

Final Design Report for the RH LLW Disposal Facility (RDF) Project

Project File: 31055

May 2015



The INL is a U.S. Department of Energy National Laboratory
operated by Battelle Energy Alliance

DISCLAIMER

This information was prepared as an account of work sponsored by an agency of the U.S. Government. Neither the U.S. Government nor any agency thereof, nor any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness, of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. References herein to any specific commercial product, process, or service by trade name, trade mark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the U.S. Government or any agency thereof.

Final Design Report for the RH LLW Disposal Facility (RDF) Project

Project File: 31055

May 2015

**Idaho National Laboratory
Idaho Falls, Idaho 83415**

<http://www.inl.gov>

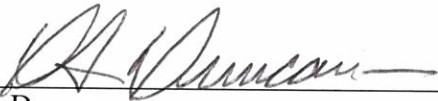
**Prepared for the
U.S. Department of Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517**

Final Design Report for the RH LLW Disposal Facility (RDF) Project

INL/EXT-15-34701
Revision 1

Project File: 31055
May 2015

Approved by:



D. S. Duncan
Project Manager

5/13/15


Date



G.R. Tarbet
Design Authority

5-13-15

Date



S.L. Austad
Project Engineer

5.13.15

Date

CONTENTS

1.	Overview.....	2
2.	BEA Review Process.....	2
3.	Final Design Report Documents.....	2
3.1	General Deliverables.....	2
3.2	Infrastructure Deliverables.....	3
3.2.1	Drawings.....	3
3.2.2	Construction Specifications.....	3
3.2.3	Design Support Information.....	3
3.2.4	Performance Specifications.....	4
3.2.5	Miscellaneous.....	4
3.3	Vault System Deliverables.....	4
3.3.1	Drawings.....	4
3.3.2	Construction Specifications.....	5
3.3.3	Design Support Information.....	5
3.3.4	Concrete Mix Design.....	5
3.3.5	Miscellaneous.....	6
3.4	Ancillary Equipment Deliverables.....	6
3.4.1	Drawings.....	6
3.4.2	Design Support Information.....	6

FINAL DESIGN REPORT FOR THE RH LLW DISPOSAL FACILITY (RDF) PROJECT

1. Overview

The RH LLW Disposal Facility (RDF) Project was designed by AREVA Federal Services (AFS) and the design process was managed by Battelle Energy Alliance (BEA) for the Department of Energy (DOE). The final design report for the RDF Project is a compilation of the documents and deliverables listed in Appendix A.

2. BEA Review Process

A preliminary review (60%) kickoff was held on November 3, 2014. The review was conducted using the BEA electronic change request (eCR) review system. Comments and resolutions for the preliminary review are included in eCR 627027 as "Review Number 1." A final design review (90%) kickoff was held on December 10, 2014. The review process used the electronic eCR system to track comments, resolutions, and acceptance. Final documents will be uploaded to the eCR system for final concurrence after the DOE review is complete. Copies of review comments are provided electronically with other design documentation on CD-ROM to support the scheduled DOE review and can be found in each main design deliverable folder (Infrastructure, Vault System, and Ancillary Equipment System).

3. Final Design Report Documents

Components of the final design are organized into four main sections: General, Infrastructure, Vault System, and Ancillary Equipment.

3.1 General Deliverables

Undated Project Definition Rating Index (PDRI): The PDRI was updated to reflect the status at CD 2/3.

Construction Safety and Health Plan (TOC-732): Consists of the Subcontractor Requirements Manual (SRM) effective documents list, the 1000-, 2000-, and 8000- series requirements documents from the SRM.

Code of Record (INL/EXT-10-20044): The Code of Record was updated to reflect the actual scope of building types and materials used in the final design of the project.

Approved Construction Field Problems (CFPs) and Project Addendums: Included in the final design report are the approved CFPs that document any scope or requirement changes to the project contract documents and the project addendums.

Constructability Review: AFS coordinated a constructability review during the final design review. The review was conducted by Curt Ulferts, a construction consultant to AFS, and DelHur Industries, a teaming partner to AFS on the Project.

Construction Plan: This plan describes the approach that AFS will employ to systematically plan for, construct and deliver the RDF, thus ensuring that the nuclear safety, quality, specifications, and contract requirements are satisfied in full.

Startup Test Plan: This plan will be developed in accordance Section 5.3 of DOE G 413.3-9 to confirm the ability of the facility to operate by assessing and verifying system performance, environmental permit conditions, and safety requirements. This plan is not a final design review deliverable and is not shown on the list in Appendix A. It is anticipated that this plan will be complete by June 2015 based on approved design documentation and detailed construction planning.

3.2 Infrastructure Deliverables

The Project Infrastructure Deliverables include drawings; performance and construction specifications; calculations; engineering information records (EIRs); and vendor data schedules. The construction scope is divided into several different specification and drawing packages to complement the construction and bidding strategy. Stand-alone performance specifications will be used to procure the design and fabrication of the metal building systems for the Admin and Maintenance Buildings. Stand-alone performance specifications procure the design and installation of the fire alarm and fire sprinkler systems for the buildings. The scope of each document is described below.

3.2.1 Drawings

Infrastructure Drawings (788748 – 788912): The infrastructure drawings include the construction drawings for the installation of the buildings, site work including surface grading, sediment and erosion control, fencing, roadwork, monitoring wells, exterior lighting, and utilities.

3.2.2 Construction Specifications

Admin Building Construction Specification (RH LLW-SPC-00006 / SPC-1858): This specification accompanies the Infrastructure Drawings and includes the installation of the Admin Building, including architectural scope, HVAC, piping, plumbing fixtures, lighting, power distribution, lightning protection, and telecom/data.

General Site Construction Specification (RH LLW-SPC-00008 / SPC-1860): This specification includes underground utilities (potable, sewer, fire water, electrical, telecom, data, and security), and site work (fencing, sidewalks and slabs, road work, surface grading). This specification will also accompany the Infrastructure Drawings.

Maintenance Building Construction Specification (RH LLW-SPC-00007 / SPC-1859): This specification accompanies the Infrastructure Drawings and includes the installation of the Maintenance Building, including architectural and structural scope, HVAC, piping, plumbing fixtures, lighting, power distribution, lightning protection, and telecom/data.

3.2.3 Design Support Information

Mechanical Design Calculation (RH LLW-CALC-00008 / ECAR-2813): This document includes the sizing studies for the plumbing and HVAC systems for the new buildings and includes equipment data sheets for specific components used in the mechanical design. It also documents the building energy analyses, water usage documentation.

Electrical Calculation (RH LLW-CALC-00007 / ECAR-2812): This calculation documents the electrical distribution design established in the SKM modeling.

Civil Design Calculation (RH LLW-CALC-00010 / ECAR-2815): Calculations include roadway structural section design, vault yard layout design, and storm drain swale sizing.

Electrical Design Support Calculation (RH LLW-CALC-00011 / ECAR-2816): This calculation includes the lightning risk assessment for the Admin and Maintenance Buildings and photometric assessments for the building interiors and exteriors.

Architectural Design Support Detail (RH LLW-EIR-00002 / TEV-2454): This engineering information record includes the building code analysis, daylighting analysis, and architectural energy conservation analysis.

Admin and Maintenance Buildings Foundation Calculations (RH LLW-00003 / ECAR-2892): The calculations document the foundation design for both buildings, consisting of reinforced concrete footings, grade walls, and concrete slab-on-grade floors.

SKM Electrical Design Model Results: The SKM native model files were transmitted to BEA and reviewed. Included in this deliverable are various analysis reports generated by BEA indicating that appropriate sizes and ratings have been used for breakers, fuses, cables, and transformers.

3.2.4 Performance Specifications

Admin Building Performance Specification (RH LLW-SPC-00001 / SPC-1861): The Admin Building structure will be a pre-fabricated metal building system, comprised of rigid and portal frames enclosed with metal roofing and metal wall panels. The Admin Building will also have column-supported canopies for protecting exterior doorways. This specification includes design, analysis, shop drawings, and fabrication of the building metal building system, metal wall panels, and metal roofing. This specification does not include installation of the metal building system.

Maintenance Building Performance Specification (RH LLW-SPC-00002 / SPC-1862): The Maintenance Building structure will be a pre-fabricated metal building system, comprised of rigid and portal frames enclosed with metal roofing and metal wall panels. The Maintenance Building will also have column-supported canopies for protecting exterior doorways. This specification includes design, analysis, shop drawings, and fabrication of the building metal building system, metal wall panels, and metal roofing. This specification does not include installation of the metal building system.

Fire Alarm Performance Specification (RH LLW-SPC-00004 / SPC-1864): This specification includes the requirements for design, shop drawings, material, and installation of the project fire alarm system.

Fire Sprinkler Performance Specification (RH LLW-SPC-00003 / SPC-1863): Specification scope includes design, analysis, shop drawings, material, fabrication, and installation of the fire sprinkler system for the Maintenance Building.

3.2.5 Miscellaneous

Infrastructure Vendor Data Schedules: Included are the vendor data schedules for each specification.

Utilities Tie-in Subsurface Investigation Report: Included in the subsurface investigation report for the utilities tie-in.

USQ Evaluation for Utilities Tie-in Installation (ATR Complex-USQ-2014-539): A USQ has been performed for the tie-in to the ATR utility systems (fire water, potable water, power, etc.)

Building Septic System Permit (Vendor Data): Copies of the Septic System Permit application and approval forms have been provided for information.

3.3 Vault System Deliverables

The vault system consists of the prefabricated, precast concrete vaults and vault plugs, and the vault backfill material. The precast vaults fabrication is performed in accordance with a vault fabrication construction specification and vault fabrication drawings. Installation is performed in accordance with the vault installation specifications and drawings.

3.3.1 Drawings

Vault Installation Drawings (RH LLW-DRAW-0001 – 0016 / 788643 – 788658): Scope of drawings package includes installation of prefabricated, precast vaults and vault backfill material.

Vault Fabrication Drawings (Vendor Data): These drawings include the shop drawings to which the precast vaults will be fabricated.

3.3.2 Construction Specifications

Construction Specification – Vault Fabrication (RH LLW-SPC-00005 / SPC-1857): Scope includes fabrication of the precast concrete vaults.

Construction Specification – Vault Installation (RH LLW-SPC-00014 / SPC-1910): Scope includes installation of the precast concrete vaults and vault backfill materials, including pea gravel, controlled low-strength material, drainage course, and native alluvium.

3.3.3 Design Support Information

Vault System Design Description (SDD-410): Provides the system design description as required for Hazard Category 2 nuclear facility safety systems. SDDs identify the requirements associated with structures, systems, and components, explains why those requirements exist (that is, provides the bases for the requirements), and describes the features of the system design provided to meet those requirements. As part of a configuration management change control process, the SDD helps ensure consistency among the engineering requirements for systems, the actual installed physical configuration, and the associated documentation.

Vault System Structural Design (RH LLW-CALC-00001 / ECAR-2810): The purpose of this calculation is to document the structural design of the RH-LLW pre-cast concrete disposal vaults for the required dead, live, and seismic loads including code-driven combinations thereof.

Vault System Minimum Reinforcement and Lifting Lug Design (RH LLW-CALC-00005 / ECAR-2744): This set of calculations documents the detailed design of the precast concrete RH-LLW Disposal Vault System including minimum reinforcement and lifting lug design.

Vault Plug and CVAS Shielding Analysis (RH LLW-CALC-00006 / ECAR-2747): This document provides shielding calculations for the Remote Handled Low Level Waste (RH-LLW) including:

1. Calculation of shielding provided by the five foot vault plug.
2. Calculation of exposure rates from most limiting operational steps associated with ancillary equipment.
3. Estimation of source terms from historical contact canister dose rates.

3.3.4 Concrete Mix Design

Vault Concrete Selection Report (RH LLW-EIR-00014 / PLN-4952): The purpose of this evaluation is to provide the explanation for selection of the concrete mix designs to be used for the RH LLW precast concrete disposal vaults.

Vault Concrete Durability Test Plan (RH LLW-TEST-00002 / PLN-4867): This test plan provides the requirements for testing the Concrete Mix Design provided in AFS Document RH LLW-EIR-00001, RH LLW Vault Concrete Mix Design. The mix tested was developed in accordance with BEA Specification SPC-1437. The mix design was tested to provide parameters to support strength and durability requirements for the vault components.

Vault Concrete Mix Design Report (RH LLW-EIR-00001 / PLN-4953): This document documents the precast vault concrete mix design.

Vault Concrete Safety-Related Design Parameters (RH LLW-EIR-00013 / PLN-4954): This document discusses the Safety Related parameters associated with vault concrete and provides the safety-related test results. The concrete durability parameters are provided in RH LLW-EIR-00014, Vault Concrete Durability Report.

Vault Concrete Safety-Related Test Plan (RH LLW-TEST-00001 / PLN-4955): This test plan provides the requirements for testing safety related characteristics of the concrete mix design provided in AFS Document RH LLW-EIR-00001, Vault Concrete Mix Design. The mix tested was developed in accordance with BEA Specification SPC-1437. The mix design was tested to ensure safety-related parameters are provided to support the vault plug design and shielding calculations.

Vault Hydraulic and Concrete Performance Analysis: This document provides quantitative assessments of vault area hydraulic and concrete performance for precast concrete vault components. The analyses are provided to evaluate the final vault area and concrete design against the requirements of the Design-Build-Operate Performance Specification (SPC-1437, 2011).

3.3.5 Miscellaneous

Vault Vendor Data Schedules: Included are the vendor data schedules for each specification.

Vault Array Summary Table: This table is an updated version of the vault scope table provided in the TFR.

3.4 Ancillary Equipment Deliverables

3.4.1 Drawings

Ancillary Equipment Drawings (791350 – 791353): Includes CVAS drawings for the HFEF-5 and Modified FTC casks, and the arrangement and alignment guide drawings for the NuPac 14210 cask.

3.4.2 Design Support Information

Ancillary Equipment Design (RH LLW-EIR-00009 / TEV-2339): This document provides the inputs, requirements, assumptions and results for the RH-LLW Vault Canister emplacement system for the HFEF-5, Modified-FTC and 14-210L casks.

3.5 Summary

The design meets the requirements as specified in the T&FR 483 and the SPC-1437 as verified by internal BEA design reviews and DOE design review.

Appendix A

RH LLW Disposal Facility Project Final Design Review Deliverables

RH LLW Disposal Project Final Design Review Package

(DOE Review CD-ROM Contents)

Deliverable	Folder	AREVA Document #	BEA Document # (if applicable)
General			
Updated Project Definition Rating Index (PDRI)	\\1-General\\A-PDRI	N/A	N/A
Construction Safety & Health Plan (site SRM)	\\1-General\\B-Construction Safety & Health Plan	N/A	TOC-732
Code of Record Update	\\1-General\\C-Code of Record	N/A	INL/EXT-10-20044
Technical and Functional Requirements Update	\\1-General\\D-TFR	N/A	TFR-483
Design-Build-Operate Performance Specification	\\1-General\\E-Design Building Specification	N/A	SPC-1437
Constructability Review	\\1-General\\F-Constructability Review	N/A	N/A
Construction Plan	\\1-General\\G-Construction Plan	RH- LLW-CNP-0001, Rev A	N/A
LFRG Approval of Design-Build Approach	\\1-General\\H-LFRG Approval	N/A	N/A
Preliminary Disposal Authorization Statement	\\1-General\\I-Prelim Disposal Auth	N/A	N/A
Interim Cover Considerations Report	\\1-General\\J-Interim Cover Considerations	N/A	N/A
Contract Addendums	\\1-General\\K-CFPs & Addendums	N/A	N/A
Approved Construction Field Problems (CFPs)	\\1-General\\K-CFPs & Addendums	N/A	N/A
Construction Quality Inspection Plans	N/A	RH LLW-EIR-00020	PLN-4957
Infrastructure			
Review Comments & Resolutions			
Infrastructure Review Comments & Resolutions	\\2-Infrastructure_Review Comments & Resolutions\\	N/A	N/A
Drawings			
Infrastructure Drawings	\\2-Infrastructure\\A-Infrastructure Drawings\\	RH LLW-DRAW-0030 – 0194	788748 - 788912
Construction Specifications			
Admin Building Construction Specification	\\2-Infrastructure\\B-Construction Specs (Admin, Maint, Gen)\\Admin\\	RH LLW-SPC-00006	SPC-1858
General Site Construction Specification	\\2-Infrastructure\\B- Construction Specs (Admin, Maint, Gen)\\General Site\\	RH LLW-SPC-00008	SPC-1860
Maintenance Building Construction Specification	\\2-Infrastructure\\B- Construction Specs (Admin, Maint, Gen)\\Maintenance\\	RH LLW-SPC-00007	SPC-1859
Design Support Information			

**BEA Document #
(if applicable)**

Deliverable

Folder

AREVA Document #

**BEA Document #
(if applicable)**

Administration/Maintenance Building Foundation Design	2-Infrastructure\C-Foundation Calcs\	RH LLW-CALC-00003	ECAR-2892
Mechanical Design Support Information	2-Infrastructure\D-Mech Calculations\	RH LLW-CALC-00008	ECAR-2813
Electrical Design Support Information	2-Infrastructure\E-Elec Calculations\	RH LLW-CALC-00007	ECAR-2812
Civil Design Calculation	2-Infrastructure\F-Civil Calculations\	RH LLW-CALC-00010	ECAR-2815
Electrical Design Support Calculation	2-Infrastructure\E-Elec Calculations\	RH LLW-CALC-00011	ECAR-2816
Architectural Design Support Detail	2-Infrastructure\G-Arch Information (EIR)	RH LLW-EIR-00002	TEV-2454
SKM Electrical Design Model Results	2-Infrastructure\H-Final SKM Model\	N/A	N/A
Performance Specifications			
Admin Building Performance Specification	2-Infrastructure\I-Admin Bldg Perf Spec\	RH LLW-SPC-00001	SPC-1861
Maintenance Building Performance Specification	2-Infrastructure\J-Maint Bldg Perf Spec\	RH LLW-SPC-00002	SPC-1862
Fire Sprinkler Performance Specification	2-Infrastructure\L-Fire Sprinkler Perf Spec\	RH LLW-SPC-00003	SPC-1863
Fire Alarm Performance Specification	2-Infrastructure\K-Fire Alarm Perf Spec\	RH LLW-SPC-00004	SPC-1864
Miscellaneous			
Utilities Tie-in Subsurface Investigation Report	2-Infrastructure\M-Subsurface Investigation	N/A	N/A
USQ Evaluation for Utilities Tie-in Installation	2-Infrastructure\N-USQ Evaluation for Utilities Tie-In Installation	N/A	ATR Complex-USQ-2014-539
Building Septic System Permit	2-Infrastructure\F-Civil Calculations\	N/A	N/A
Vault System			
Review Comments & Resolutions			
Vault System Review Comments & Resolutions	3-Vaults_Review Comments & Resolutions\	N/A	N/A
Drawings			
Vault Installation Drawings	3-Vaults\A- Vault System Drawings\	RH LLW-DRAW-0001 - 0016	788643 – 788658
Vault Fabrication Shop Drawings	3-Vaults\A- Vault System Drawings\	RH LLW-DRAW-0200 - 220	N/A
Construction Specifications			
Vault Construction Specification - Vault Installation	3-Vaults\B-Construction Specs\	RH LLW-SPC-00014	SPC-1910
Vault Construction Specification - Vault Fabrication	3-Vaults\B-Construction Specs\	RH LLW-SPC-00005	SPC-1857
Design Support Information			
System Design Description	3-Vaults\J-SDD\	N/A	SDD-410
Vault Plug and CVAS Shielding Analysis	3-Vaults\I-Shielding Calcs\	RH LLW-CALC-00006	ECAR-2747
Vault System Structural Design	3-Vaults\C-Structural Calcs\	RH-LLW-CALC-00001	ECAR-2810

Deliverable	Folder	AREVA Document #	BEA Document # (if applicable)
Vault System Minimum Reinforcement and Lifting Lug Design	\3-Vaults\C-Structural Calcs\	RH-LLW-CALC-00005	ECAR-2744
Concrete Mix Design & Related Documents			
Vault Concrete Selection Report	\3-Vaults\H-Other Concrete Related Documents \	RH LLW-EIR-00014	PLN-4952
Vault Concrete Durability Test Plan	\3-Vaults\G-Vault Concrete Durability Test Plan\	RH LLW-TEST-00002	PLN-4867
Vault Concrete Mix Design Report:	\3-Vaults\E-Mix Design\	RH LLW-EIR-00001	PLN-4953
Vault Concrete Safety-Related Design Parameters	\3-Vaults\F-Vault Concrete Safety Related Test Plan \	RH LLW-EIR-00013	PLN-4954
Vault Concrete Safety-Related Test Plan	\3-Vaults\ F-Vault Concrete Safety Related Test Plan \	RH LLW-TEST-00001	PLN-4955
Vault Compliance Test Plan	\3-Vaults\ H-Other Concrete Related Documents\	RH LLW-TEST-00003	PLN-4956
Vault Hydraulic and Concrete Performance Analysis	\3-Vaults\ H-Other Concrete Related Documents\	N/A	N/A
Miscellaneous			
Vault Array Summary Table	\3-Vaults\D-Vault Summary Table\	RH LLW-EIR-00015	N/A
Ancillary Equipment			
Review Comments & Resolutions			
Ancillary Equipment Review Comments & Resolutions	\4-Ancillary Equipment_Review Comments & Resolutions\	N/A	N/A
Design			
Ancillary Equipment Design	\4-Ancillary Equipment\A-Design\	RH LLW-EIR-00009	N/A
Cask Seismic Stability Evaluation	N/A	RH LLW-CALC-00013	ECAR-2878
Drawings			
Ancillary Equipment Drawings	\4-Ancillary Equipment\B-Design Drawings\	RH LLW-DRAW-0230 - 0242	INL Drawing 791350 - 791353
Crane			
Manitowoc Crane Report	\4-Ancillary Equipment\C-Crane Report\	N/A	TEV-2339

