adequate and define acceptable operating/disposal conditions.

Technical evaluation TEV-4000 was conducted for UDQE-RHLLW-041, "ATR-5 waste canister purging/dewatering functional testing and acceptance," to demonstrate the canister could be purged/dewatered to meet WAC. The ATR-canal cleanout-project team designed a new shielded transport container system for disposing of activated metals from the ATR canal. The RHLLW Disposal Facility WAC (PLN-5446), Section 3.7, prohibits liquid waste from disposal at the facility and further specifies that waste containing free liquids shall be drained to the point it contains as little freestanding liquid as reasonably achievable, but in no case shall the liquid exceed 1% of the waste volume. The underwater waste loading and purging/dewatering the ATR-5 waste canister was not considered at the time the PA and the WAC were developed. The ATR Canal Cleanout Project team fabricated two protype waste canisters that were used for testing and demonstration of a purging, dewatering process. Test plan TP-106, "ATR-5 Outer Waste Canister Functional Testing," documents the procedure for purging/dewatering the ATR-5 canister and TEV-4000 documents the testing and results. Based on the evaluation the procedure for purging/dewatering the ATR-5 canister system is acceptable because it will result in a waste package that will meet WAC and does not violate assumptions in 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 eight UDQS/UDQEs completed and approved in FY 2020. 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 2020 will be reported in the FY 2021 ASR.

Table 2-2. Unreviewed disposal question screens and evaluations performed during FY 2020.

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-026	Canister MFC110124 radionuclide inventory flagged by RHINO for exceeding PA inventory checks	Waste canister MFC110124, a legacy HFEF-5 canister from MFC containing activated metals and surface contamination, was flagged by RHINO[c] while performing PA checks. A decision was made to postpone shipment of the waste canister indefinitely and the UDQE was cancelled. The acceptance testing will be started from the beginning when the canister is resubmitted for consideration. No further action required.	Cancelled	N/A	Cancelled	N/A	N/A
UDQE-RHLLW-027	Proposed change to the monitoring plan (PLN-5501) and the monitoring system as-built report (INL/EXT-17-43081)	During the first lysimeter sampling event in spring of 2019, it was discovered that the lysimeter installations in two wells were different from documented in the as-built report (INL/EXT-17-43081) and the monitoring plan (PLN-5501). The UDQE was screened negative as the discrepancy is deemed minor and does not affect the assumptions and/or conclusions of the PA. Both documents were corrected and approved in FY 2020. No further action required.	Negative	N/A	Approved	None	None
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. UDQE completion expected in FY 2021.	Positive	In Progress	In Progress	TBD	TBD
UDQE-RHLLW-032	Canister MFC170305 radionuclide inventory flagged by RHINO for exceeding PA inventory checks	Waste canister MFC170305, a new-generation HFEF-5 canister from MFC containing activated metals and surface contamination, was flagged by RHINO[c] while performing PA checks. The impacts were determined to be very small 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-033	Spatial Interference between NSFH waste cask/CVAS and Power Pedestal/Monitoring Wells	The RHLLW Disposal Facility was designed prior to design of the NRF NSFH waste cask. The NSFH design team identified potential spatial interference between the CVAS and monitoring wells and power pedestals at two locations along the southern edge of LCC vault array. A technical evaluation (TEV-4037) determined the clearance was small but recommended revisiting the evaluation once the design is completed and the cask and CVAS is present on site to further define acceptable operational conditions.	Positive	Negative	Approved	None	None

Table 2-1. (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-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 are being evaluated to determine whether they are within the bounds of the approved PA. The UDQE is expected to be completed in early FY 2021.	In Progress	In Progress	In Progress	TBD	TBD
UDQE-RHLLW-035	Seven unanalyzed PA nuclides disposed of in FY 2019	During development of SCR-RHINO-004 (see UDQE-RHLLW-044), unanalyzed radionuclides disposed of in FY 2019 were identified. The UDQE will examine potential impacts of the unanalyzed radionuclides and be completed after SCR-RHINO-004 is approved early in FY 2021.	In Progress	In Progress	In Progress	TBD	TBD
UDQE-RHLLW-036	55-ton Waste Canister with Increased Tolerance on Top Ring Flatness	NRF is designing and procuring a new 55-ton waste canister for disposal and proposed an increase change to the tolerance to the canister top ring flatness from 0.015 in. to 0.030 in. It was determined the increase in tolerance would not negatively affect the self-limiting water ingress of the canister as specified in the WAC (PLN-5446). No further action required.	Negative	N/A	Approved	None	None
UDQE-RHLLW-037	Revise PA/CA maintenance plan (PLN-3368)	During preparation of the FY 2019 ASR, a review of the PA/CA maintenance plan indicated some required evaluations and reviews identified in Section 5 of the plan should be removed or explained in more detail. A review of the plan is ongoing, and the revision is expected to be complete in FY 2021.	In Progress	In Progress	In Progress	TBD	TBD
UDQE-RHLLW-038	Discovered RHINO calculating transuranic (TRU) concentration incorrectly after software change request was implemented	During the acceptance review of waste canister MFC190345, an HFEF-5 canister from MFC containing new-generation activated metals and surface contamination, a discrepancy was identified between RHINO[c] and Integrated Waste Tracking Software (IWTS) in reporting the concentration of TRU isotopes. An investigation discovered an error in RHINO that resulted during implementation of software change request (SCR)-RHINO-005. RHINO was updated to correct the error. An evaluation determined there were no previously accepted canisters impacted by the error.	Positive	Negative	Approved	None	None

Table 2-1. (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-039	Inclusion of core internal changeout components and ancillary activated metal waste from ATR not analyzed in the original PA	The radionuclide source term used in the PA for activated metals from ATR was based on a specific list of components from changeouts of the ATR core. ATR has requested the ability to package ancillary waste constructed of the same materials. An evaluation was conducted to assess the potential changes. The evaluation determined that a characterization methodology is in place to demonstrate that the waste is within the assumptions and bounds of the PA, and the impact of surface contamination on the components (not considered in the PA) is negligible. Prior to each canister disposal, the characterization documentation will be reviewed to determine whether all required information is included, and whether the components are of similar materials to those considered in the PA and the inventory passes all RHINO[c] PA and WAC checks. No further action required.	Positive	Negative	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. ATR is exploring disposal options.	In Progress	In Progress	In Progress	TBD	TBD
UDQE-RHLLW-041	ATR-5 waste canister purging/dewatering functional testing and acceptance	The ATR Canal Cleanout Project is designing a new ATR-5 waste canister for disposal of activated metals from the ATR cooling canal. The PA assumed the ATR waste would be packaged in an HFEF-5 or similar type canister. TP-106 and TEV-4000 demonstrated and documented the purging/dewatering process for the new ATR-5 waste canister meets the RHLLW WAC for free liquids and does not violate the assumptions of the PA. The ATR-5 waste canister system was deemed acceptable. No further action is required.	Positive	Negative	Approved	None	None

Table 2-1. (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-042	UDQE for previously completed RHINO SCRs that were not evaluated according to the RHLLW change control process	A decision was made during preparation of the FY 2019 ASR to manage software-change requests using the change control process. As a result, three previously completed RHINO[c] SCRs were screened, and it was determined the SCRs did not impact the assumptions and/or conclusions of the PA/CA or other supporting documentation. No further action is required.	Negative	N/A	Approved	None	None
UDQE-RHLLW-043	Damage discovered to the upper vault riser of Vault E02 in Vault Array 2	Damage to 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. It appears the damage is minor, but the evaluation will determine whether repairs are necessary given the constraints of the WAC and PA.	In Progress	In Progress	In Progress	TBD	TBD
UDQE-RHLLW-044	UDQE for SCR-RHINO-004	RHINO[c] software-change request SCR-RHINO-004 was initiated to improve waste input and acceptance procedures in RHINO[c] and have RHINO generate reports to assist in preparation of the ASR and identify unanalyzed radionuclides, meaning radionuclides that were not considered during preparation of the PA for a specific waste generator, canister type and waste form. All RHINO[c] software changes are managed using the change-control process. 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 and the UDQE are expected to be complete early in FY 2021.	In Progress	In Progress	In Progress	TBD	TBD
UDQE-RHLLW-045	2020 12 M Vault Shield Plug Inspection with Level 3 or Greater Damage Identified	Vault shield plugs are inspected annually for damage. The 2020 inspection revealed damage to a single plug, VSP-E01 in Vault Array 2. Damage and repairs are managed using the change control process. Repair is scheduled for early in FY 2021 and the UDQE will be completed after the repair and inspection.	In Progress	In Progress	In Progress	TBD	TBD

Table 2-1. (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]

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 (28, 30, and 31) were completed in FY 2019 and presented in the FY 2019 ASR.

b. "None includes impact determination described as minimal, insignificant, not-discernable, etc."

c. 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."

2.2 Land-Use Plans for the INL Site

Land-use plans for the RHLLW Disposal Facility did not change in FY 2020. 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 2020a), 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 in FY 2020. The updated CLUES report is being reviewed for changes that could impact the RHLLW Disposal Facility PA, CA, RWMB or ODAS according to the change control process SD-52.1.4. The screening/evaluation will be documented in a UDQS/UDQE.

A number of recent congressional actions[f], DOE-ID site-use permits[g], construction of new nuclear energy research infrastructure on INL, and DOE's interpretation of the definition of the statutory term *high-level radioactive waste*[h] 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 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 2020a). 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 2020, 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 RH-LLW. 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 2020.

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

[g] 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).

[h] 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

A total of 15 waste canister disposals were performed in FY 2020 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 ATR, 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. 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.

PLN-3368 includes a requirement to evaluate the potential impact of published INL Site Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) five-year reviews on the PA and CA, including review of upgradient-groundwater monitoring data.

The most recent CERCLA five-year review completed for the INL Site was published in December 2015 and addressed FYs 2010–2014. The next review will address FYs 2015–2019 and is expected to be published in FY 2021. As no five-year review has been published subsequent to the issuance of the PA, CA, other technical-basis documents, and this ASR, no changes stemming from the CERCLA 5-year review process have been identified. Future five-year reviews will be addressed in future ASRs as they become available.

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 2020, 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 2020, 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 2. The plan addresses both physical preventative and corrective maintenance at the facility, as well as maintenance of the PA, CA, RWMB and ODAS.

2.9.1 Planned Evaluations and Reviews

In accordance with the RHLLW Disposal Facility WAC (PLN-5446), facility evaluations (FEs) of waste generators are performed as part of the initial and annual certification process according to MCP-4211 "Conduct of RHLLW Disposal Facility Waste Generator Facility Evaluations." FEs are conducted to ensure each generator's waste certification program and waste streams are compliant with 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 2020 and the results are documented in ASMT 2020-0220.

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-1196-2011)
- Evaluate changes to DOE Order 458.1, "Radiation Protection of the Public and the Environment"
- Evaluate changes to DOE Order 435.1
- Evaluate changes to 40 CFR 61, Subpart H (National Emissions Standards for Hazardous Air Pollutants [NESHAPs]) and Subpart Q (radon)
- 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 air-emissions projections based on current inventory
- Review hydraulic drainage system-performance data
- Review concrete performance data.

With the exception of DOE O 458.1, "Radiation Protection of the Public and the Environment," there were no changes to any of the DOE standards, orders, or other regulations from the above list in FY 2020. The primary change to DOE O 458.1 (Change 4) was to clarify that the Order invoked DOE-STD-1196-2011. There is no impact to the RHLLW Disposal Facility related to this change because facility personnel have always regarded DOE-STD-1196-2011 as if it were an invoked standard.

A summary of waste disposal records is presented and discussed in Section 4. Groundwater-pathway compliance and performance monitoring 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. Air emissions from the facility are also not reported for the annual INL radionuclide NESHAPs report because radioactive waste is not subject to 40 CFR 61, Subpart H. Therefore, the activity to review air-

emissions projections and the activity to evaluate changes to 40 CFR 61, Subpart H will both be removed from the list in the next revision of the PA/CA maintenance plan, scheduled for FY 2021. Hydraulic drainage system performance data are reviewed annually at a minimum primarily to support lysimeter sampling. Collection of concrete performance data was removed from revision 1 of the monitoring plan, therefore, this activity will also be removed from the list in the next revision of the PA/CA maintenance plan, scheduled for FY 2021.

During review of the performance monitoring data, a higher-than-expected tritium (H-3) sampling result from a lysimeter near Vault Array 2 was discovered. As a result, several actions were initiated to provide additional information to understand the result. Each of these actions will be completed in FY 2021. Although some results were available at the time this report was prepared, the results will be presented only after all actions are concluded and the assessment complete. This issue is being tracked in the INL Site contractor issues management tracking system as condition CO 2021-0069, and all actions will be documented in accordance with LWP-13840, "Issues Management." Additional information is presented in Section 5.2.

2.9.2 Documentation Updates

Table 1 of PLN-3368 lists requirements for documentation updates, as necessary. PLN-5501 was revised in FY 2020 to correct an error in instrument locations, clarify some monitoring details and correct a reference to air-quality requirements. 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 2-1. Unreviewed disposal question screens and evaluations performed during FY 2020., UDQE-RHLLW-027). Except for the monitoring plan (PLN-5501), there were no updates to the PA, CA, or technical basis documents in FY 2020, and no revisions have been made since issuance of the ODAS. 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. Revisions to the PA/CA maintenance plan (PLN-3368), WAC (PLN-5446) and the change control process document (SD-52.1.4) are anticipated to be complete in FY 2021 (see Section 7-1).

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 2021.

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/EXT-20-57515, INL 2020a). Since any modifications to this document require mandatory screening according to change control process SD-52.1.4, the update is being reviewed and the screening results will be documented in a UDQS in FY 2021.

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. The 2020 inspection was performed under annual Work Order (WO) 293692. Inspection of the vault-yard area showed some 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 to become 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. Most locations showed degradation from the design specification of 95% of maximum dry unit weight per ASTM D 698 but were determined to still be acceptable for continued operations. As a result of the findings identified in WO 293692, a technical evaluation was performed and documented in TEV-4090, "Remote-Handled Low-Level Waste Vault Yard Corrective Maintenance Evaluation." It should be noted that per TEV-4090, compaction testing using construction-basis design criteria may not prove that the soils are not properly compacted. Compaction testing is typically only required during construction. One reason is that during construction, the ability to control the material and ensure it meets material requirements is possible. Over time, as indicated on the sieve analysis tests, the soil material composition can be altered, thus making it difficult to get accurate compaction testing results due to the proctor and actual in-place soil materials being different. Therefore, the material is not expected to maintain a compaction density of 95% in perpetuity. The facility is evaluating TEV-4090 recommended options for performance of compaction testing so that the proper method is used, and useful data are obtained from which to determine when conditions have degraded to the point repairs are needed.

Vault shield plugs are also inspected annually for damage. These activities are directed by MWO 257898 and were performed in 2020 under annual WO 295706. 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 plug no longer exhibits issues that meet or exceed need-to-repair criteria. Repairs were completed in FY 2020 for damaged vault shield plugs identified in late 2019. Repair WO 265343 was executed and completed to correct damages (chips, spalls, cracks) identified on vault shield plugs VSP-C02 and VSP-D02 of Vault Array 2. Post-repair inspections showed repairs were successful for both vault shield plugs. Only one vault shield plug was identified to have damages that exceeded need-to-repair criteria during the FY 2020 inspection. The damaged plug was VSP-E01 in Vault Array 2. Repairs are scheduled to be executed under WO 299411 early in FY 2021.

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. However, three of the four floodgates were not inspected in the spring of 2020 due to COVID-19 and manpower issues. Nevertheless, each floodgate was inspected at least once during FY 2020. Routine PM was performed, and no major issues were identified. The inspections and PM of the diversion dams and floodgates are addressed under the following work order packages:

- PM Radioactive Waste Management Complex Diversion Dam Semi-Annual Floodgate Inspection (WO Package 289705) performed March 2020
- PM Radioactive Waste Management Complex Diversion Dam Semi-Annual Floodgate Inspection (WO Package 297458) performed September 2020
- PM Experimental Breeder Reactor-II Semi-Annual Floodgate Inspection (WO Package 283433) performed October 2019
- PM Lost River Sinks Semi-Annual Floodgate Inspection (WO Package 283437) performed October 2019
- PM Howe Semi-Annual Pole Line Road Floodgate Inspection (WO Package 283438) performed October 2019.

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 2020 were evaluated. These include the:

- Upgrade of Nuclear Materials Inspection and Storage facility
- Construction of new ATR Maintenance Support Building
- Construction of the new ATR Administration Building
- Construction of new ATR Complex Security Building
- Extension of potable water lines through the ATR Utility Corridor
- Upgrade of the Cold Waste Pond controller.

It was determined the Cold Waste Pond upgrade improves the pump-controller system and will not impact flows to or function of the pond. Because all other projects incorporate general storm-water management features such as swales, ponds, or shallow injection wells for runoff control—and any wastewater generated from these facilities is directed to the ATR sanitary-sewer system—the evaluation concluded that the impact is insignificant with regard to 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 with regard to the facility-monitoring system was required in FY 2020. However, during the first RHLLW Disposal Facility lysimeter sampling event in the spring of 2019, discrepancies were discovered between some instrument installations and how they are presented in the facility monitoring plan (PLN-5501) and the *As-Built Characterization and Monitoring System for the RH-LLW Disposal Facility* report (INL 2017a). Changes to the documents were addressed through the change-control process (see Table 2-1, UDQE-RHLLW-027) and both documents were updated in FY 2020 (PLN-5501 2020, and INL 2020b). The discrepancy was deemed minor and none of the information discovered or the proposed changes will affect the assumptions and/or conclusions of the PA or CA.

The facility inventory management system, RHINO (Section 4.3), is maintained according to PLN-5578, "Maintenance Plan for the RHINO Database." As-needed corrective-maintenance actions are accomplished with software-change requests (SCRs), which are documented and tracked. Work on two SCRs was conducted in FY 2020:

- SCR-RHINO-04: Requested RHINO be modified to 1) generate reports to assist in preparation of ASRs and perform additional PA checks, 2) add a field for waste generators to enter % volume of combined waste, and 3) identify radionuclides not analyzed in the PA by generator, canister type and waste form. This SCR is expected to be complete early in FY 2021.
- SCR-RHINO-05: Requested change to modify the method which RHINO uses to evaluate a specific waste stream for acceptability. This SCR was completed and approved in November 2019.

All software changes undergo appropriate reviews under the subcontractor's configuration-management plan, accompanied by the required acceptance-testing reviews and testing by the INL Site contractor BEA according to PLN-5579, "Acceptance Test Plan for the RHINO Database." An Unreviewed Safety Question screening was performed for each SCR and each was screened negative, meaning the change does not involve a temporary or permanent change in the facility as described in the existing documented safety analysis, does not involve a temporary or permanent change in procedures as described in the existing documented safety analysis, and does not involve a test or experiment not described in the existing documented safety analysis. These changes, as well as any errors or deficiencies identified that necessitated changes, do not impact the assumptions and conclusions of the PA and CA, or impact the validity of the RWMB and ODAS.

During preparation of the FY 2019 ASR, it was discovered that, while changes to RHINO are subject to strict verification, validation, and acceptance testing, the proposed changes are not screened or evaluated through the UDQS/UDQE process prior to implementation. An SCR may be the result of a UDQE, but it does not have to be. Therefore, it was determined that, going forward, all previously approved and future SCRs will be subject to screening or evaluation through the change-control process identified in SC-52.1.4, "DOE Order 435.1 Documentation Change Control Process for the RHLLW Disposal Facility." As a result, three SCRs completed and approved in FY 2019 were screened in FY 2020 (see Table 2-1, UDQE-RHLLW-042) and were screened negative, meaning the changes would have no impact on the assumptions and conclusions of the PA and CA, or impact the validity of the RWMB and ODAS.

3. CUMULATIVE EFFECTS OF CHANGES

As described in Section 2, there were no changes identified in FY 2020 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.

5. WASTE CERTIFICATION AND RECEIPTS

5.1 Waste Certification

In accordance with the RHLLW Disposal Facility WAC (PLN-5446), an annual FE (see Section 2.9.1) was conducted in FY 2020 to re-certify MFC's waste certification program and waste streams are compliant with the WAC. The FE was conducted according to MCP-4211 (2018) and documented in ASMT 2020-0220. 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.

5.2 Waste Receipts

During FY 2020 a total of 15 waste canisters were received and disposed of in the RHLLW Disposal Facility. Table 4-1 contains information on these 15 canisters including waste form, disposal date and disposal location.

Table 4-3. Waste receipts and disposals in FY 2020.

Generator	Generator Canister ID#	Container Type	Waste Form[a]	Shiptask #	Waste Receipt Date	Disposal Date	Vault Array	Disposal Position
MFC	MFC170305	HFEF-5	AM	RHLLW-MFC-19-001	11/19/2019	11/21/2019	HFEF	02-E02-2a (Bottom)
MFC	SN-100	HFEF-5	AM	RHLLW-MFC-20-002	6/8/2020	6/9/2020	HFEF	02-E02-2b (Top)
MFC	SN-126	HFEF-5	Combined	RHLLW-MFC-20-003	6/10/2020	6/11/2020	HFEF	02-E02-3a (Bottom)
MFC	SN-122	HFEF-5	AM	RHLLW-MFC-20-004	6/12/2020	6/15/2020	HFEF	02-E02-3b (Top)
MFC	SN-103	HFEF-5	AM	RHLLW-MFC-20-005	6/16/2020	6/17/2020	HFEF	02-E02-4a (Bottom)
MFC	SN-102	HFEF-5	Combined	RHLLW-MFC-20-006	6/19/2020	6/22/2020	HFEF	02-E02-4b (Top)
MFC	SN-113	HFEF-5	AM	RHLLW-MFC-20-007	6/23/2020	6/24/2020	HFEF	02-E02-5a (Bottom)
MFC	SN-90	HFEF-5	Combined	RHLLW-MFC-20-008	6/25/2020	6/25/2020	HFEF	02-E02-5b (Top)
MFC	SN-97	HFEF-5	AM	RHLLW-MFC-20-009	6/29/2020	6/29/2020	HFEF	02-E02-6a (Bottom)
MFC	SN-86	HFEF-5	AM	RHLLW-MFC-20-010	7/6/2020	7/8/2020	HFEF	02-E02-6b (Top)
MFC	SN-111	HFEF-5	Combined	RHLLW-MFC-20-011	7/8/2020	7/8/2020	HFEF	02-E03-1a (Bottom)
MFC	N-103	HFEF-5	Combined	RHLLW-MFC-20-012	7/14/2020	7/14/2020	HFEF	02-E03-1b (Top)
MFC	SN-119	HFEF-5	AM	RHLLW-MFC-20-013	7/20/2020	7/21/2020	HFEF	02-E03-2a (Bottom)
MFC	SN-93	HFEF-5	Combined	RHLLW-MFC-20-014	7/22/2020	7/22/2020	HFEF	02-E03-2b (Top)
MFC	SN-101	HFEF-6	Combined	RHLLW-MFC-20-015	7/23/2020	7/23/2020	HFEF	02-E03-3a (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 HFEF-5 canisters from MFC and ATR. In FY 2020, the remaining 10 spaces in Vault E02 were filled with HFEF-5 canisters from MFC. Seven of the 10 canisters contained only activated metals, and three canisters contained combined activated metals and surface contaminated debris. The other five HFEF-5 canisters placed in FY 2020 were placed in Vault E02 and four of the five contained activated metals and surface contaminated debris.

A summary of the canisters placed, and facility capacity are presented in Table 4-2. This contains the vault capacity, the percentage of vaults/positions and total vaults/positions filled through FY 2020. Table 4-3 contains a summary of the volume of canisters placed in the vaults.

Table 4-4. Vault capacity summary through FY 2020.

Array	Vault Type	Vault Description	Positions Filled FY 2020	Positions Filled Cumulative Through FY 2020	Empty Positions Remaining Through FY 2020	Total Positions	Percent Positions Filled Through FY 2020
01	NuPac	1 Hole (2 Levels)	0	0	120	120	0.00%
	HFEF-5	6 Holes (2 Levels)	15	29	151	180	16.1%
02	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	15	29	910	939	3.1%

Table 4-5. Placed canister volume summary through FY 2020.

Array	Vault Type	Canister Type, Generator, Waste Form	Generator	Gross Volume (m^3) FY 2020	Cumulative Gross Volume (m^3) Through FY 2020
02	HFEF-5	HFEF-5 - MFC Activated Metals w/ lead plug	MFC	0.154	0.154
		HFEF-5 - MFC Activated Metals w/ steel plug	MFC	1.078	2.464
		HFEF-5 - MFC Combined w/ lead plug[a]	MFC	0.154	0.154
		HFEF-5 - MFC Combined w/ steel plug[a]	MFC	0.924	1.694
			Array Total	2.310	4.466
			Facility Totals	2.310	4.466

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

5.3 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 15 waste canisters placed in FY 2020 there were 18 radionuclides reported in activated metals and 62 radionuclides reported as 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 4-4 contains the inventory placed in FY 2020 and cumulative inventory for the groundwater pathway radionuclides fully analyzed in the PA. These are recorded and presented by array, generator, and waste form. Three of the 14 radionuclides (Cl-36, H-3 and I-129) were not reported in any of the FY 2020 disposals.

Given that the number of HFEF-5 canisters placed through FY 2020 is 16% of the HFEF vault array capacity (Table 4-2), the cumulative inventory of this vault array as a percent of the PA inventory is as expected or less than expected for all but two of 14 groundwater-pathway radionuclides (Np-237 [246%] and Pu-240 [82%], Table 4-4). The large percentages of Np-237 and Pu-240 are primarily the result of a single canister placed in FY 2020. Canister MFC170305 was flagged by RHINO for exceeding the 10% PA inventory threshold for a single canister for radionuclides Np-237, Pu-240, U-235 and U-238. This is a new-generation (non-legacy) waste canister, and it was expected that there may be new-generation waste canisters, the inventories of which would differ from the projected inventories assumed for the PA. Because the canister was flagged by RHINO, the inventory was evaluated in UDQE-RHLLW-032 (Section 2.2). The evaluation determined that although the percentages of these radionuclides were higher than expected for a single canister based on the projected inventory, the canister inventory did not represent a significant increase in the facility inventory, and the dose contributed by each radionuclide and the canister is not significant with respect to performance objectives (Section 4.4).

The new-generation waste canister MFC170305 also contained Tc-99 in activated metal. This was unusual because Tc-99 as activated metal was not listed in the proposed inventory for MFC legacy or new-generation HFEF-5 canisters. 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 4-6. Radionuclide activities disposed of by array, generator and waste form through FY 2020 compared to inventory analyzed in the PA for the groundwater pathway.

Nuclide	Vault Array	Waste Generator	Waste Form[a]	FY-2020 Inventory (Ci)	Cumulative Inventory (Ci)	PA Inventory (Ci)	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	9.97E-02	9.97E-02	2.75E+00	3.63%
	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			1.21E+01	
			S			3.49E-05	
	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	

Table 4-4. (Continued.)

Nuclide	Vault Array	Waste Generator	Waste Form[a]	FY-2020 Inventory (Ci)	Cumulative Inventory (Ci)	PA Inventory (Ci)	Cumulative Inventory as % of PA Inventory
	Large Concept Cask	NRF	A			5.87E-06	
			R			1.27E-06	
			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	1.11E-01	1.11E-01	2.78E+00	3.99%
	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	2.55E-02	2.55E-02	1.11E+00	2.30%
	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	4.44E-01	4.44E-01	8.85E+00	5.02%
	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	1.49E-07	1.68E-07	6.86E-08	246%
	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	1.04E-05	4.83E-04	1.56E-02	3.09%
	Large Concept Cask	NRF	A			1.47E-01	

Table 4-4. (Continued.)

Nuclide	Vault Array	Waste Generator	Waste Form[a]	FY-2020 Inventory (Ci)	Cumulative Inventory (Ci)	PA Inventory (Ci)	Cumulative Inventory as % of PA Inventory
			R			7.07E-05	
			S			3.78E-04	
	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	4.99E-05	4.99E-05	6.11E-05	81.8%
	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	2.55E-04	2.55E-04	0.00E+00[b]	NA[b]
		MFC	S	1.04E-02	1.04E-02	5.36E-01	1.95%
	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	7.49E-06	7.49E-06	1.17E-04	6.39%
	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	1.85E-07	3.68E-07	1.81E-06	20.3%
	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	1.06E-07	1.23E-07	9.11E-07	13.5%
	Large Concept Cask	NRF	A			1.04E-04	

Table 4-4. (Continued.)

Nuclide	Vault Array	Waste Generator	Waste Form[a]	FY-2020 Inventory (Ci)	Cumulative Inventory (Ci)	PA Inventory (Ci)	Cumulative Inventory as % of PA Inventory
			R			1.18E-08	
			S			2.92E-08	
	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. Tc-99 was not reported as an activated metal legacy or new-generation waste from MFC in HFEF-5 canisters. The dose contribution is calculated by RHINO and included in the all-pathway dose.

Table 4-5 presents the FY 2020 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, but it is less than 1% of the action level. Co-60 is the next highest at 0.175%.

Table 4-7. Radionuclide inventory of primary dose contributors to the chronic intruder pathway.

Nuclide	Vault Array	FY-2020 Inventory (Ci)	Cumulative Inventory (Ci)	Cumulative Inventory as % of Vault Array Action Level	Vault Array Action Level[a] (Ci)
Co-60	55-ton				7.33E+05
	HFEF-5	1.39E+03	6.64E+03	0.175%	3.79E+06
	Large Concept Cask				1.17E+06
	Modified FTC				2.68E+04
	NuPac				4.24E+03
Cs-137	55-ton				1.27E+02
	HFEF-5	2.41E-01	2.45E-01	0.401%	6.12E+01
	Large Concept Cask				2.76E+02
	Modified FTC				1.69E+04
	NuPac				1.14E+02
Nb-94	55-ton				8.53E+01
	HFEF-5	2.55E-02	2.55E-02	0.020%	1.25E+02
	Large Concept Cask				1.92E+02
	Modified FTC				1.17E+04
	NuPac				3.00E+02
Ni-63	55-ton				1.36E+06
	HFEF-5	2.48E+01	2.48E+01	0.005%	4.68E+05
	Large Concept Cask				2.11E+06
	Modified FTC				8.64E+04
	NuPac				6.29E+02
Sr-90	55-ton				6.88E+01
	HFEF-5	3.10E-01	3.21E-01	0.044%	7.27E+02
	Large Concept Cask				1.57E+02
	Modified FTC				8.90E+01
	NuPac				1.57E+01

a. Vault array action levels (Engineering Calculations and Analysis Report (ECAR)-2073, 2018 Table A-3 or INL 2018b, 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/yr). This ratio, 100/5.42 = 18.5, was multiplied by the estimated total 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 twenty-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.

[i] 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.

5.4 Performance Objectives Tracking Using RHINO

The RHLLW Disposal Facility does not depend on the radionuclide sum-of-fractions rule[i] to determine compliance with performance objectives. Rather, the facility uses RHINO 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 2018b).

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 are based on vault array (location), canister type, and waste form for each radionuclide. For example, a curie of H-3 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 H-3 on surface-contaminated debris in an HFEF-5 canister in the HFEF vault array.

Table 4-6 summarizes the performance measures for all disposals in FY 2020 and cumulative disposals through FY 2020. As expected, the calculated dose and concentration performance measures for all canisters placed through FY 2020 are a very small fraction of the applicable performance objectives. Based on this, the impact of cumulative disposals is consistent 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 2020 waste and cumulative waste disposed of through FY 2020 consists of both activated metals and surface contamination, the dose was dominated by the surface contamination.

[i] 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 4-8. Summary of facility performance through FY 2020.

Performance Objective or Measure	Performance Standard	Point of Assessment Location	Compliance Period			Post-Compliance Period		
			Maximum Based on FY-2020 Disposals	Maximum Based on Cumulative Disposals Through FY 2020	Cumulative Disposal Maximum as % of Standard	Maximum Based on FY-2020 Disposals	Maximum Based on Cumulative Disposals Through FY 2020	Cumulative Disposal Maximum as % of Standard
All-Pathway Dose	25 mrem/yr	100 m	8.52E-06	8.52E-06	0.002%	4.96E-03	4.96E-03	0.020%
Air-Pathway Dose[a]	10 mrem/yr	100 m	1.21E-07[b]	1.21E-07[b]	0.002%[b]	NA[c]	NA[c]	NA[c]
Intruder Dose	100 mrem/yr	Facility	1.81E-03	2.34E-03	0.002%	NA[c]	NA[c]	NA[c]
Beta-gamma DE[d]	4 mrem/yr	100 m	6.05E-06[e]	6.05E-06[e]	0.000%[e]	3.52E-03[e]	3.52E-03[e]	0.088%[e]
Beta-gamma ED[d]	4 mrem/yr	100 m	3.31E-06[e]	3.31E-06[e]	0.000%[e]	1.93E-03[e]	1.93E-03[e]	0.048%[e]
Gross alpha	15 pCi/L	100 m	1.55E-31	1.65E-32	0.000%	3.22E-07	3.53E-07	0.000%
Ra-226/228	5 pCi/L	100 m	7.19E-34	7.19E-34	0.000%	6.72E-08	6.72E-08	0.000%
Uranium Mass	30 ug/L	100 m	4.78E-29	6.39E-29	0.000%	9.01E-07	1.21E-06	0.000%

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. Only C-14 was reported in FY 2020.
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, H-3 and I-129 were not reported in FY 2020.

6. 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).

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-water 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. 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 2019 (DOE-ID 2020), 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, covered under WO 293692 for Calendar Year 2020. 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 and inspection of vault shield plugs for damage. The road-apron inspection showed some 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 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 one vault shield plug with a chip/spall that required repair. Repairs are scheduled in early FY 2021 (see Section 2.9.3.1). Any damage and repairs (if necessary) are managed using the change control process. UDQEs associated with vault damage or repairs are presented in Section 2.1. Two 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.

6.1 Compliance Monitoring

Compliance monitoring for the groundwater pathway is performed by sampling three aquifer wells near the RHLLW Disposal Facility (see Figure 5-1). 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 semiannual. However, the performance-monitoring action levels apply after a 3-year period to establish background concentrations.

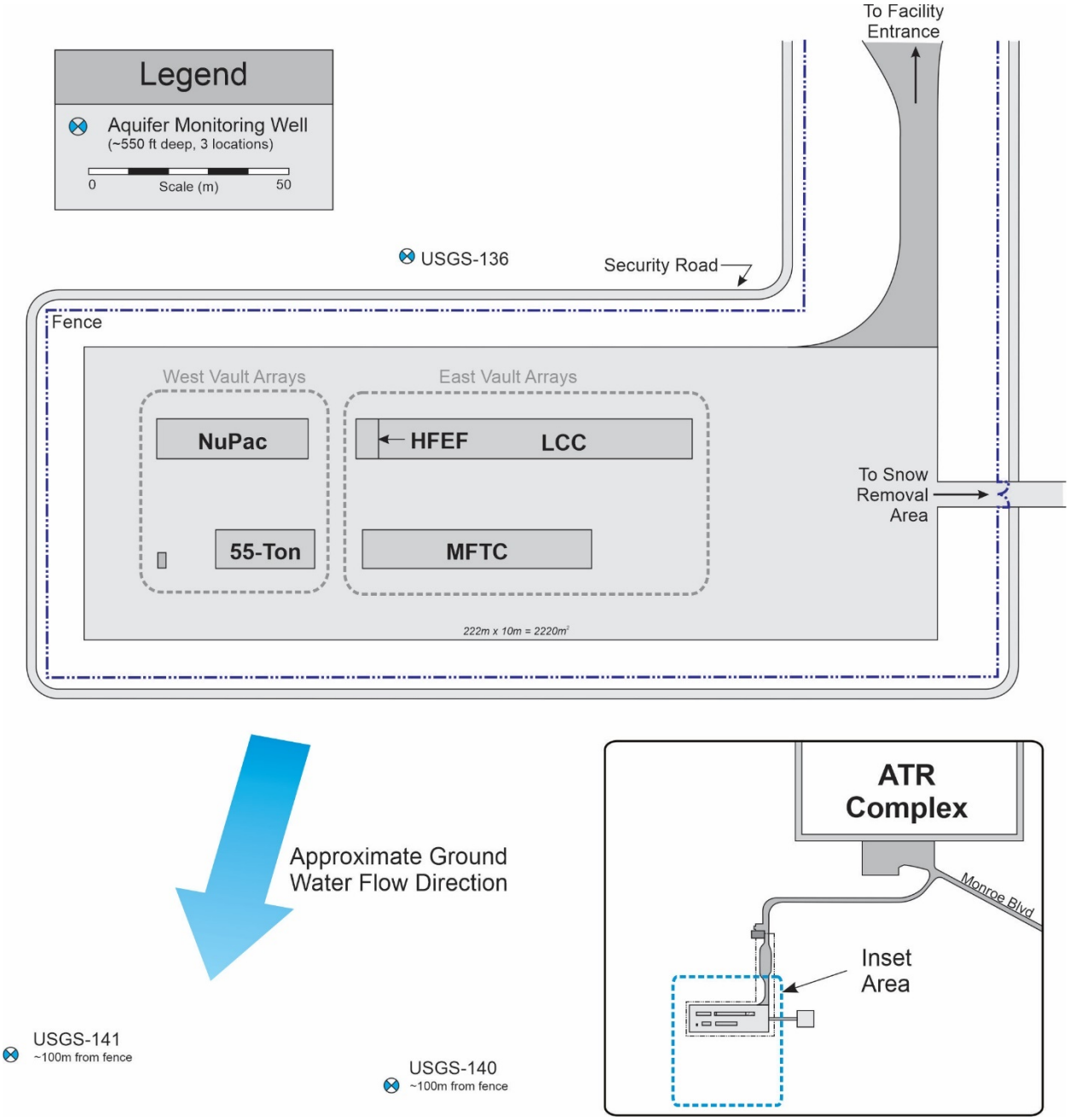

Figure 5-4. RHLLW Disposal Facility layout showing aquifer monitoring well locations.

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 indicator analytes, samples are analyzed for 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 2020. Results of the compliance monitoring are presented in Appendix B and summarized in Table 5-1. H-3 was detected in all three aquifer wells, while gross alpha and gross beta were positively detected in wells USGS-136 and USGS-140, but not USGS-141. However, the gross alpha and gross beta results for well USGS-141 were qualified as UJ in the validation report, which indicates the analyte may or may not be present and the result is questionable. 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 2017b) (see Appendix B).

6.2 Performance Monitoring

Performance monitoring of the facility is achieved by analysis of soil water samples collected from vadose zone lysimeters. All lysimeters are installed adjacent to vault arrays (see Figure 5-2) 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 water is present and can be collected.

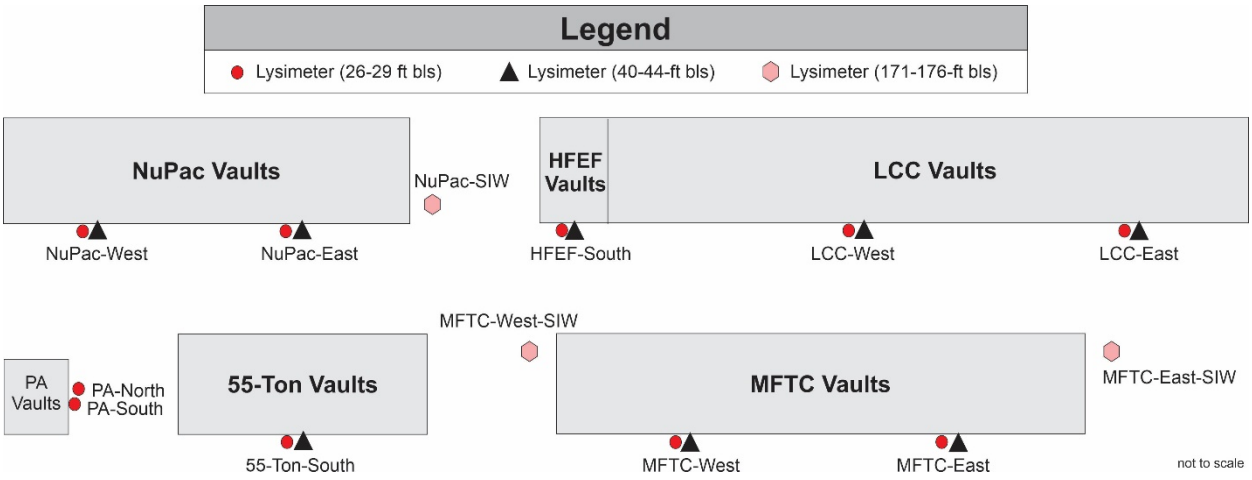

Figure 5-5. Plan view of the vault arrays showing the lysimeter locations.

FY 2019 began a three-year period to establish background concentrations for all lysimeters. Samples are collected annually and analyzed for the same target and indicator analytes as the aquifer samples. In the event of insufficient water 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, 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 semiannually (as soil water is available) and continue as long as action levels are exceeded. Semiannual samples will be analyzed for target analytes H-3, C-14, Tc-99, and I-129, in addition to gross alpha and gross beta.

Lysimeter-sample collection was performed March 25 through June 25, 2020. Approximately 530–730 mL of sample is required for the full suite of analytes. Multiple sample collections were performed in order to increase the total sample volume from each lysimeter in hopes of having enough to analyze for the full suite of analytes. After each sample-collection event, vacuum was reapplied to the

lysimeters and samples collected again in one or two weeks. All 10 of the lysimeters in the shallow alluvium yielded water, and sufficient volume was collected from all but one of the lysimeters (PA-South) for the full suite of analytes. Water from the PA-South lysimeter was analyzed for gross alpha and gross beta only. Sufficient volume was collected from five lysimeters to perform duplicate analysis for some of the analytes. Seven of the eight lysimeters in the deep alluvium yielded water, but the quantities were insufficient to analyze for all analytes. A decision was made to combine the samples from all eight lysimeters, and the total volume (630 ml) was sufficient to analyze for all analytes.

In FY 2019, none of the three sedimentary interbed well lysimeters yielded a sample, and the same was true for the first attempt to collect samples in FY 2020. As a result, an assessment of the sampling procedure for the deep lysimeters was conducted, and it was determined that the pump pressure may be insufficient to drive any existing water in the lysimeters to the surface. After increasing the pressure, two of the three lysimeters yielded samples. After two sampling events one week apart, one of the three lysimeters yielded sufficient water on both events to perform the full suite of analysis and another yielded enough for a gross-alpha and gross-beta analyses. The third deep lysimeter did not produce water.

Of the 10 shallow-alluvium lysimeter samples analyzed for gross alpha and gross beta, eight detected gross alpha, and five detected gross beta. The single combined sample from the deep-alluvium lysimeters detected both gross alpha and gross beta. Both samples from the sedimentary-interbed lysimeters were positive for gross alpha, but only one detected gross beta.

C-14, I-129 and Tc-99 were not detected in any of the lysimeter samples. C-14 may have been detected in three of the samples, and I-129 in one of the samples, 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.[j]

Tritium (H-3) was detected in six of 11 lysimeters analyzed for H-3, with one of those results qualified J in the validation report. A J qualifier indicates the radionuclide is considered present in the sample, but the result may not be an accurate representation of the amount of activity actually present in the sample.

Results of the performance monitoring are presented in Appendix B and summarized in Table 5-2. All sample concentrations were less than action levels, with three exceptions. These are discussed below bearing in mind that, according to PLN-5501, exceedance of action levels is demonstrated by trend analysis, and the intent is to apply action levels only after the three-year baseline period.

1. The gross-alpha result from the PA-North lysimeter sample (13.4 pCi/L) exceeded the action level of 10 pCi/L. The duplicate from this well was less than the action level (8.8 pCi/L). This is similar to last year, when the first sample was slightly above the action level and a reanalysis of the original sample resulted in a concentration slightly less than the action level. Although the result from last year seemed anomalous when compared to samples from other lysimeters, the result from this year does not seem so unusual. That is because two of the lysimeters that yielded a sample this year, but not last year (the combined deep-alluvium lysimeter sample and a sedimentary-interbed sample) were also near or above the gross-alpha action level. Because the concentration is only slightly above the action level, and the three-year period to establish background concentrations is ongoing, the concentrations will continue to be monitored.
2. The gross-alpha result from the combined sample from the deep-alluvium lysimeters (11.6 pCi/L) exceeded the action level of 10 pCi/L. Again, this sample was the combined sample from the seven lysimeters in the deep alluvium that yielded water and, therefore, does not represent a single location. Because the concentration is only slightly above the action level, and the three-year period to

[j] 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.

establish background concentrations is ongoing, the concentrations will continue to be monitored. After the three-year baseline period, it may be necessary to reassess the action levels for gross alpha.

3. The H-3 result for the HFEF-South lysimeter (47,100 pCi/L) exceeded the action level of 20,000 pCi/L. Because this elevated level was unexpected, several actions were initiated to provide additional information to better understand the result. These actions include:

   - Request the laboratory reanalyze the original sample and review the original analyses to check for any irregularities or potential for cross-contamination
   - Resample the HFEF-South lysimeter and other selected lysimeters near the HFEF-South lysimeter and analyze for H-3
   - Assess H-3 concentrations in the water used for dust suppression, compaction, and infiltration tests during facility construction
   - Examine disposal records to determine the amount of H-3 (if any) in waste canisters placed at the facility prior to the sampling event that resulted in the higher-than-expected H-3 concentration
   - Assess the potential influence of perched water at the ATR Complex on lysimeter samples at the facility
   - Assess the potential impact on the aquifer from an elevated H-3 concentration at the lysimeter location using the PA groundwater model.

Each of these actions will be completed in FY 2021. Although some results and assessments were available at the time this report was prepared, the results will be presented only after all actions are concluded and the assessment complete. This issue is being tracked in the INL Site contractor issues management tracking system as condition CO 2021-0069, and all actions will be documented in accordance with LWP-13840, “Issues Management.”

Table 5-9. Compliance monitoring summary for the RHLLW Disposal Facility in FY 2020.

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, while gross alpha and gross beta were detected in wells USGS-136 and USGS-140, but not 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 2017b).	State of Idaho Groundwater Quality Rule (IDAPA 58.01.11)	Aquifer Maximum Contaminant Levels	No actions taken. Annual sampling will continue as long a performance-monitoring actions levels are not exceeded after the three-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 5-10. Performance monitoring summary for the RHLLW Disposal Facility in Fiscal Year 2020.

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.	Provide data to establish background concentrations for future performance monitoring. The baseline period to establish background is 3 years (2019-2021). Provide data to indicate potential radionuclide release from source zone and migration toward aquifer.	All but 2 of the 21 lysimeters yielded water, and 9 yielded sufficient water for the full suite of analytes. This was an improvement over the previous year and is attributed to increased sample attempts and changes in procedures. All sample concentrations were non-detects or less than action levels with three exceptions. The gross alpha results for the PA-North lysimeter sample and the combined sample from the deep alluvium lysimeters were 13.4 pCi/L and 11.6 pCi/L respectively. These are greater than the action level of 10 pCi/L. The duplicate sample result for the PA-North lysimeter was 8.80 pCi/L, less than the action level. The HFEF-South sample result for H-3 was 47,100 pCi/L, substantially above the action level of 20,000 pCi/L. This is being investigated.	FY 2020 is year two of a three-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 H-3 result from the HFEF-South lysimeter which is being investigated.	Continue with annual sampling incorporating procedural changes that increased success in obtaining samples. Complete actions to address the elevated H-3 concentration in lysimeter HFEF-South. These actions will be completed in FY 2021.	None. No changes to PA/CA results and conclusions.

CA = composite analysis
PA = performance assessment

7. RESEARCH AND DEVELOPMENT

No research and development activities were conducted at the RHLLW Disposal Facility in FY 2020 (see Table 6-1).

Table 6-11. Research and development activities.

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

8. PLANNED OR CONTEMPLATED CHANGES

Planned or contemplated changes are presented in Table 7-1. These include planned and contemplated changes to technical-basis documents, and design of a new waste canisters for ATR activated-metal waste and a new NRF 55-ton waste canister. No changes are planned or contemplated for facility design, construction, operations, or closure.

Planned changes to technical-basis documents include revisions to the PA/CA maintenance plan (PLN-3368), WAC (PLN-5446) and the change control process document (SD-52.1.4). A review of the PA/CA maintenance plan indicated some required evaluations and reviews identified in Section 5 of the plan should be removed or explained in more detail. The plan is currently being reviewed for other possible changes, and all changes will be evaluated through the change-control process. The WAC is also being evaluated for potential revisions. During first-year operations, some recommendations for process improvement were made. One of these recommended the waste generator or the RHLLW facility disposition specialist complete the Integrated Waste Tracking System (IWTS) ship task, which would require a change to the WAC. A recommendation was also made to evaluate the radionuclide-reporting requirements in Section 2.1 of the WAC to determine whether the 1% activity cutoff is consistent with PA assumptions. These potential changes will be evaluated through the change-control process. SD-52.1.4 will be revised to include mandatory UDQSs of all RHINO SCRs consistent with the decision discussed in the FY 2019 ASR.

Other planned changes include the design and use of new waste canisters. During preparation of the PA, it was assumed ATR activated metals would be packaged in a canister similar to the HFEF-5 canisters used at MFC and would be placed in the same vaults. The new ATR-5 waste-canister design is nearing completion, and some aspects have been evaluated through the change-control process. Four of these (UDQE-RHLLW-019, UDQE-RHLLW-021, UDQE-RHLLW-022, and UDQE-RHLLW-023) were evaluated in FY 2019, and one (UDQE-RHLLW-041, Table 2-1) was evaluated in FY 2020. While the canister is similar to the HFEF-5, the differences are not expected to impact the assumptions and conclusions of the PA. In fact, the canister performance is expected to exceed that assumed in the PA. The final design is expected to be complete in FY 2021.

NRF is designing a new 55-ton waste canister. The new canister is similar in size to the existing 55-ton waste canister used for previous disposals at the Radioactive Waste Management Complex but is made of Type 316L stainless steel. The previous canisters were made of carbon steel. The new canister is consistent with assumptions in the PA, but a small tolerance change in the top ring flatness was necessitated by difficulties associated with machining Type 316L stainless steel. The difference was evaluated in UDQE-RHLLW-036 (Table 2-1) to determine whether the canister could meet water ingress requirements outlined in the WAC. The new canister, along with a new CVAS, bearing plate, lift fixture and work platform are scheduled for operational readiness demonstration in FY 2022. The existing cask (with modifications) and existing hoist platform will be used.

One contemplated monitoring change is increasing the sampling frequency of selected lysimeters from annual to semi-annual, based on a high H-3 concentration from a lysimeter sample in FY 2020. The cause and potential impact of the detection is currently being investigated, including possible response actions outlined in the monitoring plan. One action was to collect additional samples from several lysimeters in the fall of 2020. This and other actions being taken as a result of the detection are 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 7-12. Planned or contemplated changes for the RHLLW Disposal Facility.

Planned or Contemplated Change	Change Basis	PA/CA Impact	Schedule
Revise PA/CA maintenance plan (PLN-3368)	Examine the list of annual evaluations and reviews to be conducted and remove unnecessary activities.	None	FY 2021
Revise "Waste Acceptance Criteria for the RHLLW Disposal Facility" (PLN-5446)	Update the process flow for shipping RHLLW to the facility. Evaluate radionuclide reporting requirements for consistency with PA assumptions.	None	FY 2021
New ATR-5 waste canister ATR activated metal waste stream	A new waste-canister for ATR activated metals is currently being designed and developed. Some changes have been evaluated through the change control process. The final design will be evaluated to ensure consistency with PA assumptions.	None	FY 2021 continuing into FY 2022
New NRF 55-ton waste canister and cask	A new NRF 55-ton waste canister for activated metal and resins is being designed. A small change of the top-ring flatness was evaluated in UDQE-RHLLW-036 based on WAC considerations associated with potential water ingress. Operational readiness activities with the new canister are scheduled for FY 2022.	None	FY 2021 continuing into FY 2022
Changes in sampling frequency	An increase in the frequency of sampling selected lysimeters is being considered based on detection of an unexpectedly high H-3 concentration in a lysimeter. An investigation and other actions are currently underway to understand the cause and impacts and develop a path forward.	TBD	FY 2021 and possibly continuing into FY 2022

9. 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 2020.

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 8-1.

Table 8-13 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 2020.

10. 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 2018a).

This FY 2020 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).
- The RWMB was reviewed and a few minor corrections/modifications to some technical basis documents were identified (Section 7). None of these corrections or modifications were significant changes that would challenge the continued validity of the RWMB. Projected disposal operations indicate continued compliance with the RWMB (Section 2). The revised RWMB was submitted to DOE for review and approved by the Field Element Manager on December 11, 2020 (FY2021).

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Appendix A

Fiscal Year 2020 Unreviewed Disposal Question Screens and Evaluations for the RHLLW Disposal Facility

Appendix A

Fiscal Year 2020 Unreviewed Disposal Question Screenings and Evaluations for the RHLLW Disposal Facility

This appendix includes copies of UDQSs and UDQEs that were completed and approved at the end of FY 2020. Evaluations that were initiated but not completed are listed as "in-progress" in Table 2-1 of the ASR are not included here. Evaluations that were cancelled are also not included here. No special analyses were completed in FY 2020, 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-027

Subject: Proposed change to the Monitoring System As-Built report (INL/EXT-17-43081) and the Monitoring Plan (PLN-5501)

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:

During the first RH-LLW Disposal Facility lysimeter sampling event in the Spring of 2019, it was discovered that there is a discrepancy between some instrument installations and how they are presented in the following documents:

1. As-Built Characterization and Monitoring System for the RH-LLW Disposal Facility (INL/EXT-17-43081), hereinafter referred to as "As-Built report," and
2. Monitoring Plan for the INL RH-LLW Disposal Facility (PLN-5501), hereinafter referred to as "Monitoring Plan."

Specifically, both documents report the PA-North and PA-South instrumented tubes do not have lysimeters in them and the PA-45 well has a lysimeter in it. This is opposite from the actual instrument installation as both the PA-South and PA-North instrumented tubes have a single lysimeter in each, and the PA-45 well does not have a lysimeter. The actual lysimeter installation is consistent with the original design documented in, Characterization and Monitoring System Design for the RH-LLW Disposal Facility (INL/EXT-16-37963), hereinafter referred to "Design report." The error in the As-Built report showing a lysimeter in the PA-45 well, and no lysimeters in the PA-North and PA-South instrumented tubes went unnoticed and was subsequently translated into the Monitoring Plan.

It is proposed that both the As-Built report and the Monitoring Plan be modified to make them consistent with actual instrument installations and consistent with the Design report. In addition, minor changes and clarification to monitoring activities listed in the Monitoring Plan are also proposed as a result of this discovery. Accompanying changes in monitoring activities will also be made in LI-859, Sampling Vadose Zone Water at the Remote-Handled Low-Level Waste Disposal Facility.

SD-52.1.4, Section 3.1 requires a mandatory Unreviewed Disposal Question Screening (UDQS) for any proposed change to DOE Order 435.1 Disposal Compliance Documentation. Both the As-Built report and the Monitoring Plan are part of the DOE Order 435.1 Disposal Compliance Documentation for the facility. SD-52.1.4 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.

Although both the As-Built report and the Monitoring Plan will be corrected, none of the information discovered or the proposed changes has the potential to affect the assumptions and/or conclusions of the PA or CA. The PA-North and PA-South instrumented tubes and the PA-45 well are located a few feet from each other next to the PA vaults. The PA vaults are not intended to receive waste and neither the PA or CA rely on contaminant information from the PA vaults for compliance or performance monitoring of the facility. Lysimeter samples from the PA vaults will be used solely for establishing background concentrations and are only intended to be sampled for three years. Table 7 in the Monitoring Plan currently directs lysimeters next the PA vaults be sampled to establish background concentrations. The Monitoring Plan will be simply be modified so that the intended wells (instrumented tubes) and media (alluvium depth) to be sampled are correct.

The changes proposed for both the As-Built report and the Monitoring Plan do not have the potential to affect the assumptions and/or conclusions of the PA or CA, and therefore a screening is not mandatory according to SD-52.1.4. However, the information used to make this determination will serve as the screening and is documented here to provide justification.

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?*

Comments: Yes ☐ No ☒

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).*

Comments: Yes ☐ No ☒

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?*

Comments: Yes ☐ No ☒

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?*

Comments: Yes ☐ No ☒

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

Comments: Yes ☐ No ☒

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)?*

Comments: Yes ☐ No ☒

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)?*

Comments: Yes ☐ No ☒

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)?*

Comments: Yes ☐ No ☒

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

Comments: Yes ☐ No ☒

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	08/10/2020
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Larry Evens	Larry Evens	08/10/2020
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)?*

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

Comments: ——— Yes ☐ No ☐

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

Comments: ——— Yes ☐ No ☐

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

Comments: ——— Yes ☐ No ☐

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-032

Subject: Canister MFC170305 radionuclide inventory flagged by RHINO for threshold exceedances

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 RHLLW Inventory Online (RHINO) software which performs several checks to evaluate the canister for acceptance. Waste canister MFC170305, an HFEF-5 canister containing activated metal waste with surface contamination from MFC and generated after 4/21/2015 was flagged by RHINO because the estimated inventory/activity (ECAR-4033) exceeded threshold reporting activities contained in Table 18 of INL/EXT-18-45184 (2018). Specifically, the canister inventory exceeded:

- the total activity of Pu-240 analyzed in the PA for the specific generator, waste form and canister type, and
- 10% of the total activity of Sr-90, Cs-137, U-235, U-238 and Pu-240 analyzed in the PA for the specific generator, waste form and canister type.

According to INL/EXT-18-45184 (2018), the inventory of any canister that exceeds 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.

Another issue identified during this review is Np-237 is listed in the canister inventory but there are no threshold inventory values for Np-237 in Table 18 of INL/EXT-18-45184 (2018) for future-generated (non-legacy) waste from MFC in HFEF-5 canisters. Since Np-237 was not part of the future-generated (non-legacy) waste inventory analyzed in the PA for this generator, waste form and canister type, this issue is reviewed as part of this UDQE.

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 MFC170305 was flagged by RHINO because the estimated inventory/activity exceeded: 1) the total generator, waste-form, and canister-type specific activity for Pu-240 analyzed in the PA; and 2) 10% of the total generator and waste-form specific activity for radionuclides Sr-90, Cs-137, U-235, U-238 and Pu-240 analyzed in the PA. 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.

In addition, Np-237 is listed in the canister inventory but there are no threshold inventory values for Np-237 in Table 18 of INL/EXT-18-45184 (2018) for future-generated (non-legacy) waste from MFC in HFEF-5 canisters.

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 ☐

Jonathon Jacobson		11/7/19
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
JAMES MAYER		11/7/19
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

Two issues regarding the radionuclide inventory of canister MFC170305 were evaluated as part of this UDQE.

Issue 1: Some radionuclide activities in canister MFC170305 were flagged by RHINO for exceeding PA inventory and container threshold values for the specific waste generator, waste form and canister type. These exceedances were evaluated to determine if they are anomalous or indicative of a change in waste generation rates; and to determine the impact on the PA.

Issue 2: Np-237 is a groundwater radionuclide of concern analyzed in the PA and was listed in the canister inventory, but it was not analyzed in the PA for this generator, waste form and canister type. As a

result, it was not compared to any PA threshold values, but was discovered during preparation of this UDQE. Therefore, the Np-237 inventory was evaluated to determine if it is anomalous or indicative of a change in waste generation rates; and to determine the impact on the PA.

Issue 1 Evaluation

Table 1 shows the isotopic activity levels for canister MFC170305 that exceed threshold values from Table 18 of INL/EXT-18-45184 (2018). The waste canister was flagged by RHINO because the activity for Sr-90, Cs-137, U-235, U-238 and Pu-240 exceeds 10% of the projected PA inventory (a canister threshold) for activated metal or surface contamination future (non-legacy) waste in HFEF-5 canisters from MFC. The canister was also flagged because the Pu-240 activity exceeds the total PA activity projected for surface contamination of non-legacy waste in HFEF-5 canisters from MFC. Each of these exceedances are addressed below.

Table 1. Isotopic inventory of waste canister MFC170305 showing comparison with threshold values from INL/EXT-18-45184 (2018) for HFEF-5 future (non-legacy) surface contamination.

Nuclide	Canister MFC170305 activity[a] (Ci)	PA inventory threshold activity for future HFEF-5 canisters from MFC[b,c] (Ci)	Container threshold activity for future HFEF-5 canisters from MFC (10% of PA inventory)[b] (Ci)	Canister activity as a percentage of PA inventory threshold for future HFEF-5 canisters from MFC
Sr-90	0.307	1.65	**0.165**	19%
Cs-137	0.240	0.817	**0.0817**	29%
U-235	1.85E-07	1.50E-06	**1.50E-07**	12%
U-238	1.06E-07	7.11E-07	**7.11E-08**	15%
Pu-240	4.99E-05	**7.16E-06**	**7.16E-07**	697%

Numbers in **BOLD font** indicate threshold values that were exceeded

a. ECAR-4033, Table 3
b. INL/EXT-18-45184 (2018), Table 18
c. ECAR-3225, Table 6

It is helpful in understanding this evaluation to know the inventory of future generated (non-legacy) waste analyzed in the PA (DOE/ID-11421 2018) was determined by calculating the average inventory of the 23 most recently generated HFEF-5 waste canisters that contain activated metals with surface contamination (ECAR-3225). These canisters were generated between years 1983 and 2015, with most (18) generated between years 1994 and 2000. The average inventory was then multiplied by the estimated number of cans that would be generated over the 20-year life of the facility (25).

Sr-90 and Cs-137

Sr-90 and Cs-137 are addressed separately because they are not radionuclides of concern for the groundwater pathway in the PA. They were both screened out in Phase III of the groundwater pathway screening in the PA which used the entire projected facility inventory and conservative assumptions to estimate the groundwater pathway dose. They are however radionuclides of concern for the intruder pathway, but they passed the intruder pathway screening in RHINO. This is obvious from looking at Table 2 which shows the total activity of both Cs-137 and Sr-90 analyzed in the PA and the canister activity as a percentage of that activity (last two columns in Table 2). The canister inventory is less than 0.05% of the total PA inventory for both radionuclides. Thus, the inventory of Cs-137 and Sr-90 in canister MFC170305 will have an insignificant impact on the conclusions of the PA.

Although the radionuclide activities in canister MFC170305 will not impact the PA, they were reviewed to determine if they are anomalous (which could indicate a problem with characterization) and/or indicative of a change in waste generation rates. The range of Cs-137 activity in the 23 canisters used to estimate the PA inventory is 4.5E-05 to 0.652 Ci, and the range of Sr-90 activity is 1.2E-04 to 1.39 Ci (ECAR-3225, Appendix A). While the activities of Cs-137 and Sr-90 in canister MFC170305 are toward the upper end

of these ranges, they are well within the ranges and therefore are not anomalous or indicative of a change in waste generation rates.

Table 2. Comparison of Cs-137 and Sr-90 activity in waste canister MFC170305 with range of activity from the 23 canisters used to estimate the 20-year inventory of future generated waste for the PA, and the total activity analyzed in the PA.

Nuclide	Canister MFC170305 activity[a] (Ci)	Range of activity in 23 canisters used to estimate the 20-year inventory of future generated waste for the PA (Ci)	Total activity analyzed in the PA (Ci[b,c]	Canister activity as a percentage of total activity analyzed in the PA
Sr-90	0.307	4.5E-05 to 0.652	673	0.046%
Cs-137	0.240	1.24E-04 to 1.39	945	0.025%

a. ECAR-4033, Table 3
b. Summed from values in INL/EXT-18-45184 (2018), Table 18
c. The canister activity is compared to total activity of all waste forms because the intruder pathway dose does not depend on waste form. Nevertheless, most of the inventory for these radionuclides is surface contamination.

U-235, U-238 and Pu-240

The activity of U-235, U-238 and Pu-240 in canister MFC170305 will have an inconsequential impact on the PA because: 1) these radionuclides are small dose contributors, and 2) the activities are a small percentage of the total activity analyzed in the PA. U-235, U-238 and Pu-240 were three of the 14 radionuclides that were not screened out for the groundwater pathway and fully analyzed in the PA. However, the groundwater all-pathways dose contribution from each is a small fraction of the total peak dose for the facility. Table 3 shows the dose contribution from each radionuclide ranges from a low of 0.00004% for Pu-240 (east side sources) to 0.2% for U-235 (east side sources) for the post-compliance period. The percentages for the 1000-year compliance period are infinitesimally small (< 1E-22%). Table 4 shows the canister activities are a small percentage of the total activity analyzed in the PA (see last two columns of Table 4). The two uranium isotopes are less than 0.015% and the Pu-240 activity is higher at 2.19%. Although the P-240 activity is higher, the impact on the dose and the conclusions of the PA will be inconsequential for all three radionuclides.

Although the radionuclide activities will not impact the PA, they were reviewed to determine if they are anomalous and/or indicative of a change in waste generation rates. Table 4 compares the canister activity of these three radionuclides to the range of activity in the 23 containers used to estimate the total surface contamination in future (non-legacy) waste in HFEF-5 canisters from MFC that was analyzed in the PA. Although the canister activities are outside the ranges, they are not very far outside the ranges. In addition, this is not a big concern because the radionuclides were listed in so few of the 23 containers used to estimate the future-generation inventory for the facility. U-235 and U-238 were only listed in 4 of the 23 containers and Pu-240 was only listed in 3 of the 23 containers. Given the radionuclides were listed in so few containers, the fact that they are outside the ranges is not a good indicator that the canister inventory may be anomalous or indicative of a change in waste generation rates.

Table 3. Summary of U-235, U-238 and Pu-240 dose contribution to the groundwater all-pathway dose in the PA for the for post-compliance period.

	East Side Sources		West Side Sources	
Nuclide	Dose contribution (mrem/yr)[a]	Dose contribution as % of total dose	Dose contribution (mrem/yr)[b]	Dose contribution as % of total dose
U-235	1.51E-03	0.23520%	3.76E-05	0.00977%
U-238	4.23E-04	0.06589%	1.14E-04	0.02955%
Pu-240	2.63E-07	0.00004%	3.47E-07	0.00009%
Total Dose	0.642	100%	0.385	100%

a. Table 4-3 of the PA (DOE/ID-11421) and TEV-3431.
b. Table 4-4 of the PA (DOE/ID-11421) and TEV-3431.

Table 4. Comparison of U-235, U-238 and Pu-240 activity in waste canister MFC170305 with range of activity from the 23 canisters used to estimate the 20-year inventory of future generated waste for the PA, and the total activity in surface contamination analyzed in the PA.

Nuclide	Estimated canister activity[a] (Ci)	Range of activity in 23 canisters used to estimate the 20-year inventory of future generated waste for the PA (Ci)	Total activity analyzed in the PA as surface contamination[b,c] (Ci)	Canister activity as a percentage of total activity analyzed in the PA
U-235	1.85E-07	1.91E-12 to 1.75E-07	3.70E-03	0.005%
U-238	1.06E-07	1.96E-16 to 9.59E-08	7.41E-04	0.014%
Pu-240	4.99E-05	7.78E-12 to 8.27E-07	2.28E-03	2.189%

a. ECAR-4033, Table 3
b. Summed from values in INL/EXT-18-45184 (2018), Table 18
c. The canister activity is compared only to the total surface contamination activity because the impact on the groundwater pathway dose is waste-form dependent and the canister activity that was flagged is surface contamination.

One possible explanation why some of the radionuclide activities in this canister were flagged by RHINO is that canister MFC170305 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 activities in canister MFC170305 appear to be reasonable and do not represent a significant increase in the facility inventory. However, future canisters from FCF may also be flagged for the same reason.

Issue 2 Evaluation

The inventory for canister MFC170305 lists 1.48E-07 Ci of Np-237 as surface contamination. Np-237 is a groundwater radionuclide of concern analyzed in the PA, but it was not analyzed in the PA for this generator (MFC), waste form (surface contamination) and canister type (HFEF-5). As a result, there are no PA threshold values for RHINO to compare to for this generator, waste form and canister type.

Table 18 of INL/EXT-18-45184 (2018) does not list a threshold value for Np-237 for MFC future generated waste in HFEF-5 canisters because it was not listed in the inventory of the 23 legacy HFEF-5 canisters used to estimate the inventory of future-generated waste. Although it was not listed, it is not surprising that Np-237 in trace quantities was picked up on smears used to characterize canister MFC170305 because some of the 23 legacy canisters contained Pu-241 and Am-241, and Np-237 is a decay product of both radionuclides. So, while the appearance of Np-237 in the inventory appears to be anomalous and indicative of a change in waste generation rates, it should not be considered such.

Although there was no Np-237 as surface contamination in HFEF-5 future generation waste analyzed in the PA, there is an indicial response function in RHINO to account for the impact on future dose and gross-alpha concentration. That is because the PA groundwater model treats legacy and future-generated waste in HFEF-5 cans the same. RHINO estimated the dose contribution from canister MFC170305 as 3.33E-11 mrem/yr during the compliance period, and 5.60E-07 mrem/yr during the post-compliance period. RHINO checks these values against values of 1 and 12.5 mrem/yr respectively. The gross alpha concentrations (1.15E-32 and 2.17E-07 pCi/L for the compliance and post-compliance periods) are similarly very much lower than the limits checked by RHINO (0.6 and 7.5 pCi/L). Since the contribution of the canister to dose and gross-alpha concentration is exceptionally low, the impact on the PA from Np-237 in canister MFC170305 is insignificant. This conclusion is also supported by comparing the Np-237 inventory in canister MFC170305 (1.49E-07 Ci) to the total Np-237 surface contamination inventory analyzed in the PA (5.83E-04 Ci).

Summary

Canister MFC170305 was flagged by RHINO because the estimated inventory/activity exceeded: 1) the total generator, waste-form, and canister-type specific activity for Pu-240; and 2) 10% of the total generator and waste-form specific activity for radionuclides Sr-90, Cs-137, U-235, U-238 and Pu-240. According to INL/EXT-18-45184 (2018), the canister was 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.

In addition, Np-237 is a groundwater radionuclide of concern analyzed in the PA and was listed in the canister inventory, but it was not analyzed in the PA for this generator, waste form and canister type. As a result, it was not compared to any PA threshold values.

A review of the information available indicates the radionuclide inventory of canister MFC170305 will have an insignificant 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-3225, 2017, Baseline Profile of the Remote-Handled Low-Level Waste Streams at the Materials and Fuels Complex, Revision 3, Idaho National Laboratory, December 2017.

ECAR-4033, 2019, Radiological Source Term Determination for Fuel Conditioning Facility (FCF)-5 Can Having Unique ID MFC170305, Revision 1, Idaho National Laboratory, July 2019.

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.

Jonathon Jacobson Print/Type Name Originator/FDS	 Signature Originator/FDS	11/12/19 Date
A R PRATHER Print/Type Name System Engineer/SE	 Signature System Engineer/SE	11-12-19 Date
A. Jeff Sondrup Print/Type Name PA/CA SME	 Signature PA/CA SME	11/13/19 Date
Amy M. Cox Print/Type Name Waste Management/WMP	 Signature Waste Management/WMP	2019.11.12 Date
PATRICK W. KEKI Print/Type Name Nuclear Facility Manger/NFM	 Signature Nuclear Facility Manger/NFM	11/13/2019 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-033

Subject: Spatial Interference Between NSFH Waste Cask/ Cask to Vault Adapter System (CVAS) and Power Pedestals/Monitoring Wells

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 RHLLW Disposal Facility was designed and constructed prior to design being completed for the NRF Naval Spent Fuel Handling (NSFH) waste cask. The design basis for the facility was based on bounding conditions that were identified by Naval Reactors at the time the facility design was underway. The RHLLW Disposal Facility has since been constructed and design of the NSFH waste cask has matured significantly. The NSFH design team has identified that there are spatial interferences between the waste cask and/or CVAS and the power risers and monitoring wells that were placed along the south edge of the NSFH (a.k.a. LCC) vault array. The interferences could potentially render a number of the south edge disposal vaults unusable. The NSFH design team has requested an evaluation of options from the PA/CA Review Committee (PARC) to address this conflict. Attached figures of the NSFH waste cask have been provided by the NSFH design team. The figures indicate the area of concern for the spatial interference. The CVAS has not been designed and therefore no dimensions are provided. For the purpose of this evaluation, it should be assumed that the CVAS can be designed to fit within the footprint of the NSFH waste cask. The height of the CVAS should be assumed to conservatively place the NSFH waste cask directly on the RHLLW Disposal Facility vault (i.e. CVAS height = 0").

Options discussed to date with the NSFH design team to resolve the spatial interference include:

- Abandonment of affected disposal vaults (very undesirable)
- Raising the height of the CVAS to raise the waste cask above the top of the monitoring wells and/or power pedestals
- Temporary removal of power pedestals and monitoring well surface components
- Permanent removal of power pedestals and monitoring well surface components (dropping well heads below grade)
- Permanent relocation of power pedestals and/or monitoring well surface components

Attachments:

- NSFH provided preliminary sketches showing plan and elevation of the NSFH waste cask and a concept block for the CVAS.

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: The electrical power supply at the vault arrays is an operational convenience and the presence or absence of the power does not affect any aspect of the PA or associated documentation. The monitoring well network, however, is an integral component of the performance and compliance posture of the facility. While changes to the monitoring well network do not directly impact the PA or the long-term performance of the facility, it could impact the ability to assess performance, and thus any potential impact to the monitoring well network needs to be evaluated.

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 ☒

3. Comments: Changes to the monitoring well network do not impact the potential to increase effective dose analyzed in the PA or challenge conclusions of the CA. *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: The presence or absence of the monitoring wells does not affect the disposal process or procedures analyzed in the PA and associated documentation. Based on the NSFH waste cask design, the presence of the wells actually does present an operational impact in that it could force abandonment of some south edge disposal vaults. This would result in a net decrease in analyzed effects as less inventory would be disposed than planned.

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: The presence or absence of the monitoring wells does not affect the WAC.

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: Changes to the monitoring well network do not directly impact inputs or assumptions in the PA. However, the PA assumes that the monitoring wells are present and functioning allowing monitoring to be conducted as defined in the facility monitoring plan. Any impacts to the wells should be evaluated to determine the impact on the ability to assess the long-term performance of the facility.

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: The monitoring well network is planned to be in service during the operational period and could be used following closure of the facility if deemed necessary. Impact to the monitoring network needs to be evaluated to determine the impact the ability to assess the long-term performance of the facility.

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: The proposed activity does not constitute a test or experiment.

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: The location of the monitoring wells is not an error, omission, or deficiency. The location of the wells was identified during the design as necessary to properly monitor the facility. No information available at the time of the facility design indicated that the well location would be problematic. The interference is an emergent

condition that has resulted from maturation of the design of the NSFH waste cask.

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

Yes ☐ No ☒

Comments: There are no additional considerations.

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 NSFH design team has requested a documented response from the PARC as to the path forward to address the spatial interference between the NSFH waste cask and the power pedestals and monitoring wells. The documented path forward will allow the NSFH design team to continue finalization of the NSFH waste cask design and will alleviate concerns that may arise from customers regarding proper design scoping and pro-active problem solving. It is recommended that an evaluation be conducted to determine the PARC-recommended path forward to address the potential interference problem. However, the potential interference with the power pedestals is unrelated to the environmental performance of the facility (PA, CA, ODAS, etc.) and as such, addressing this portion of the evaluation request is an operations and industrial/electrical safety consideration and is not related to UDQE-RHLLW-033. Therefore, the evaluation only needs consider the spatial interference between the NSFH waste cask and the monitoring wells.

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	**08/02/2020**
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Larry Evens	Larry Evens	**08/03/2020**
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:
A technical evaluation (TEV-4037) was conducted to determine the potential interference between the NFSH waste cask and/or cask-to-vault adapting structure (CVAS) and the two sets of monitoring wells along the south side of the LCC vault array. The evaluation found the monitoring well riser pipes, which are positioned outboard (south) of the edge of the vault array, do not interfere with the current cask/CVAS design provided that the monitoring well instrumentation boxes can be temporarily displaced or removed to support the four disposal evolutions for the four affected vaults. TEV-4037 further recommends the following:

1. Revisit TEV-4037 once the CVAS design is complete and confirm that the CVAS is within the cask footprint with respect to the critical south-facing dimension (55.85" from vault center to south edge of cask/CVAS).
2. Once the CVAS and cask are present on site and operating experience has been gained handling the equipment, determine if the available clearance between the equipment and the well riser piping is sufficient for safe operations. Determine appropriate mitigations, if necessary, as informed by operational experience with the equipment in-hand.

Consultation with installers of the monitoring wells has confirmed the assumption that the monitoring well boxes can be temporarily placed to the side (while still connected) and not interfere with the cask/CVAS. Based on this and the evaluation in TEV-4037, it has been determined that the current cask/CVAS design will not impact the ability of the monitoring wells to continue to collect data and maintain their functionality provided that facility operators can effectively and safely operate within the expected clearance. Therefore, the cask/CVAS design as presented in Appendix A of TEV-4037 is approved for use at the RHLLW Disposal Facility for the four potentially impacted vaults located adjacent to the monitoring wells provided that the critical south-facing dimension (maximum 55.85" from vault center to south edge of cask/CVAS) is met.

Jonathan Jacobson Print/Type Name Originator/FDS	Jonathan Jacobson Signature Originator/FDS	**08/03/2020** Date
Allen Prather Print/Type Name System Engineer/SE	A. R. Prather Signature System Engineer/SE	**08/03/2020** Date
A.J. Sondrup Print/Type Name PA/CA SME	Jeff Sondrup Signature PA/CA SME	**08/03/2020** Date
Amy Cox Print/Type Name Waste Management/WMP	Amy M. Cox Signature Waste Management/WMP	**08/02/2020** Date
Larry Evens Print/Type Name Nuclear Facility Manger/NFM	Larry Evens Signature Nuclear Facility Manger/NFM	**08/03/2020** 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-036

Subject: 55-Ton Waste Canister with Increased Tolerance on Top Ring Flatness

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 Naval Reactors Facility (NRF) is designing and procuring the Type IV 55-Ton waste canisters for disposal of radioactive waste in the RHLLW 55-Ton vault array. They are proposing a change to the tolerance of the canister top ring flatness parameter from the current 0.015-inches to 0.030-inches because it is extremely difficult to achieve with no corresponding operational benefit.

The RHLLW waste acceptance criteria (WAC) requires waste canisters be "designed to minimize the potential water ingress." This proposed change is being reviewed to determine if the increased tolerance could increase the potential for water ingress.

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?*

Comments: Yes ☐ No ☒

The proposed change in the top ring flatness tolerance does not involve a change to the disposal facility.

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

Comments: Yes ☐ No ☒

The proposed change in top ring flatness tolerance will not result in an increase in effective dose from the disposal facility.

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?*

Comments: Yes ☐ No ☒

The proposed change in the top ring flatness tolerance does not affect the disposal process or procedures.

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?*

Comments: Yes ☐ No ☒

The proposed change in the top ring flatness tolerance does not change the WAC. The change equates to less than a millimeter over the diameter of the canister top ring. This will not increase the potential for water ingress and still provides for a reliable and effective sealing surface. Refer to the

"Explanation/Additional Comments" section for further discussion.

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

Comments: Yes ☐ No ☒

The proposed change in top ring flatness tolerance does not involve a change of inputs or assumptions of the PA or SA.

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)?*

Comments: Yes ☐ No ☒

The proposed change in the top ring flatness tolerance does not affect the facility preliminary closure approach or criteria.

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)?*

Comments: Yes ☐ No ☒

The proposed change in the top ring flatness tolerance is not a test or experiment.

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)?*

Comments: Yes ☐ No ☒

The proposed change in the top ring flatness tolerance does not involve any analytical errors, omissions, or deficiencies of the PA, CA, approved UDQEs or closure plan.

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

Comments: Yes ☐ No ☒

There are no known additional considerations associated with the proposed change to the top ring flatness tolerance that would warrant development of an evaluation or special analysis.

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 proposed change to the top ring flatness tolerance from 0.015-inches to 0.030-inches results in an increase in tolerance of 0.015-inches (0.38 millimeters) over the entire top ring of the canister (46.63-inches in diameter). This change alone would not negatively influence the ability of the lid and canister to provide a reliable seal. This Type IV canister lid design includes a 12-bolt configuration for closure to ensure a mechanical seal is achieved. Additionally, during fabrication the canister assemblies are required to pass a hydrostatic test of 3 psi over 10-minutes. Therefore, this proposed change would not negatively affect the self-limiting water ingress requirement.

Does the Unreviewed Disposal Question Screening screen negative or positive?

Negative ☒ Positive ☐

Is an Unreviewed Disposal Question Evaluation or Special Analysis needed?

No ☒ UDQE ☐ Special Analysis ☐

Jonathan Jacobson		**4/16/20 20**
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
James Mayer	**JAMES MAYER (Affiliate)** Digitally signed by JAMES MAYER (Affiliate) Date: 2020.04.16 15:51:04 -06'00'	**4/16/2020**
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)?*

Comments: Yes ☐ No ☐

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

Comments: Yes ☐ No ☐

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

Comments: Yes ☐ No ☐

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

Comments: Yes ☐ No ☐

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-038

Subject: RHINO reporting transuranic mass-based concentration incorrectly after software change request

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:

During the acceptance review of MFC190345 HFEF-5 canister from MFC with combined activated metal and surface contaminated debris generated after 4/21/2015, a discrepancy was identified between RHINO and IWTS software in reporting the mass-based concentration (nanocuries per gram, nCi/g) of transuranic (TRU)-waste isotopes. IWTS reported the TRU waste concentration of the canister as 1.42 nCi/g and RHINO reported the concentration as 1.21 nCi/g.

An investigation discovered RHINO TRU-waste concentration calculation was not including radionuclides Np-237, Pu-238, Pu-240 and Pu-242 for this canister. The investigation also discovered the discrepancy was the result of a change made to RHINO as a result of software change request (SCR-RHINO-05) completed in November 2019. SCR-RHINO-05 was implemented because RHINO had been using the wrong look-up table for waste generated after 4/21/2015 from MFC per Appendix A of PLN-5446 Waste Acceptance Criteria for the Remote-Handled Low-Level Waste Disposal Facility. MFC waste generated before 4/21/2015 is identified as legacy waste, and waste generated after 4/21/2015 is considered newly generated waste from MFC. RHINO was incorrectly using the legacy waste table for waste generated after 4/21/2015 requiring SCR-RHINO-05 to correct the error.

Appendix A of PLN-5446 contains nuclear safety-derived activity limits for radionuclides, mass-based concentration limits (100 nCi/g) for TRU-waste isotopes, and minimum radionuclide reporting levels for waste canisters by generator and waste form. When SCR-RHINO-05 was implemented to use the correct table in Appendix A for waste generated after 4/21/2015 from MFC, TRU-waste isotopes with nuclear safety-derived limits from the correct table (Am-241 and Pu-239) were included in RHINO but TRU-waste isotopes without nuclear-safety derived activity limits (Np-237, Pu-238, Pu-240, and Pu-242) were incorrectly omitted. This discovery led to cancellation and delay of the shipment until the issue is corrected. The issue was entered into the Battelle Energy Alliance Labway system under CO 2020-0304 to be evaluated.

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

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: Although the source of the miscalculation in RHINO does not involve a change to the WAC, it involves a change in how the canister-specific TRU-waste isotope limits from Appendix A in the WAC are checked in RHINO and how the total TRU concentration is calculated. An evaluation should be conducted to determine if the modification to RHINO has been correctly implemented and if use of the incorrect table has any impact on previously placed canisters.

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: 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		03/05/2020
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
J MAYER		3/5/2020
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:

As a result of the discrepancy between the RHINO and IWTS software in calculating the TRU-waste concentration for MFC HFEF-5 future-generation waste canisters, a condition was entered into the INL Labway system (CO 2020-0304) and a corrective action (CA 2020-0291) was performed. The corrective action has been completed and approved and it has been verified that RHINO is now correctly calculating the TRU-waste calculation for MFC HFEF-5 future generation waste canisters.

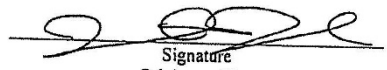
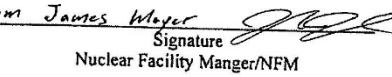
Another purpose of this evaluation was to determine if any previously placed waste canisters evaluated by RHINO before the correction was made would violate the WAC or impact the PA. The only other placed canister that could have been impacted by the error in RHINO is MFC170305, an HFEF-5 canister that contains combined activated metal and surface contamination generated after 4/21/2015.

During the initial acceptance review of canister MFC170305, RHINO was comparing against activity limits from the wrong lookup table for waste generated after 4/21/2015. MFC waste in HFEF-5 canisters generated before 4/21/2015 is identified as legacy waste, and waste generated after 4/21/2015 is considered future-generated waste from MFC. RHINO was incorrectly using the legacy waste table for future-generated waste (generated after 4/21/2015) requiring SCR-RHINO-005 to correct the error. But because the legacy waste table had all TRU-waste isotopes properly identified, the TRU-waste concentration calculated and reported by RHINO during the initial acceptance review was correct and matched the result from IWTS and FRM-2544.

After SCR-RHINO-005 was implemented and approved on 11/13/2019 and the updated version of RHINO was used for final acceptance testing of MFC170305, the updated version of RHINO was using the correct table, but the correct table did not properly identify all of the TRU-waste isotopes. This led to an incorrect calculation of the TRU-waste concentration, but this went unnoticed because the initial acceptance testing reported the correct concentration. The corrective action to use the correct table in RHINO and properly identify all TRU-waste isotopes has resulted in RHINO checking against the proper limits and correctly reporting the TRU-waste concentration for future-generated waste from MFC. The reported TRU mass-based concentration in MFC170305 is now correctly reported in RHINO as 1.838 nCi/g which is less than the 100 nCi/g limit.

Thus there is no impact or violation of the WAC and the previous miscalculation has no impact on any PA checks performed by RHINO, or the performance measure calculation performed by RHINO for the PA. Therefore, the error has no impact on the PA. The issue has been entered into the Battelle Energy Alliance Labway system under CO 2020-0304 and CA 2020-0291.

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

Jonathan Jacobson Print/Type Name Originator/FDS	 Signature Originator/FDS	3/10/2020 Date
Allen Prather Print/Type Name System Engineer/SE	 Signature System Engineer/SE	3-11-20 Date
A. Jeff Sondrup Print/Type Name PA/CA SME	 Signature PA/CA SME	3/11/2020 Date
Amy M. Cox Print/Type Name Waste Management/WMP	 Signature Waste Management/WMP	2020.03.30 Date
Jonathan Jacobson per email from James Moyer Print/Type Name Nuclear Facility Manger/NFM	 Signature Nuclear Facility Manger/NFM	3/30/2020 Date

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

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

PARC Assigned SME: _____

Special Analysis Document Number: _____

Proposed Activity Approved? Yes ☐ No ☐

Comments: _____

Print/Type Name	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-039

Subject: Inclusion of CIC components and ancillary activated metal waste from ATR not analyzed in original PA.

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 Advanced Test Reactor (ATR) Canal Cleanout Project plans to pre-package remote-handled low-level waste (RHLLW) into baskets for ultimate disposal at the INL RHLLW Disposal Facility. The RHLLW Performance Assessment (PA) model included activated metal waste and ion-exchange resins from ATR. The activated metal waste source term used for the PA was based on a specific list of ATR core-internal changeout (CIC) components that was provided to the RHLLW project team in the early stages of disposal facility planning. The list of CIC components analyzed for the PA included aluminum, Inconel, zircaloy, and stainless-steel components. However, the list provided was not inclusive of all reactor core components and did not specify ancillary RH waste generated during CIC evolutions or normal operations.

ATR is requesting the ability to package and ship RH waste that is constructed out of the same material (e.g., aluminum, Inconel, zircaloy, and stainless-steel) and claimed to be radiologically bounded by the CIC components analyzed in the existing PA. This change in the ATR activated metal source term is being reviewed/assessed for potential impacts to the PA. In addition, ATR is acknowledging that all activated metal waste from ATR is likely to have a minimal amount of surface contamination due to radioactivity in the ATR canal water. Surface contamination was not reported for ATR activated metal waste and this will be reviewed/assessed for potential impacts to the PA.

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: Inclusion of additional activated metal components is a change from the inputs or assumption of the most recent PA. The RHINO software that calculates facility performance for comparison to regulatory standards is capable of calculating the impacts from the additional components so long as the components are made of the same materials and can be radiologically characterized using the same methodology. Also acknowledging that all ATR activated metal waste is likely to have surface contamination is a change from the most recent PA. Both changes should be reviewed and assessed for potential impacts 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:

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 ☐

Jonathon Jacobson		
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Larry Evens		
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: The impact of each waste shipment from ATR on the PA performance measures will be calculated by RHINO. Acceptance of each canister will be based on those calculations and PA performance measures will not be exceeded.

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:

Inclusion of additional components that were not part of the original ATR activated metal source term is a change from the inputs or assumptions of the most recent PA. Although most of the additional components are part of the CIC process, they were not on the list of components in ECAR-854 that was used to develop the ATR activated metal source term used in the PA. For these components and other ancillary waste to be accepted for disposal at the RHLLW Disposal Facility:

- The waste must be made of similar materials to the ATR activated metal source term so the corrosion data used in the PA and by RHINO is applicable. This information should be included in the radiological source term ECAR for each waste canister.

- The characterization methodology should be justified in the radiological source term ECAR for each waste canister,
- The waste must have a radiological makeup similar to the ATR activated metal source term and meet all PA and WAC checks performed by RHINO.

In order to meet the first two requirements, the ATR Canal Cleanout Project has developed an ECAR template that will document the radiological source term for each waste canister sent to RHLLW Disposal Facility for disposal. Each ECAR will have a unique number associated with each waste canister. The ECAR will document the component materials (e.g. stainless steel, Inconel, Zircaloy, aluminum), the radionuclide inventory and include justification explaining why the activity in the components is bounded by the CIC component activities used to determine the original source term. The source term will be determined using the methodology from ECAR-854 and documented in the ECAR. The ECAR template is included as an attachment to this UDQE. The assumptions used to characterize the canisters and determine the inventory (from the ECAR template) are listed below:

1. The core component radionuclide specific activity values (Ci/m3) listed in ECAR-854, "Appendix A – 10-Year Decayed Radionuclide Inventory", are conservative and appropriate to perform radionuclide inventory determinations using underwater direct radiation measurements of the waste loaded into an ATR-5 basket in the ATR canal. Conservative assumptions used in determining the activities are recorded and explained in ECAR-854.
2. The core component quantities, material, density, mass, volume and in-core and out-of-core locations listed in ECAR-854, "Table 3 – Core Internal Changeout Component Characteristics", are conservative and appropriate to perform radionuclide inventory determinations using underwater direct radiation measurements of the waste loaded into an ATR-5 basket in the ATR canal. The conservative assumptions used in determining the activities that are recorded and explained in ECAR-854 for CIC in-core and out-of-core components bound non-CIC components; primarily based on CIC components greater material mass and longer irradiation times, resulting in a greater amount of activated material.
3. Consistent with PLN-5446, "Waste Acceptance Criteria for The Remote-Handled Low-Level Waste Disposal Facility", the minimum reporting levels for individual radionuclides have been set at 0.1% of the lowest maximum canister waste limit presented in Tables A-1 Through A-12. However, all radionuclides listed in ECAR-854, Appendix A are included in the source term for Performance Assessment considerations (DOE/ID-11421).
4. Consistent with PLN-5446, "Waste Acceptance Criteria for The Remote-Handled Low-Level Waste Disposal Facility", section 2.1 "Radionuclide Reporting Requirements", reporting is also required for all radionuclides not listed in Appendix A, Table A-13 that contribute to greater than 1% of the total canister activity and have a half-life greater than 1 year. Conservatively, all radionuclides listed in ECAR-854 Appendix A less than 1% are also included in the canister source term.
5. It is expected that activated metal waste will have surface contamination radionuclide content in addition to the activated metal radionuclide content. These radionuclide activities are bounded by the characterization in Appendix C. The surface contamination activity is provided in Table 2. The radionuclides and relative abundance were obtained from 2018 canal radiochemistry results, which are characteristic of the ATR canal water. The activity values were obtained from Visual Survey Data System (VSDS) Standard Map Survey Report M-20190204-11, "ATR 670 Canal Scum Line" as shown in Appendix B. The SCO calculation is provided in Appendix C, which assumes the maximum basket mass which has been administratively established at 700 pounds (per drawing 814600 the maximum basket mass is 800 pounds).
6. It is anticipated that multiple waste items of various metals will likely be loaded into the ATR-5 waste baskets based on radiation levels, quantity of items/materials, limitation on available basket volume and other factors. For this eventuality and for convenience, an "ATR Canal Composite Material" has been developed using the Custom Material tool in the MicroShield modeling software. The ATR Canal Composite Material was developed using the mass fractions and weighted densities for the SS304, SS348, Inconel X750 and Aluminum 6061 components for a typical CIC (see Table 2, ECAR-854). An effective density may be determined for the

waste in each ATR-5 basket to account for the estimated void space inside the loaded basket. One common method to estimate the effective density is to divide the net mass of the loaded basket by the volume. Non-CIC RHLLW components are exclusively aluminum and stainless-steel alloy material approved for insertion into the ATR. The CIC materials listed in ECAR-854 are characteristic of non-CIC materials, which are predominantly structural waste materials from experiments irradiated in ATR.

In instances where it is known one material type will be the dominant material loaded into a basket, the ATR Canal Composite Material can be modified, or a specific Custom Material can be developed and applied to the specific basket. The ATR Canal Composite Material Custom Material file is included an Appendix D.

7. Attenuation from the ATR canal water is considered negligible, and therefore is not included as a shield material.

Assumption 5 acknowledges that the activated metal waste is likely to have surface contamination due to radioactivity in the ATR canal water. Surface contamination on ATR activated metal waste was not addressed in the PA. As discussed in Assumption 5 above, bounding surface contamination activities have been calculated in the ECAR template and will be reported in the radiological source term ECAR for each waste container. The bounding activities are shown below:

Radionuclide	Half-life	Total Package Activity (Ci)
Co-60	5.27 years	3.71E-03
Cr-51	< 1 year[a]	2.80E-03
Re-188	< 1 year[a]	2.03E-03
W-187	< 1 year[a]	1.46E-03
Mo-99	< 1 year[a]	1.10E-03
Na-24	< 1 year[a]	1.90E-04
Hf-181	< 1 year[a]	3.68E-05
	Total	1.13E-02

a. Radionuclides with half-lives less than 1 year were screened from the groundwater pathway.

The bounding surface contamination activities in the table above will have a negligible impact on the PA for several reasons. Firstly, all of the radionuclides were screened from the air and groundwater pathway analysis in the PA. All but Co-60 were screened from the groundwater pathway based on half-life. Co-60 was screened from the groundwater pathway in the PA during the Phase 3 site specific screening step. Secondly, the activities are very low and are likely to be below the reporting threshold of 1% of total canister activity as specified in the WAC (PLN-5446). Co-60 is an important intruder analysis radionuclide, but the bounding Co-60 activity for a waste package (3.7E-03 Ci) is less than 0.001% of the total Co-60 surface contamination in the PA base case inventory (734 Ci, DOE/ID-11421, Table 2-14), and less than 0.00001% of the total Co-60 inventory in the PA base case inventory (3.1E+05 Ci, DOE/ID-11421, Table 2). Nevertheless, the Co-60 inventory as surface contamination (if reportable) will be included in the intruder dose calculations by RHINO even though it will be negligible.

Based on a review of the ECAR template, RHLLW subject matter experts concur that the characterization methodology and assumptions are appropriate; and the surface contamination activities will have a negligible impact on the PA. Prior to disposal, each ECAR will be reviewed to determine if the required information is included. So long as component materials are similar, the characterization methodology is appropriate, and the inventory passes all RHINO PA and WAC checks, the canister can be accepted for disposal.

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

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

PARC Assigned SME: _____

Special Analysis Document Number: _____

Proposed Activity Approved? Yes ☐ No ☐

Comments: _____

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

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

UDQE Tracking No.: UDQE-RHLLW-041

Subject: ATR-5 waste canister purging/dewatering functional testing and acceptance

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 Advanced Test Reactor (ATR) Canal Cleanout Project has designed a new shielded transport container system for packaging and disposing of legacy activated metal waste from the ATR canal at the RHLLW Disposal Facility (RHLLW). The system will consist of an internal waste basket, an outer waste canister, and a shielded transfer container. The waste canister will serve as the outermost waste package that will be disposed of at RHLLW Disposal Facility.

The internal waste basket will be loaded underwater with irradiated metal components from core internal changeouts (CICs) that have been stored in the ATR canal. The outer waste canister will be submerged in the canal and the loaded waste basket will be placed into the canister underwater. The canister lid will be secured to the canister, forming a water-tight package. The canister will then be purged of water using positive air pressure while still submerged. Once purged, the canister will be lifted into the waste cask and readied for shipment to the RHLLW Disposal Facility.

The RHLLW Disposal Facility Waste Acceptance Criteria (WAC), PLN-5446, "Waste Acceptance Criteria for the Remote-Handled Low-Level Waste Disposal Facility," prohibits disposal of liquid waste. It specifically states, "Waste containing free liquids shall be drained to the point it contains as little free-standing liquid as reasonably achievable, but in no case shall the liquid exceed 1% of the waste volume of the waste in the outer most waste canister.

> *"The free liquid volume for RHLLW-waste canisters loaded underwater shall be as low as reasonably achievable through either active or passive means, including liquid evacuation or gravity drainage, but may not exceed the limits above."*

The ATR Canal Cleanout Project team fabricated two protype waste canisters that will be used for testing. An ATR-5 Outer Waste Canister Functionality Test plan (TP-106) has been developed and describes the processes that will demonstrate various aspects of the waste loading process and demonstration of the purging/dewatering of the canister system. The prototype purge testing will be documented in a test report. The demonstration and report will serve to validate the design of the system and justify the purging process such that RHLLW Disposal Facility personnel are assured that compliance with the WAC is achievable.

Underwater loading of the ATR canal waste and sealing/purging the canister is a process that was not previously considered at the time the PA and the WAC were developed. This purpose of this screening and evaluation is to assess the proposed process for dewatering the canister and verify that it will meet WAC requirements.

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: The RHLLW WAC (PLN-5446), Section 3.7, prohibits liquid waste from disposal at the RHLLW Disposal Facility. The WAC specifies that waste containing free liquids shall be drained to the point it contains as little free-standing liquid as reasonably achievable, but in no case shall the liquid exceed 1% of the waste volume when the waste is in the disposal canister. It is recommended that an evaluation of the test plan and test report be conducted to verify that the dewatering process will meet the requirements specified in the WAC.

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:

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	09/17/2020
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Larry Evens	Larry Evens	09/23/2020
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:

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:

The RHLLW WAC (PLN-5446), Section 3.7, prohibits liquid waste from disposal at the RHLLW Disposal Facility. The WAC specifies that waste containing free liquids shall be drained to the point it contains as little free-standing liquid as reasonably achievable, but in no case shall the liquid exceed 1% of the waste volume when the waste is in the disposal canister.

Underwater waste loading and purging/dewatering the ATR-5 waste canister are processes that were not previously considered at the time the PA and the WAC were developed. This purpose of this evaluation is to assess the proposed process for purging/dewatering the waste canister and verifying that it will meet WAC requirements.

Based on operational considerations and radiation fields, it is impractical to directly verify the absence of free liquids with actual radioactive waste packages. Compliance with free-liquid provision of the WAC was demonstrated through prototype waste canister testing and procedure validation. Test Plan (TP)-106 documents the procedure purging/dewatering the mock-up waste canisters. The procedure was demonstrated at the INL Engineering Demonstration Facility (IEDF) (IF-657) and documented in Technical Evaluation (TEV)-4000.

The testing was rigorous and demonstrated various aspects of the waste loading process but was specifically intended to address demonstration of the purging/dewatering capabilities of the canister system. The prototype canisters were seal tested both with and without surrogate waste. The waste canisters were purged/dewatered to determine compliance with WAC requirements, and they were also tested to ensure they did not refill after purging/dewatering. During testing, engineers also examined ways to improve the purging/dewatering process in order to meet the more strict WAC requirement of reducing the liquid level to "as low as reasonably achievable" and not simply meet the 1% of waste volume requirement.

RHLLW personnel reviewed both TP-106 and TEV-4000, and personally witnessed some of the purging/dewatering tests. Based on a review of test results, RHLLW personnel are confident the ATR-5 waste canister system can be safely dewatered down to a level that meets/exceeds the RHLLW WAC criteria for free liquids so long as changes/modifications to the:

- canister design as documented in TEV-4000 Section 7 are implemented, and
- purging/dewatering procedural requirements as documented in TEV-4000 Section 8 are followed.

The ATR Canal Cleanout Project team has committed to implementing the changes/modifications into the ATR-5 waste canister design and the purging/dewatering procedure. RHLLW personnel will check to ensure each of these changes/modifications have been implemented and followed prior to canister certification and waste acceptance.

Based on this evaluation the procedure for purging/dewatering the ATR-5 waste canister system is acceptable as it will result in a waste package that will meet RHLLW WAC and does not violate the assumptions and stipulations of the PA.

References

TP-106, ATR-5 Outer Waste Canister Functional Testing, Test Plan TP-106, Project No. 32889, Idaho National Laboratory, 5/13/2020.

TEV-4000, ATR-5 Mock-Up Purging Results, Technical Evaluation TEV-4000, Project No. 32889, Idaho National Laboratory, 6/18/2020.

Jonathan Jacobson	Jonathan Jacobson	9/24/2020
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Allen Prather	A. R. Prather	9/24/2020
Print/Type Name System Engineer/SE	Signature System Engineer/SE	Date
Jeff Sondrup	Jeff Sondrup	9/24/2020
Print/Type Name PA/CA SME	Signature PA/CA SME	Date
Amy Cox	Amy M. Cox	2020.09.24
Print/Type Name Waste Management/WMP	Signature Waste Management/WMP	Date
Larry Evens	Larry Evens	9/24/2020
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-042

Subject: UDQE for previously completed RHINO software change requests (SCRs) that were not evaluated according to the RHLLW change control process

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 Request (SCR) shall be subject to 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. During preparation of the first ASR, it was discovered that SCRs are not screened or evaluated through the UDQS/UDQE process prior to implementation. Even though changes to RHINO are subject to strict verification, validation, and acceptance testing, it was determined that going forward all previously approved and future SCRs will be subject to the UDQS/UDQE process. Three SCRs had been approved before issuance of the first ASR and are listed below:

- **SCR-RHINO-002** added the capability to remove a vault from service to RHINO. For example, the HFEF-5 vault array has 12 storage locations in each vault, a single storage location may need to be removed from service without removing the whole vault from service. Previous to the change only an entire vault could be removed from service. This change added the capability to remove part of a vault from service.

- **SCR-RHINO-003** added a missing parameter for one of the PA checks performed by RHINO. The canister 10% inventory threshold check failed in RHINO when a radionuclide inventory in the canister was under the 10% activity level contained in Table 18 of INL/EXT-18-45184 (2018). The 10% threshold is canister specific and the PA check in RHINO is calculating it as cumulative.

- **SCR-RHINO-005** updated use of the correct table for performing a WAC check for HFEF-5 canisters generated after 4/21/2015. Appendix A of PLN-5446, Waste Acceptance Criteria for the Remote Handled Low-Level Waste Disposal Facility, contains nuclear safety-derived radionuclide limits established by generator and waste type. RHINO was using the incorrect table for waste generated after 4/21/15. RHINO was using either Table A-7 or Table A-8 depending on waste type instead of using Table A-9 for newly generated waste.

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 three previously completed SCRs underwent appropriate reviews under the subcontractor's configuration management plan, accompanied by the required acceptance-testing reviews and tested by the INL Site contractor BEA according to PLN-5579, "Acceptance Test Plan for the RHINO Database". An Unreviewed Safety Question screening was performed for each SCR and each SCR was screened negative, meaning the change does not involve a temporary or permanent change in the facility as described in the existing documented safety analysis, does not involve a temporary or permanent change in procedures as described in the existing documented safety analysis and does not involve a test or experiment not described in the existing documented safety analysis. These changes, as well as any errors or deficiencies identified that necessitated changes, do not impact the assumption and/or the conclusion of the PA and CA or impact the validity of the RWMB and ODAS. Since RHINO performs checks based on cumulative inventory as well as canister inventory, any adverse impacts to the PA would have been evident as acceptance tests were performed for subsequent canisters using updated versions of RHINO.

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	08/18/2020
Print/Type Name Originator/FDS	Signature Originator/FDS	Date
Larry Evens	Larry Evens	08/18/2020
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	

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 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 2020 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 results are documented in the following reports:

- Lab Data Report for Sample Data Group: BEA01-2123-01, Work Order: 510368
- Limitations and Validation Report: AR0005_BEA01-2123-01_LVR for Idaho National Laboratory.

Lysimeter sample results are documented in the following reports:

- Lab Data Report for Sample Data Group: BEA01-2085-01, Work Order: 509492
- Radioanalytical Limitations and Validation Report: AR0006_BEA01-2085-01_LVR_REV01 for Idaho National Laboratory
- Lab Data Report for Sample Data Group: BEA01-2086-01, Work Order: 515457
- Radioanalytical Limitations and Validation Report AR0008_BEA01-2086-01_LVR for Idaho National Laboratory
- Lab Data Report for Sample Data Group: BEA01-2091-01, Work Order: 513322
- Radioanalytical Limitations and Validation Report AR0007_BEA01-2091-01_LVR for Idaho National Laboratory.

All aquifer and lysimeter results are uploaded and stored in the INL Environmental Data Warehouse.

Table B-1 contains aquifer sampling results for RHLLW Disposal Facility-compliance monitoring wells for FY 2020.

Table B-2 presents average aquifer concentrations in RHLLW Disposal Facility compliance monitoring wells for FY 2020. Table B-3 presents a summary of RHLLW Disposal Facility lysimeter sample volumes and sampling results for FY 2020.

Table B-1. Aquifer sampling results for RHLLW Disposal Facility compliance monitoring wells for FY 2020.

Constituent	Result Type	Date Collected	Concentration (pCi/L)	Uncertainty	Validation Qualifier
Well USGS-136					
Gross alpha	Original	04/27/20	1.19	0.568	UJ
	Field Duplicate	04/27/20	1.73	0.496	
Gross beta	Original	04/27/20	1.19	0.324	
	Field Duplicate	04/27/20	1.73	0.505	UJ
C-14	Original	04/27/20	-4.9	10.8	U
	Field Duplicate	04/27/20	-3.83	10.8	U
H-3	Original	04/27/20	961	137	
	Field Duplicate	04/27/20	902	130	
I-129	Original	04/27/20	-0.126	0.164	U
	Field Duplicate	04/27/20	0.106	0.135	U
Tc-99	Original	04/27/20	8.4	12.6	U
	Field Duplicate	04/27/20	9.59	12.4	U
Well USGS-140					
Gross alpha	Original	04/28/20	1.88	0.671	
Gross beta	Original	04/28/20	1.84	0.456	
C-14	Original	04/28/20	-4.88	1.18	U
H-3	Original	04/28/20	964	191	
I-129	Original	04/28/20	-0.483	0.0273	U
Tc-99	Original	04/28/20	7.72	1.86	U
Well USGS-141					
Gross alpha	Original	04/28/20	1.52	0.535	UJ
Gross beta	Original	04/28/20	1	0.361	UJ
C-14	Original	04/28/20	-6.55	10.8	U
H-3	Original	04/28/20	815	124	
I-129	Original	04/28/20	0.0407	0.13	U
Tc-99	Original	04/28/20	2.49	13.4	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 2020.

Well	Average Sample Result (pCi/L)[a]					
	Gross alpha	Gross beta	C-14	H-3	I-129	Tc-99
USGS-136	1.73	1.19	U	961	U	U
USGS-140	1.88	1.84	U	964	U	U
USGS-141	UJ	UJ	U	815	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 do not include duplicate sample data unless the analyte was detected in the duplicate sample, but not detected in the original sample. In this case the average is the result of the duplicate sample.
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/yr critical organ dose for beta/photon emitters.
c. *Assessment of Aquifer Baseline Conditions at the INL RHLLW Disposal Facility* (INL 2017b).

Table B-3. Summary of RHLLW Disposal Facility lysimeter sampling results for FY 2020.

Lysimeter	Total Sample Volume (mL)	Sample Result (pCi/L)					
		Gross alpha	Gross beta	C-14	H-3	I-129	Tc-99
Shallow Alluvium Lysimeters (26–29 ft below land surface)							
PA-North	1677[a]	**13.4**	8.86 (J)	UJ	880	U	U
PA-North (Dup)		8.8	6.98 (J)	U	788	UJ	---
PA-South	263	6.74	7.04 (J)	---	---	---	---
NuPac-West	1500[a]	2.33	1.40 (J)	U	261	U	U
NuPac-West (Dup)		2.15	UJ	UJ	---	U	---
NuPac-East	1025[a]	U	UJ	U	845	U	U
55-ton-South	1191[a]	1.35	1.71 (J)	U	U	U	U
55-ton-South (Dup)		1.62	UJ	---	---	---	---
HFEF-South	847	3.33	U	U	**47,100**	U	U
LCC-West	760	U	U	U	797	U	U
LCC-East	664	1.34	UJ	U	U	U	U
MFTC-West	1095[a]	UJ	UJ	U	327	U	U
MFTC-West (Dup)		1.34	1.22 (J)	---	---	---	---
MFTC-East	1426[a]	1.80	UJ	UJ	U	U	U
MFTC-East (Dup)		1.65	UJ	U	---	U	---
Deep Alluvium Lysimeters (40–43 ft below land surface)							
NuPac-West-45	20[c]	**11.6**	10.9	U	UJ	U	U
NuPac-East-45	16[c]						
55-ton-South-45	33[c]						
HFEF-South-45	174[c]						
LCC-West-45	278[c]						
LCC-East-45	88[c]						
MFTC-West-45	11[c]						
MFTC-East-45	0						
Sedimentary Interbed Lysimeters (170–176 ft below land surface)							
NuPac-SIW	0	---	---	---	---	---	---
MFTC-West-SIW	221	7.71	11.3	---	---	---	---
MFTC-East-SIW (1)	745	U	20.6	U	U	U	U
MFTC-East-SIW (2)[b]	535	U	24.2	U	U	U	U
Action Level		10[d]	40[d]	2000[e]	20000[e]	1[e]	900[e]

a. Sample volume sufficient for full suite of analytes and duplicates (Dup) of many or most analytes.
b. Sample is independent sample collected on a different day (not a duplicate).
c. Sample volumes from seven lysimeters combined into single sample volume (620 ml) for analysis.
d. Action level (PLN-5501)
e. Groundwater maximum contaminant level (IDAPA 58.01.11)

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 or groundwater maximum contaminant level (see footnotes d and e).