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Revision 2

Safety Design Strategy for the Remote-Handled Low-Level Waste Disposal Project

October 2010

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Safety Design Strategy for the Remote-Handled Low-Level Waste Disposal Project

October 2010

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Prepared for the
U.S. Department of Energy
Assistant Secretary for Nuclear Energy
Under DOE Idaho Operations Office
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ABSTRACT

In accordance with the requirements of U.S. Department of Energy (DOE) Order 413.3B, "Program and Project Management for the Acquisition of Capital Assets," safety must be integrated into the design process for new or major modifications to DOE Hazard Category 1, 2, and 3 nuclear facilities. The intended purpose of this requirement involves the handling of hazardous materials, both radiological and chemical, in a way that provides adequate protection to the public, workers, and the environment. Requirements provided in DOE Order 413.3B and DOE Order 420.1B, "Facility Safety," and the expectations of DOE-STD-1189-2008, "Integration of Safety into the Design Process," provide for identification of hazards early in the project and use of an integrated team approach to design safety into the facility. This safety design strategy provides the basic safety-in-design principles and concepts that will be used for the Remote-Handled Low-Level Waste Disposal Project.

NOTE:

This document presents the safety design strategy for processes associated with onsite handling and disposal of remote-handled low-level waste. A new onsite facility has been identified as an alternative for providing continued remote-handled low-level waste disposal capability in support of ongoing Department of Energy missions at the Idaho site. However, a decision has not been made by the Department of Energy to develop a new onsite disposal facility. The decision, following all required analyses and evaluation of the impacts of all viable alternatives, will be made in accordance with the National Environmental Policy Act of 1969. Use of words indicating requirements or specifying intention, such as "shall" or "will," are used for the convenience of discussion or to indicate requirements or activities that are conditioned on a decision to develop a new onsite disposal facility. Such usage should not be construed to mean that a final selection of an alternative has been made.

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ACRONYMS

ATR	Advanced Test Reactor
DOE	Department of Energy
HC	hazard category
INL	Idaho National Laboratory
IPT	Integrated Project Team
LLW	low-level waste
NRF	Naval Reactors Facility
RWMC	Radioactive Waste Management Complex
SDC	seismic design category

Safety Design Strategy for the Remote-Handled Low-Level Waste Disposal Project

1. PURPOSE

In accordance with Department of Energy (DOE)-STD-1189-2008, "Integration of Safety Into the Design Process," this safety design strategy for the Remote-Handled Low-Level Waste (LLW) Disposal Project at the Idaho National Laboratory (INL) describes the overall safety strategy; describes the strategy for certain high-cost, safety-related design decisions; identifies key assumptions or inputs that may represent potential risks to design decisions; and identifies expected safety deliverables through the project. In accordance with the requirements of DOE Order 413.3B, "Program and Project Management for the Acquisition of Capital Assets," safety must be integrated into the design process for new or major modifications to DOE Hazard Category (HC) 1, 2, and 3 nuclear facilities. Safety analysis documentation will meet the requirements of 10 CFR 830, "Nuclear Safety Management," Subpart B, "Safety Basis Requirements."

2. DESCRIPTION OF PROJECT

As part of ongoing cleanup activities at INL, closure of the Radioactive Waste Management Complex (RWMC) is proceeding under the Comprehensive Environmental Response, Compensation, and Liability Act (42 USC 9601 et seq. 1980). Disposal of remote-handled LLW in concrete disposal vaults at RWMC will continue until the facility is full or until it is closed in preparation for final remediation of the Subsurface Disposal Area (approximately at the end of Fiscal Year 2017).

The continuing nuclear mission of INL, associated ongoing and planned operations, and Naval spent nuclear fuel activities at the Naval Reactors Facility (NRF) require continued capability to appropriately dispose of remote-handled LLW. Development of a new onsite disposal facility for the disposal of INL and tenant-generated remote-handled LLW has been identified as being needed to provide continued, uninterrupted INL remote-handled LLW disposal capability. The need for this proposed Remote-Handled LLW Disposal Project is to have replacement disposal capacity in place by the end of Fiscal Year 2017.

The proposed Remote-Handled LLW Disposal Project will be designed and constructed similar to the remote-handled LLW concrete disposal vaults currently in use in the RWMC Subsurface Disposal Area. This will accommodate, to the maximum extent possible, uninterrupted operations at the generating facilities and will capitalize on the operations experience and cost efficiencies of current remote-handled LLW disposal practices. The vaults will be constructed of precast concrete cylinders (i.e., pipe sections) stacked on end and placed in a honeycomb-type array (see Figure 1). A removable concrete plug will be set on top of the stacked precast concrete cylinders to serve as a radiation shield and water barrier.

2.1 Operational Overview

Remote-handled LLW destined for disposal will be packaged into shielded transportation packages with waste containers. The waste containers will normally consist of cylindrical containers designed specifically for the transportation package systems used. It is assumed that remote-handled LLW will be transported from NRF to the proposed disposal facility in the same 55-ton scrap cask that is currently used at RWMC. Operations involving this cask will be substantially the same as those used at RWMC. The operational systems associated with transportation packages and transfer systems used by other INL generators will be determined once specific waste container designs and transportation package systems are identified.

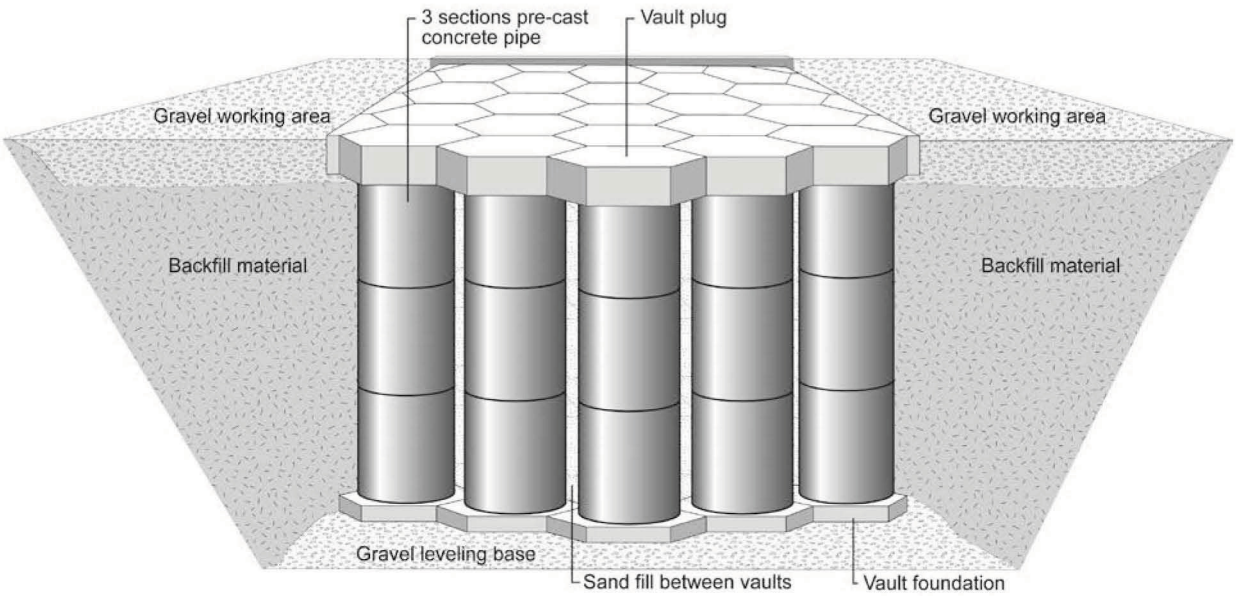

Figure 1. Concrete vault layout.

2.2 Anticipated Waste Streams

Anticipated waste for this project consists of remote-handled LLW from a variety of sources, nonhazardous activated metals, and resins. Descriptions of the waste streams from specific generating facilities and waste stream characterization data are provided in INL/EXT-09-17152, *Remote-Handled Low-Level Waste Disposal Project Alternatives Analysis* (INL 2010b).

Ion-exchange resins from pool and reactor operations are generated at the Advanced Test Reactor (ATR) Complex and from pool operations at NRF. ATR ion-exchange resin is generated approximately four to six times annually from reactor loop and reactor ion-exchange systems. The generation rate depends on reactor operations and also varies during the years when core internal changeouts are performed. The ion-exchange resin waste streams have typical contact exposure rates up to 15 R/hour, although individual waste containers may have higher contact exposure rates.

The ATR Complex also produces activated metals during reactor core internal changeout operations, approximately every eight years. These components require decay time before they can be handled for disposal and are currently in temporary storage at the ATR Complex. NRF produces activated metals from examination of test components and during routine operations removing irradiated non-fuel components from spent nuclear fuel modules. The activated metals waste streams have typical contact exposure rates up to 30,000 R/hour, although individual waste containers may have higher contact exposure rates.

In addition, activated metals and other remote-handled LLW streams are expected from new INL programs and from processing of remote-handled waste stored at the Radioactive Scrap and Waste Facility, which is located at the Materials and Fuels Complex. These materials can contain a variety of radionuclides and can have contact exposure rates up to 30,000 R/hour, although individual waste containers may have higher contact exposure rates.

2.3 Facility Layout

Facility configuration for the proposed Remote-Handled LLW Disposal Project is similar to the existing vault design and configuration that is currently present at RWMC. This facility includes concrete vaults, vault plugs, access roads, and support infrastructure. Figure 2 shows the proposed layout for the new Remote-Handled LLW Disposal Project.

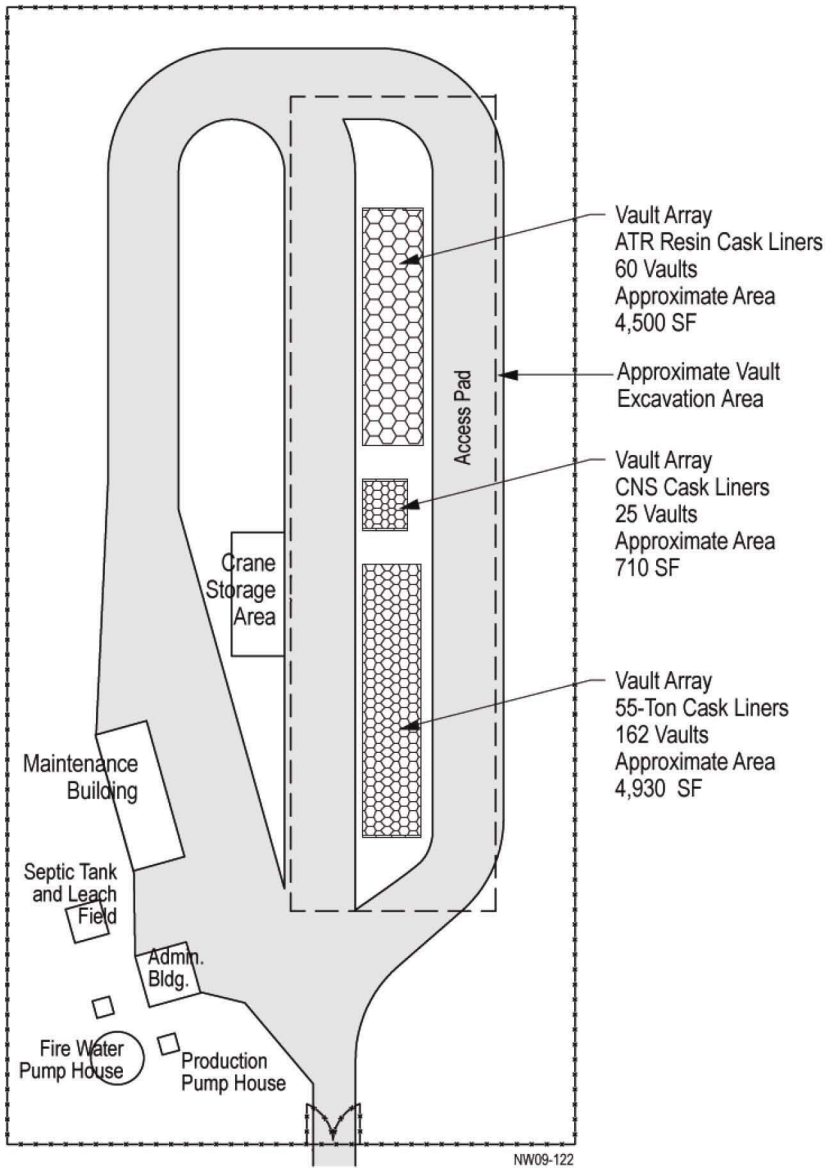

Figure 2. Proposed layout for the Remote-Handled Low-Level Waste Disposal Project.

The proposed facility layout is based on the assumption that the facility that will be constructed and operated will be a stand-alone facility and will provide its own administration buildings and infrastructure to support disposal operations. If a facility site is selected that is located in the vicinity of an existing facility, where existing buildings may be utilized, then new construction of some of the infrastructure components may not be needed (e.g., the administration building).

3. SAFETY DESIGN STRATEGY

The overall safety strategy for the Remote-Handled LLW Disposal Project is presented in the following sections.

3.1 Safety Guidance and Requirements

Conceptual design for the new Remote-Handled LLW Disposal Project is substantially based on the existing concrete disposal vaults in the RWMC Subsurface Disposal Area. In addition to providing for operational efficiencies, reliance on the existing design provides a fundamental basis for implementation of safety requirements for the new disposal facility. The basic design of the facility and corresponding operations activities consider the high radiation levels associated with the remote-handled LLW streams and minimize worker radiological exposure. The major facility components, as described in INL/EXT-07-12901, *Conceptual Design Report for the Remote-Handled Low-Level Waste Disposal Project* (INL 2010a), are the vaults, vault plugs, and cask-to-vault adapting structure (CVAS). These components, coupled with the generator transportation packaging and waste containers, provide for passive control of worker radiological exposure.

The design and safety evaluation will be completed in accordance with requirements delineated in DOE-STD-1189-2008. A tailored approach will be used where known facility hazards from the existing RWMC vaults will be used to support the preliminary hazard analysis and the conceptual safety design report. Because there are relatively no inherent radiological release hazards associated with confinement, ventilation, fire, or seismic releases from the facility, the associated hazards for this facility will be few and result in low hazard accident scenarios, as addressed in the conceptual safety design report. A detailed hazard review will be performed during the preliminary design phase that will entail a detailed review and incorporation of the existing facility operations and hazards into the preliminary safety design report. Further review of the proven design and operations that are currently ongoing will be incorporated into development of the preliminary documented safety analysis during the final design. Development of the final documented safety analysis will be completed prior to start of operations.

The facility will be designed and operated in accordance with the requirements, codes, and standards identified in TFR-483, "Remote-Handled Low-Level Waste Disposal Facility Technical and Functional Requirements," including DOE Order 420.1B "Facility Safety." Specifically, DOE Order 420.1B requires integration of design with safety analyses, adherence to nuclear facility design practices appropriate for the hazard category of the facility and operations, and implementation of a process that ensures that facility design and construction will be in compliance with the nuclear facility safety requirements of the order.

In accordance with Section C.2.4.B of the INL Contract DE-AC07-05ID14517 (INL 2004), DOE's safety expectations of the INL contractor are as follows:

1. Establish clear safety, environmental protection, health, and quality assurance priorities and manage activities consistent with those priorities

2. Use a graded approach to the program and project safety integration process

3. Have an effective employee involvement program

4. Maintain an effective Integrated Safety Management System.

The specific requirement related to management of INL remote-handled waste is delineated in Part III, Section J, Attachment P of the INL Contract DE-AC07-05ID14517 (INL 2004), that states:

> *The INL Contractor shall manage INL-generated LLW and, if directed by DOE, LLW generated by other tenants (e.g., NRF) upon closure of the RWMC LLW disposal operations...LLW management includes development of on/offsite LLW disposal capability and the supporting infrastructure.*

DOE expects the INL contractor to manage remote-handled LLW in a manner that is protective of both human health and the environment.

3.2 Hazard Identification

Hazardous material inventories for construction and operation of the Remote-Handled LLW Disposal Project are very low in comparison to other nuclear operations and are commensurate with existing RWMC remote-handled LLW disposal operations. No chemicals found in the Occupational Safety and Health Administration substance-specific standards have been identified that would create a potential for exposure triggering medical surveillance during construction or operations. Additionally, no highly hazardous chemicals, as listed in 29 CFR 1910.119, "Process Safety Management of Highly Hazardous Chemicals (Appendix A, List of Highly Hazardous Chemicals, or Toxics and Reactives)," will be generated, used, stored, or disposed of at this facility. The primary hazard associated with the facility is worker exposure to the high radiation levels associated with the waste through a variety of exposure scenarios.

The waste streams that will be accepted for storage at the Remote-Handled LLW Disposal Project must meet the requirements for LLW as specified in DOE Manual 435.1, "Radioactive Waste Management." These requirements specify that the material must contain <100 nCi/g transuranic radionuclides. The strategy for developing material-at-risk for estimating inhalation dose consequences in subsequent hazard and accident analysis will be based on these levels. In terms of direct radiation exposure consequences, the material-at-risk will be based on identifying radioactive material inventories that do not exceed the 30,000 R/hr contact exposure rate specified in the technical and functional requirements and the conceptual design report as the shielding design basis.

3.2.1 Preliminary Hazard Categorization

Based on the preliminary assessment of the anticipated remote-handled LLW streams and a comparison with DOE-STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports," the Remote-Handled LLW Disposal Project would have an initial hazard categorization of a HC-2 nuclear facility.

Operationally, the proposed facility is designed to accept shipments of remote-handled LLW (including activated metals and resins) from NRF, ATR, and other INL generators. The total Remote-Handled LLW Disposal Project radioactive material inventory anticipated to be present in the facility at a given time will exceed the HC-2 threshold quantity values for several radionuclides per DOE-STD-1027-92. However, DOE-STD-1027 supplemental guidance provides for facility categorization modification in the final hazard categorization process, considering 1) alternative release fractions or 2) change in material subject to an accident due to facility features that preclude bringing material together or causing harmful interaction from a common severe phenomenon (facility segmentation). These provisions will be further evaluated during the development of the preliminary documented safety analysis and documented safety analysis per NS-18101, "INL Safety Analysis Process," to determine if modification to the preliminary facility HC is appropriate based on alternative

release fractions or facility segmentation considerations. If the segmented facility consideration is successful, the facility may be categorized based on the contents of a single vault. Such a categorization may result in a reduced facility HC.

It also is recognized that uncertainties in waste stream characterization data may impact the facility HC. This is particularly true for potential MFC waste streams that are anticipated from new INL programs and processing remote-handled waste currently stored at the Radioactive Scrap and Waste Facility. These inventories will be further evaluated during development of the preliminary documented safety analysis and documented safety analysis and may impact the final facility HC.

3.2.2 Preliminary Hazard Identification

With respect to nuclear safety, a hazard is defined as "a source of danger (i.e., material, energy source, or operation) with the potential to cause illness, injury, or death to personnel or damage to an operation or to the environment (without regard for the likelihood or credibility of accident scenarios or consequence mitigation)." To identify potential facility hazards, the following were examined:

- Quantity, form, and location of radioactive and hazardous materials that would be potentially releasable from the proposed Remote-Handled LLW Disposal Project
- Potential energy sources and initiating events that could directly result in injury to workers or lead to release of radioactive or hazardous materials.

From review of the Remote-Handled LLW Disposal Project conceptual design report (INL 2010a) and previous lessons learned, an analysis for potential hazards was performed. The result of this analysis is found in Table 1, which presents hazards that should be considered as the design progresses and the safety basis documentation is being prepared. This table, which lists identified hazards and major safety concerns associated with these hazards, is not intended to be all inclusive and may be updated, as required.

Table 1. Preliminary hazards identified for the Remote-Handled Low-Level Waste Disposal Project.

Hazard	Hazard Source(s)	Concern
Fissionable materials	Fissionable materials in waste containers	Preliminary evaluations indicate that waste streams for the facility do not contain significant quantities of fissionable material.
Radioactive materials	Radioactive materials in waste containers	Potential radioactive material release hazard to the facility workers, the collocated workers, the offsite public, or the environment. Potential direct radiation exposure hazard to the facility workers.
Hazardous materials (e.g., toxic chemicals)	Hazardous materials(e.g., ion-exchange resins) in waste containers	Potential hazardous material release and subsequent chemical exposure hazard to the facility workers, the collocated workers, the offsite public, or the environment.
Fire and explosion	Pyrophoric metals (e.g., uranium and zirconium); flammable solid (i.e., sodium metal); combustible liquid (e.g., diesel fuel); hydrogen buildup inside waste container; combustible waste inside waste containers; and transient combustible materials	Potential fire and subsequent loss of confinement, resulting in a material release, which leads to a radiological or chemical exposure hazard to the facility workers, the collocated workers, the offsite public, or the environment.

Table 1. (continued).

Hazard	Hazard Source(s)	Concern
Electrical energy	Batteries, battery charging stations, electrical panels, electrical utilities, generators, instrumentation and controls, motor control center, static electricity in radiation detector, switchgear, and low voltage (less than 600 volts)	
Kinetic energy	Moving loads: transport truck, transportation package, payloads of transportation packages, scissors lift, vehicle impact	Potential to cause a loss of confinement, resulting in a material release, which leads to a radiological or chemical exposure hazard to the facility workers, the collocated workers, the offsite public, or the environment.
Potential energy	Suspended loads: crane, hoist, lift	
Pressure	Compressed air, pressurized hydraulic systems	
External events	Range fire, plane crash, vehicle accident	
Natural phenomena	Earthquake, severe weather (e.g., extreme wind, flood, lightning, snow load)	
Potential asphyxiants	None	No asphyxiants anticipated.
Thermal energy	Lights, heated air in support buildings	Thermal energy does not pose a direct hazard but may cause injury to facility workers.
Radiant energy	None	No radiant energy hazards anticipated.

3.3 Key Safety Decisions

Decisions will be made during the initial project life cycle that will affect the eventual design and construction of a new Remote-Handled LLW Disposal Project at INL. Those key safety decisions that could potentially result in significant cost are addressed herein along with the strategy justified consistent with the hazard categorization.

3.3.1 Seismic and Other Natural Phenomena Design Categorization

Based on an initial review of the applicable facility hazards and in accordance with ANSI/ANS-2.26-2004, "Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design," the Remote-Handled LLW Disposal Project seismic design category (SDC) will be SDC-1. This determination is based on the assumption that failure of a vault will not cause radiological material to be brought to the surface and that it will remain in place without causing significant radiological exposure to workers, the public, or the environment. As stated in the standard, no limit state identification is required for SDC-1 structures, systems, and components; therefore, seismic evaluation on the facility will be performed in accordance with the International Building Code (IBC 2009). In accordance with DOE-STD-1189-2008 requirements, other natural phenomena hazards and their impact on the Remote-Handled LLW Disposal Project design will be in accordance with DOE-STD-1020-2002, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities," as applicable.

3.3.2 Confinement Strategy

Conceptual design for the new Remote-Handled LLW Disposal Project is substantially based on the remote-handled LLW concrete disposal vaults currently in use in the RWMC Subsurface Disposal Area, including their associated confinement functional requirements. In addition to providing an overall confinement function of the radioactive waste materials discussed in Section 2.2, reliance on the existing design provides a fundamental basis for implementation of safety requirements for this new disposal facility.

As previously discussed in Section 2.1, the vaults will be constructed of precast concrete cylinders (i.e., pipe sections) stacked on end and placed in a honeycomb-type array. Each stacked cylinder will be placed on a concrete base and will have a separate removable concrete plug placed on top of the cylinder. The remote-handled LLW will be packaged into sealed steel waste containers at the generating facilities. One waste container at a time will be shipped within a shielded transportation package from the generating facility to this disposal facility. Upon transportation package arrival at the appropriate vault array location, the waste container will be transferred directly from a bottom-unloading transportation package into the concrete vault. If a top-unloading transportation package is used, then additional equipment will be required for lifting waste containers out of the transportation package and transferring them into the concrete vaults. These waste containers will function as a contamination barrier. A removable concrete plug will be set on top of the stacked precast concrete cylinders to serve as a radiation shield and water barrier to prevent surface water intrusion into the concrete vaults.

The basic design of this facility and corresponding operations activities consider the high radiation levels associated with the remote-handled LLW stream and will minimize worker radiological exposure by providing for an overall confinement function and passive control of worker radiological exposure.

3.3.3 Fire Mitigation Strategy

The Remote-Handled LLW Disposal Project will be considered as an unoccupied, below ground disposal facility. A fire safety analysis will be performed as part of the final design to determine the need for fire detection and suppression systems to be installed for this disposal facility. The lifting and handling of transportation packages and waste containers at this disposal facility will require the use of diesel-powered trucks, tractor/trailer combinations, and a crane; these vehicles introduce the potential for a vehicle fire that is postulated to occur during transport or during transportation package/waste container unloading evolutions. The fire safety analysis will specifically take this postulated fire scenario into account and identify appropriate preventative and mitigative features and administrative controls for implementation during these process operations.

Fire protection for the administration and maintenance buildings will adhere to requirements of the NFPA 101, "Life-Safety Code" and the International Fire Code 2003 (as adopted by the State of Idaho in the Idaho Administrative Procedures Act [IDAPA] 18, Title 01, Chapter 50).

3.3.4 Criticality

In the conceptual design stage of the Remote-Handled LLW Disposal Project, preliminary evaluations indicate that waste streams for the facility do not contain significant enough quantities of fissionable material to make nuclear criticality a credible accident. Further evaluation will be made on the need for criticality safety requirements (e.g., specific packaging configurations for high fissile materials) pertaining to this facility during development of the preliminary documented safety analysis.

3.3.5 Anticipated Safety Functions

Based on the results of the preliminary hazard identification, there are no safety-class structures, systems, and components identified or required for this facility. In the worst case design-basis accident identified for the Remote-Handled LLW Disposal Project, it was concluded that potential exists for an accident that could result in direct radiation exposure exceeding evaluation guidelines to the facility worker. The 5-ft-thick concrete vault plugs were identified as a structural component that provides a radiation shielding safety function that would protect the facility worker from these consequences after the waste containers are placed in the vaults. In addition, shielding required during transportation package unloading and waste container transfer operations is identified for protecting the facility worker from these consequences during placement of the waste containers in the vaults. Because the vault plugs and shielding during waste container unloading and transfer provide a radiation shielding safety function, they are designated as safety-significant structures, systems, and components for design and facility planning purposes. As the facility design matures, further analyses will be performed evaluating the direct radiation exposure to the facility worker from specific material being stored.

4. RISKS TO PROJECT SAFETY DECISIONS

Because the proposed Remote-Handled LLW Disposal Project is being planned substantially based on the existing disposal facility design and operations, no significant changes to the remote-handled waste characteristics are anticipated. As previously discussed in Section 3.2.1, based on the preliminary assessment of the estimated inventory in the identified remote-handled LLW streams and comparison with DOE-STD-1027-92, the proposed Remote-Handled LLW Disposal Project would have a radionuclide inventory that would result in an initial hazard categorization as a HC-2 nuclear facility. However, DOE-STD-1027 supplemental guidance provides for facility categorization being modified in the final hazard categorization process, considering 1) alternative release fractions or 2) change in material subject to an accident due to facility features that preclude bringing material together or causing harmful interaction from a common severe phenomenon (i.e., facility segmentation). These provisions will be further evaluated during the development of the preliminary documented safety analysis and documented safety analysis per NS-18101 to determine if modification to the preliminary facility hazard categorization is appropriate based on alternative release fractions or facility segmentation consideration. If the alternative release fractions or segmented facility considerations are successful, the decision to designate the facility as HC-2-may be modified based on using the contents of a single vault and/using an alternate method of evaluating the presence of individual radionuclides. Such an updated categorization may result in a final facility categorization of HC-3.

It should be noted, however, that complete waste characterization is not available for every potential waste stream that might be placed in the Remote-Handled LLW Disposal Project. This is particularly true for the potential MFC waste streams that are anticipated from new INL programs and processing remote-handled waste currently stored at the Radioactive Scrap and Waste Facility. These inventories will be further evaluated during development of the preliminary documented safety analysis and documented safety analysis and may impact the final facility hazard categorization.

Concrete shield plugs perform the safety function of shielding. As previously discussed in Section 3.3.5, direct radiation exposure from a vault with a damaged or missing shield plug may exceed evaluation guidelines to the facility worker. Therefore, the 5-ft-thick concrete shield plugs are identified as components that would protect the facility workers from those consequences. The shield plugs may be designated as safety-significant structures, systems, and components for design and facility planning purposes. As facility design matures, further analyses will be performed, evaluating specific postulated exposure scenarios for the specific material being stored. Additional controls may be identified for a

specific waste container with contact exposure rates that exceed the shielding design parameters specified in the conceptual design report (INL 2010a) and TFR-483.

Pre-cast concrete storage vaults perform the safety function of shielding and confinement; however, they are not identified as safety significant. The vaults are located completely below ground surface, isolating contents from facility workers and, upon failure, would not impose any risk of fatality or serious injury to workers. There are no accident scenarios for the vaults that result in a loss of function needed to preserve the health and safety of workers. Furthermore, in the improbable event of vault or shield plug failure, there would be no significant offsite consequences.

Further evaluation also will continue during the transportation package selection process. The current design for RWMC involves a bottom-unloading cask that is placed over a concrete vault with the waste container lowered directly into the vault. This approach is proposed for NRF waste streams destined for disposal at the Remote-Handled LLW Disposal Project. If a top-unloading transportation package is selected for other waste streams, then additional equipment will be required for lifting waste containers out of the transportation package and transferring them into the vault. Additional shielding or administrative controls may be required to minimize worker exposure.

5. SAFETY ANALYSIS APPROACH AND PLAN

As a potential HC-2 nuclear facility, the Remote-Handled LLW Disposal Project must meet specified nuclear safety requirements delineated in accordance with 10 CFR 830. The following requisite nuclear safety documentation will be developed as part of the project:

- Safety design strategy
- Preliminary hazards analysis
- Conceptual safety design report
- Preliminary safety design report
- Preliminary documented safety analysis
- Final documented safety analysis.

This nuclear safety documentation will be developed in accordance with DOE-STD-1189-2008 and NS-18101 nuclear facility safety requirements.

This project is following the requirements of DOE Order 413.3B to the extent practical. As such, the nuclear safety documentation identified above may be combined as part of tailoring for the project. Specifically, the preliminary hazards analysis is being used as input into the project conceptual safety design report to be prepared with the conceptual design. A preliminary safety design report will be developed during preliminary design. The development of the preliminary documented safety analysis will be completed during final design, followed by a final documented safety analysis prior to the start of operations.

Project safety basis document preparation will follow the guidance of DOE-STD-1189-2008, which is to integrate safety analysis throughout the design process. The standard is intended to implement safety-in-design philosophies listed in DOE Order 413.3B and facility safety criteria listed in DOE

Order 420.1B. This approach is intended to ensure that hazards are identified early in the project and that a safety design integration team approach is used to design safety into the facility.

As the project design matures, generation of other necessary safety documents and analyses will be required. These supporting documents, other than operational procedures, will include the following as appropriate:

- Fire hazard analysis
- Criticality safety evaluation
- Hoisting and rigging plan
- Engineering design files
- As low as reasonably achievable reviews
- Radiation work permits
- Operational job safety analyses
- Industrial hygiene exposure assessments prepared in accordance with the associated INL procedures.

6. SAFETY DESIGN INTEGRATION TEAM – INTERFACES AND INTEGRATION

The purpose of the project Integrated Project Team (IPT) is to provide cross-functional groups of individuals organized for the specific purpose of delivering a project where the technical, management, budgetary, safety, and security interests are met. Use of IPTs is the primary tool for breaking down the walls that can exist between different organizations, different professions, and different levels within the command structure. A successful IPT brings the diverse elements together to form a unit that is willing to share information and balance priorities and ideologies in efforts to successfully execute the project mission while achieving the overall safety strategy.

The safety design integration team includes appropriate representatives from traditional worker safety disciplines, emergency management, and safeguards and security. The safety integrated project teams that will be used for this project include the Federal IPT, contractor IPT, and the local project safety design integration team. Each of these IPTs consists of individuals representing diverse disciplines with specific areas of expertise and the ability to support the Federal Project Director in successful execution of the project. Membership may be full time or part time and will change as the project matures through the various phases from initiation through closeout. Membership will include federal and contractor employees and will consist of the members, or designees, defined in Table 2.

Table 2. Remote-Handled Low-Level Waste Disposal Project safety design integration team.

Organization	Responsibility	Member
DOE	Acquisition Executive, DOE NE-1	Warren Miller
	NE-32	Tracey Bishop
	Manager, DOE-ID	Dennis Miotla
	Deputy Manager—Nuclear Energy, DOE-ID	Raymond Furstenau
	Assistant Manager of Infrastructure, DOE-ID	William Hamel
	Federal Project Director, DOE-ID	Julie Conner
INL Project Management Office	Director	Robert Miklos
	Waste Programs Manager	Lisa Harvego
	Project Manager	David Duncan
INL Project Support	Systems Engineering	Danny Anderson
	Environmental Compliance	Timothy Carlson
	Nuclear Safety Engineering	Michael Lehto
	Occupational Safety and Health	Carolyn Mascarenas
	Project Engineering	TBD
	Procurement	TBD
	Planning and Financial Controls	Linda Hergesheimer
	Construction Services	Eric Anderson
	Construction Environment, Safety, and Health	TBD
	Quality Engineering	Leonard Stenzel/Evert Mouser
	Operations	TBD
NRF	Point-of-Contact	Chris Henvit

The responsibilities of the IPTs include the following:

- Support the Federal Project Director
- Support preparation and submittal of funding request documents, as necessary, to secure project funding
- Support development of the project acquisition strategy
- Ensure interfaces are identified, defined, and managed to completion
- Identify, define, and manage implementation of environment, safety, health, and quality requirements
- Identify and define appropriate and adequate technical scope, schedule, and cost parameters

- Perform periodic reviews and assessments of project performance and status against established performance parameters, baselines, milestones, and deliverables
- Plan and participate in project reviews, audits, and appraisals, as necessary
- Review and comment on project deliverables, as appropriate
- Review change requests and support change control board actions, as appropriate
- Participate in readiness reviews or readiness assessments
- Support preparation, review, and approval of project completion and closeout documentation
- Ensure that safety is fully integrated into design, construction, and operations of the HC-2 nuclear facility.

7. REFERENCES

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*, Office of the Federal Register, January 2000.

29 CFR 1910.119, "Process Safety Management of Highly Hazardous Chemicals," *Code of Federal Regulations*, Office of the Federal Register, August 17, 2006.

42 USC § 9601 et seq., 1980, "Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA/Superfund)," *United States Code*, December 11, 1980.

ANSI/ANS 2.26-2004, "Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design," American National Standards Institute/American Nuclear Society, December 2004.

DOE Order 413.3B, "Program and Project Management for the Acquisition of Capital Assets," U.S. Department of Energy, July 2006.

DOE Order 420.1B, "Facility Safety," U.S. Department of Energy, December 2005.

DOE Order 435.1, "Radioactive Waste Management," Change 1, U.S. Department of Energy, July 1999.

DOE-STD-1020-2002, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities," U.S. Department of Energy, April 2002.

DOE-STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE O 5480.23, Nuclear Safety Analysis Reports," U.S. Department of Energy, September 1997.

DOE-STD-1189-2008, "Integration of Safety into the Design Process," U.S. Department of Energy, March 2008.

IBC, 2009, International Building Code, International Code Council.

International Fire Code 2003 (as adopted by the state of Idaho in the Idaho Administrative Procedures Act [IDAPA] 18, Title 01, Chapter 50).

INL, 2004, INL Contract Number DE AC07-05ID14517, "Management and Operation of the Idaho National Laboratory," Idaho National Laboratory, November 9, 2004.

INL, 2010a, *Conceptual Design Report for the Remote-Handled Low-Level Waste Disposal Project*, INL/EXT-07-12901, Idaho National Laboratory, Revision 2, April 2010.

INL, 2010b, *Remote-Handled Low-Level Waste Disposal Project Alternatives Analysis*, INL/EXT-09-17152, Idaho National Laboratory, April 2010.

NFPA 101, "Life Safety Code Handbook," current edition.

NS-18101, "INL Safety Analysis Process," Idaho National Laboratory, Rev. 3, May 2008.

TFR-483, "Technical and Functional Requirements for the Remote-Handled Low-Level Waste Disposal Facility," Idaho National Laboratory, Rev. 1, November 2009.