HWMA/RCRA STORAGE and TREATMENT PERMIT

for the

MATERIALS AND FUELS COMPLEX (MFC)

ATTACHMENT 1 – FACILITY DESCRIPTION

Section D – Process Description
Section D Attachments

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D. Process Description [IDAPA 58.01.05.008 and 012; 40 CFR 264 and 270]

In accordance with the requirements of Idaho Administrative Procedures Act (IDAPA) 58.01.05.008 and 012; 40 Code of Federal Regulations (CFR) 264 and 270, this section of the Hazardous Waste Management Act (HWMA)/Resource Conservation Recovery Act (RCRA) Permit Application provides process-related information for the HWMA units described below. For reference, the locations of the HWMA units discussed in this section are shown in Attachment 1, Section B, MFC Facility Description.

The information provided in this section is organized by subsection as follows:

— Subsection D-1, HWMA Unit Process Description Overview

— Subsection D-2, Containers and Container Management Practices

— Subsection D-3, Basis System Descriptions

— Subsection D-4, Tanks and Tank Management Practices

— Subsection D-5, Miscellaneous Unit Management Practices.

D-1 HWMA Unit Process Description Overview

The MFC HWMA units will be used to perform a variety of processes (services) for on-Site[1] hazardous waste/mixed waste (HW/MW) generators. The services conducted through operations at the MFC HWMA units allow safe and efficient handling of characteristic HW/MW (ignitable, reactive, corrosive, toxic metal) and/or listed HW/MW.

The HWMA unit waste acceptance criteria (WAC) will determine the types of HW/MW that can be received at a HWMA unit and the types of HW/MW services that can be performed.

[1]. On-Site means HW/MW generated at a facility physically located on the INL site or HW/MW from a generator that is a contractor or subcontractor, and physically located on the INL site, of the INL Management and Operations contractor.

The services performed at the HWMA units include:

— Storage of HW/MW in containers and/or tanks

- Prior to, during and/or following verification/sampling, repackaging and/or treatment.

— Verification or sampling of HW/MW to facilitate

- Use in bench scale studies
- Storage and/or treatment at an MFC or off-Site HWMA unit
- Acceptance at INL or off-Site disposal facilities.

— Repackaging of HW/MW to facilitate

- Use in bench scale studies
- Storage and/or treatment at an MFC or off-Site HWMA unit
- Acceptance at INL or off-Site disposal facilities.

— Container treatment of HW/MW including

- Absorption (waste with free liquids)
- Neutralization (corrosive wastes)
- Solidification (liquid/sludge wastes)
- Stabilization (liquid/sludge waste with metals)
- Melting and draining (reactive metals)
- Deactivation (corrosive/reactive waste).

— Tank treatment of HW/MW including

- Neutralization (corrosives)
- Deactivation (ignitable/reactive waste).

— Debris treatment including

- Water spraying and water washing.

The maximum HW/MW storage capacities of each HWMA unit and the annual quantities of the HW/MW to be managed (stored, verified/sampled, repackaged and/or treated) at the HWMA units are provided in Attachment 1, Facility Description, Part A, Sections 7 and 9. A matrix of the EPA hazardous waste numbers (HWNs) (also known as waste codes) that can be received/managed at each HWMA unit, the HW/MW services (processes) performed in each HWMA unit, and the types HW/MW types (forms) accepted is provided in Attachment 1, Facility Description, Section B, MFC Facility Description, Table B-1.

Brief descriptions of the services performed at the HWMA units (HW/MW storage, verification/sampling, repackaging and/or treatment) are provided below.

D-1(a) Basic HW/MW Service Descriptions

D-1(a)(1) Storage of HW/MW

HW/MW, with and without free liquids, may be received and stored in containers and tanks while in the HWMA units prior to, during and/or following verification/sampling, repackaging and/or treatment. The HW/MW may be stored in original containers or repackaged containers or in process equipment (tanks/containers) during treatment. Services performed at the HWMA units during storage may include inert atmosphere container opening, sampling prior to treatment, nondestructive assay (NDA) and safety evaluations. Because several of the HWMA units are heated and air filtered, they are well suited for these activities.

The ability to store the HW/MW in the HWMA units may be necessary following generation and/or receipt of the HW/MW prior to the preparation of HW/MW for final disposal.

The types of containers and tanks that may be received/stored at the HWMA units include, but are not limited to, the following:

— Cans, drums, boxes and bins

- 1 pint to 8 gal cans
- 5 to 71 gal drums
- 85 to 100 gal overpack drums
- Standard/nonstandard waste boxes
- Steel waste bins

- Wooden waste boxes
- Steel container assemblies (HFEF-5 and Sodium Loop Safety Facility[2] [SLSF] cans).

— Operational components and process equipment

- Piping/pumps
- Heat exchangers
- Cold/nuclide traps
- Shipping vessels
- Transfer tanks
- Storage tanks
- Process tanks.

The MFC HWMA units that can store HW/MW are identified in Attachment 1, Section B, MFC Facility Description, Table B-1. HWMA/RCRA designated container or tank storage areas within each of the HWMA units are shown in the facility arrangement schematics provided in Attachment 1, Section B, MFC Facility Description, and its associated attachments. The maximum storage capacities for each HW/MW container and/or tank storage area are also listed on the referenced schematics.

D-1(a)(2) Verification Sampling of HW/MW

HW/MW stored and/or received may require verification and/or sampling prior to repackaging, treatment and/or final disposal. The activities may include the following:

— Visual examination (fingerprint analyses) of the HW/MW to ensure that the container contents have been correctly identified through process knowledge and/or non-intrusive analysis

— Sampling and analysis of the HW/MW while in the original container to establish and/or validate HW/MW characteristics

— Removal of HW/MW samples for testing and analysis purposes, NDA and safety evaluations.

[2] The Sodium Loop Safety Facility (SLSF) was located at the Experimental Test Reactor (ETR) and was used to perform experiments with sodium coolant from Fast Breeder Reactor fuel experiments intended to fail-test fuel pins under controlled conditions. SLSF containers were designed to contain HW/MW from this facility.

Several HWMA units are well suited for these activities because they are heated and air filtered. Following verification/sampling activities, the HW/MW may be repackaged and will then be stored, and/or treated, or transferred to a HWMA unit.

HW/MW certifications, data, and samples all result from the process of conducting HW/MW verification and/or sampling. Data is reduced and validated in accordance with generator requirements and provided to the generator. Samples are sent to qualified laboratories for testing/analysis. Following verification and/or sampling activities the HW/MW may be returned to the generator.

The MFC HWMA units that can perform HW/MW verification and/or sampling services are identified in Attachment 1, Section B, MFC Facility Description, Table B-1.

D-1(a)(3) Repackaging HW/MW

HW/MW stored and/or received may require repackaging. This involves removal and transfer of HW/MW from the original container to a new container, by the treatment facility, under, but not limited to, the following circumstances:

- HW/MW is stored in nonstandard containers (i.e., vessel, cold trap, tank) or in a form incompatible with on-Site or off-Site treatment unit equipment or processes (i.e., solid, liquid)
- HW/MW may require sorting and segregating (followed by repackaging) to meet an on-Site or off-Site treatment and/or disposal facility's WAC
- Original HW/MW container is unacceptable for storage and/or disposal due to deterioration or configuration.

Repackaging activities will include:

- Sorting and segregating the HW/MW by waste type (i.e., solid, liquid, debris) into a container compatible for storage or treatment and disposal
- Transferring the HW/MW from one container to another container while meeting the definition of treatment (i.e., sizing, compaction, etc)
- Heating/melting (if necessary) the HW/MW using portable heaters
- Transferring (pumping/draining) the HW/MW from the original container (using a transfer system such as a vacuum pump) into a container compatible for storage or treatment processes.

These repackaging activities will typically be performed within a containment/confinement consisting of a work tent, controlled area and/or glovebox for radiological control.

The MFC HWMA units that can perform HW/MW repacking services are identified in Attachment 1, Section B, MFC Facility Description, Table B-1.

D-1(a)(4) Absorption of Free Liquids in HW/MW

HW/MW stored and/or received for verification/sampling and/or repackaging may have limited amounts of free liquids that require absorption to meet storage, transport and/or waste disposal criteria. If liquid is found in HW/MW containers during verification/sampling and/or repackaging activities, the liquid will be absorbed so that the containers can safely be stored, transported and/or disposed. Specifically during verification and/or repackaging activities, any liquid will be absorbed by rearranging the absorbent originally packed in the drum. If rearranging the existing absorbent is inadequate, additional clean absorbent will be placed in the container or, if necessary due to volume increase, the additional absorbent and the HW/MW will be transferred to a larger container. If liquid is found in a sludge drum prior to core sampling, its volume is determined. A sample of the liquid may be drawn and may be shipped to a laboratory for analysis. After coring, the unused portion of the core sample is returned to the drum. Absorbent will then be added in quantities sufficient to absorb the free liquid.

Following the treatment, free liquid absorption effectiveness will be determined by conducting a visual inspection to ensure no free liquids are present in accordance with specified requirements (i.e., disposal or transport).

The MFC HWMA units that can perform HW/MW absorption services are identified in Attachment 1, Section B, MFC Facility Description, Table B-1.

D-1(a)(5) Neutralization of Corrosive HW/MW

HW/MW stored and/or received may require neutralization or pH adjustment (2 < pH < 12.5) following an initial treatment process or prior to solidification/stabilization in preparation for disposal. These situations could include, but are not limited to, corrosive HW/MW produced in a HWMA unit (e.g, the Sodium Components Maintenance Shop (SCMS)) or containerized liquid corrosive HW/MW received at a HWMA unit. These corrosive solutions or liquids can be neutralized by processes such as (1) carbonating the hydroxide solution with carbon dioxide (CO_2) in the SCMS carbonation system, or by (2) adding acids or bases to neutralize the corrosive liquids. Neutralization will be performed to within an acceptable pH range (2 < pH < 12.5) to deactivate the corrosive characteristic and/or to obtain the optimum pH for subsequent solidification/stabilization of the neutralized solutions.

Following neutralization, pH will be determined by conducting pH analysis to ensure the corrosive solutions meet HWMA/RCRA Universal Treatment Standards (UTS).

The MFC HWMA units that can perform HW/MW neutralization are identified in Attachment 1, Section B, MFC Facility Description, Table B-1. HWMA/RCRA designated container and/or tank treatment areas within each of the HWMA units are shown in the facility arrangement schematics provided in Attachment 1, Section B, MFC Facility Description. The maximum daily process rates for each HW/MW container and/or tank treatment area are provided in Attachment 1, Facility Description, Part A.

D-1(a)(6) Solidification/Stabilization of HW/MW

Solidification or stabilization will be performed, as necessary, to meet UTS and/or disposal facility WAC. The solidification/stabilization procedure and the type and amount of solidification/stabilization agent used are based on the analysis of a representative sample of the waste and/or toxic metal contaminated HW/MW solution taken prior to solidification/stabilization. The solidification/stabilization procedure/agent used falls under one of the following practices:

— A previously approved Waste Analysis Plan (WAP) and treatment procedure

— An approved WAP and treatment procedure determined by bench-scale testing

— Recommended usage and specifications provided by agent manufacturers. Solidification/stabilization agents may include natural materials such as vermiculite, silicates, clay, or synthetic materials such as absorbent polymers.

Solutions requiring solidification/stabilization are transferred directly to an empty container or to a fixed solidification system. Solidification/stabilization can also be performed in the original HW/MW container, if appropriate.

Following the solidification/stabilization procedure, a representative sample is taken and is then analyzed to ensure that the HW/MW meets UTS.

The MFC HWMA units that can perform HW/MW solidification/stabilization are identified in Attachment 1, Section B, MFC Facility Description, Table B-1. HWMA/RCRA designated container and/or tank treatment areas within each of the HWMA units are shown in the facility arrangement schematics provided in Attachment 1, Section B, MFC Facility Description. The maximum daily process rates for each HW/MW container and/or tank treatment area are provided in Attachment 1, Facility Description, Part A.

D-1(a)(7) Deactivating Ignitable and Reactive HW/MW

The ignitable and reactive characteristics of HW/MW can be deactivated (via water reaction) in a controlled manner in the SCMS water wash system. In this system, the ignitable and reactive HW/MW reacts with water and ultimately forms a hydroxide solution as illustrated in the following reaction (as shown for sodium [Na]):

- $Na + H_2O \rightarrow NaOH + 2H_2$

The hydroxide solution produced from this direct reaction with water drains into the SCMS scrubber water tank.

Following the deactivation, a representative sample of the hydroxide solution may be taken and analyzed to ensure that UTS can be met.

The MFC HWMA units that can perform deactivation are identified in Attachment 1, Section B, MFC Facility Description, Table B-1. HWMA/RCRA designated tank treatment areas within each of the HWMA units are shown in the facility arrangement schematics provided in Attachment 1, Section B, MFC Facility Description. The maximum daily process rates are provided in Attachment 1, Facility Description, Part A.

D-1(a)(8) Heating and Melting for Repackaging

HW/MW received or stored in non-standard containers such as shipping vessels, process vessels, or tanks, may be incompatible with a HWMA unit's treatment system or equipment (i.e., SCMS) and may require transfer or repackaging into a compatible feed or transfer container prior to continued treatment.

Heating and melting of the HW/MW (e.g., Na) may be necessary using portable strap heaters or steam. Once the HW/MW is melted, it can be transferred by pressurizing the container, pumping and/or vacuum draining from the original container into a container compatible with the HWMA unit's treatment processes. This activity may be performed within a containment consisting of a work tent and/or glovebox for radiological control.

D-1(b) Flow Path of HW/MW Services

The purpose of this subsection is to briefly describe the services that the MFC HWMA units provide. Brief descriptions of these services are provided in following subsections.

D-1(b)(1) HW/MW Generator Specifications

To acquire HWMA unit services, the generator specifies the desired services and specific requirements that are needed. HWMA unit personnel then determine whether the desired services can be performed. If HWMA unit personnel determine the desired services can be performed, then the generator provides information needed to verify that HWMA unit WAC can be met. This detailed information is provided to the Integrated Waste Tracking System (IWTS) Profile as described in Attachment 2, Section C, Waste Analysis Plan.

D-1(b)(2) HWMA Unit Approval to Accept HW/MW

HWMA unit personnel review and approve transfer/shipments of HW/MW to the HWMA unit based on the generator's certifications.

D-1(b)(3) HW/MW Receipt at HWMA Units

Upon HW/MW receipt at a HWMA unit transfer area, HW/MW containers are inspected to ensure that received HW/MW is consistent with the generator's description of the HW/MW (such as labels, identification numbers, container condition, and radiation levels). Any noncompliant conditions or inconsistencies are documented as required by HWMA unit-specific procedures and the generator is

contacted for assistance in the resolution. If discrepancies cannot be resolved, HW/MW is returned to the generator.

D-1(b)(4) Transfer of HW/MW to Storage

If as-received HW/MW is acceptable, it is transferred into the storage area until the requested services can be performed.

D-1(b)(5) Verification, Repackaging, and/or Container/Tank or Debris Treatment

Containers of HW/MW are transferred from the HWMA unit where it is stored to the HWMA unit where it will be opened and/or transferred to perform verification, repackaging, and/or container/tank or debris treatment. A variety of products result from the process of conducting verification, repackaging, and/or treatment. These include data, samples, repackaged generator HW/MW, and/or treated final HW/MW packaged for final disposal. Data is reduced and validated in accordance with generator requirements and provided to the generator. Samples are sent to qualified laboratories for testing/analysis. HW/MW is then packaged and transferred/shipped to the generator or another facility for disposal.

D-1(b)(6) Transfer of HW/MW to Storage Following Verification, Repackaging, and/or Container, Tank or Debris Treatment

Following completion of verification, repackaging, and/or treatment, the HW/MW is transferred to appropriate storage (HWMA/non-HWMA) until it is transferred/shipped back to the generator or to a disposal facility.

D-1(b)(7) HW/MW Shipment to Generator or Disposal Facility

Containers of verified, repackaged, and/or treated HW/MW are prepared for transfer/shipment to the generator or disposal facility and may be placed in a staging or transfer area, pending shipment. Appropriate documentation is prepared for the HW/MW to be returned to the generator or disposal facility.

In addition, fabricated overpacks or containers that are themselves hazardous (i.e., containers containing lead shot for shielding) will be disposed of in accordance with State of Idaho HW/MW management regulations, once the containers are no longer useable.

D-2 Containers and Container Management Practices [IDAPA 16.01.05.012; 40 CFR 270.15]

HW/MW (with and without free liquids) are currently stored or received from a variety of on-Site facilities as described in Attachment 1, Section B, MFC Facility Description. The HW/MW containers may be stored prior to, during, and/or following verification, repackaging, and/or treatment.

Types of Containers. The types of containers that may be received/stored at HWMA units are listed in Subsection D-1(a)(1) and summarized in Table D-1.

Storage Area and Maximum Capacities. The maximum container storage capacity for each HMWA unit is provided in Attachment 1, Facility Description, Part A. Container storage areas and maximum container storage capacities are also shown on the HWMA unit facility arrangement schematics provided in Attachment 1, Section B, MFC Facility Description.

The different types of HW/MW containers currently stored in HWMA units or in other on-Site facilities that may be transferred to HWMA units for storage and treatment are described in the following paragraphs. All containers used for storing HW/MW are compatible with the waste stored in the containers. Container types are selected after ensuring compatibility of the container with the waste type and with transportation requirements of receiving facilities. Photographs of several different types of containers described in Table D-1 are provided in the Permit Application in Attachment D-1.

Table D-1. Examples of Containers Accepted at HWMA Units.

Container Type	Description
Department of Transportation (DOT) Carbon-Steel Drums	Carbon-steel, 71-gal DOT-approved 7A closed-head drums that are externally-coated 16 gauge carbon steel with a crimped cover closure and 2 in. steel plug in the head. The internal dimensions of the drums are 22.5-in., diameter, by 33.25-in. tall. Carbon-steel, 55-gal DOT-approved 17C and UN-approved 1A2-Y1.7/150 open-head drums that are externally-coated 16 gauge carbon steel with a 2-in. steel plug in the head. The internal dimensions of the drums are 22.5-in., diameter, by 33.25-in. tall. These drums may have installed 90-mil molded polyethylene liners with an open or closed head.

Container Type	Description
DOT High-Density Polyethylene Drums and Pails	The polyethylene drums are high-density polyethylene, 55-gal, UN-approved 1H1/Y1.9/100 closed-head drums with threaded closure. The internal dimensions of the drums are 23.25-in., diameter, by 33.25-in. tall. The pails are high-density polyethylene, 5-gal, UN-approved 1H1/X1.8/100 closed-head pails with threaded closure and an external handle. The internal dimensions of the pails are 14.75-in., diameter, by 11.6-in. tall. Other types of drums and pails may be used to store liquids in HWMA units. Container types are selected after ensuring compatibility of the container with the HW/MW described on the IWTS Profile and with transportation and WAC defined by HWMA units or another receiving facility.
DOT Steel Bins	A rectangular 12-gauge steel bin used for shipment of waste or DOT-approved containers of waste and meets the requirements of 49 CFR 178.350 (DOT 7A). When used as an "overpack," it holds eight 55-gal drums in two layers of four drums each, or ten 30-gal drums in two layers of five drums each. The bins are nominally 4 x 5 x 6 ft. This category covers a range of sizes and some structural variations. At the time of use, one bin type, entitled M-III, met DOT 7A requirements. The M-III bins now meet DOT requirements for a strong-tight container.
DOT Steel Box TX-4	A mild-steel-welded construction box, developed by Lawrence Livermore National Laboratory, with a gasketed bolted closure that is used in packaging contact-handled transuranic (CH TRU) waste. The container is a steel sheet supported by an external framework of four 4 x 2-in. square tubing (the container corners are reinforced with 2-in. angle stock, skip welded). Four 3-in. steel channels support the container, allowing standard forklift access. This box comes in a range of sizes ranging from 74 to 92-in. long, 46 to 52-in. wide, and 36 to 57-in. high. This box may be lined with two 40-mil. or one 80-mil. Polyvinyl chloride (PVC) liner. The top of the liner is then folded over the top and outside of the box and secured with duct tape.
Standard Waste Box (SWB)	A steel container that is nominally 71 x 55 in. and 37-in. tall. This box may be used to package waste or to overpack any container that does not meet the WAC as long as the dimensions are compatible. The lid is then bolted to the box.

Container Type	Description
DOT 7A Steel Overpack Box	A box constructed of carbon steel supported by an external framework of four 4 x 2-in. square tubing (container corners are reinforced with 2-in. angle stock). It may be used for overpacking plywood boxes and damaged fiber-reinforced plywood (FRP) boxes. Two 2 x 1-in. steel channels support the container for forklift access. The dimensions of this box are 92 x 56 in. and 55-in. tall. A variety of other sizes may be used (i.e., special sizes will be fabricated to handle a variety of overpack needs).
Wooden Box	A box constructed of plywood. At the time of use in the 1970s, this box met DOT 19A packaging requirements. It comes in a range of sizes but generally is 7 x 4 ft and either 2 or 4-ft tall. The lid is either nailed or glued shut.
FRP Box	A box constructed in the same manner as the wooden box previously described and has the same range of dimensions. However, the exterior of the box is coated with at least 1/8 in. of fiberglass-reinforced polyester.
HFEF-5 Canisters	Container system consists of an inner container and an outer container. The inner container is placed inside the outer container, which is seal-welded shut and placed in the RSWF liners for storage. The inner container, constructed of carbon steel, is the hot cell waste receptacle. It is a cylindrical, 14 gauge carbon-steel (AISI 1010-1020) container, 59.125-in. tall by 11.60-in. diameter. It is closed by a 3/8-in. thick lid fastened to a bolt ring in the top of the container by six cap-head bolts. The outer containers are the out-of-cell containers and are used to prevent the spread of contaminants from the inner container to the environment. It is a cylindrical, 14-gauge, Type-304 stainless-steel container, 73.5-in. long by 12.75-in. diameter.
SLSF Canisters	Container is constructed like the HFEF 5 Can assembly only it is larger in diameter. It is a cylindrical, 11-gauge Type-304 or-308 stainless-steel container, 20.76-in., diameter, by 122.00-in. long. It is closed by a 1.5-in. thick lid fastened to a bolt ring in the top of the container by six cap-head bolts. In addition to using the SLSF inner can, three 45-gal steel cans will also be used as the inner waste storage containers. The SLSF outer container is a cylindrical, 11 gauge carbon-steel (AISI 1010-1020) container, 22.25-in., diameter, by 134.5-in. tall. It is closed by a 1.5-in. thick lid that is seal-welded.

Container Type	Description
Process Components	Miscellaneous carbon or stainless-steel process components such as nuclide traps, cold traps, shipping vessels that are well suited for storage because they are compatible with the HW/MW and designed to withstand processing.
Bags	A bag typically constructed of 3 or 6 mil polyethylene, or some other durable material compatible with the waste. The bag must be made secure and leak tight (i.e., taped, j-sealed, or heat sealed). Bags may be used to store rigid waste (e.g., plywood, pallets, etc.) or non-rigid waste (e.g., personal protective equipment [PPE], radiological swipes, etc.) that does not contain Na, Nak or liquid. Bags may only be used for storing waste that without treatment, the waste is not amenable for storage in any of the containers identified above.

D-2(a) Containers With and Without Free Liquids

Containers with and without free liquids are managed in the same manner with the exception of providing secondary containment for containers with free liquids.

D-2(a)(1) Description of Containers [IDAPA 58.01.05.008; 40 CFR 264.171 and 264.172]

Examples of containers of HW/MW that are currently stored in HWMA units or are candidates for storage (they will be transferred from another on-Site facility) will be compatible with the waste stored and are summarized in Table D-1.

This listing is not inclusive but serves as a representative listing of the types of containers that may be received. Containers that are not in good condition (e.g., apparent structural failures or bulging), or whose contents are not compatible with the HW/MW they are storing, will not be accepted at HWMA units. HWMA units will only accept those containers that can be stored safely. In the event a container is not in good condition, it will be returned to the generator for repackaging or, if safe to do so, will be repackaged at an appropriate HWMA unit.

Containers are stored pending treatment at MFC or for transfer to an off-site facility for treatment or disposal. To confirm the structural integrity of containers while in storage visual inspections are performed as described in Attachment 6, Section F, Inspections. Container integrity is also verified prior to transfer between MFC HWMA units or prior to transfer to an off-site facility. In addition, the primary waste streams stored in the HWMA units for an extended duration (i.e., longer than 1 year) include Na/NaK, Na/NaK contaminated debris, and characteristic metal debris. The compatibility of these waste streams with respect to the construction

material of the containers does not pose long term storage issues since the waste streams are Na/Nak including Na/NaK debris in nature. The Na/NaK and Na/NaK debris is from reactor components that were designed to handle Na/NaK at high temperatures. Long term storage of Na/NaK debris in metal containers and components is supported by various technical documents.[3]

Incompatible wastes, either solids or liquids, will be stored in accordance with the HW/MW separation precautions described in Attachment 6, Section F, Procedures to Prevent Hazards.

D-2(a)(2) Container Management Practices [IDAPA 58.01.05.008; 40 CFR 264.173]

Containers used to store HW/MW in HWMA units will be received, handled, managed and stored in a manner that reduces the likelihood of a HW/MW release as described in the following subsections.

D-2(a)(2)(a) Acceptance Criteria

Prior to the transfer of HW/MW to a HWMA unit, the HW/MW generator transferring the HW/MW must submit a completed IWTS Profile, or equivalent, and the HWMA Unit Waste Acceptance Checksheet, or equivalent, must be approved (ref. Attachment 2, Section C, Waste Analysis Plan). These forms are used to document details on the physical, chemical, and radiological characteristics of the HW/MW (which provides a detailed characterization of the HW/MW) to ensure it can be safely stored and processed with the existing HW/MW at an appropriate HWMA unit.

[3] ANL-4417, Argonne National Laboratory Resistance of Materials to Attack by Liquid Metals, By Leroy R. Kelman, Walter D. Wilkinson, and Frank L. Yaggee, Dated July, 1950. Technical Information by DUPont Specialty Chemicals, Sodium Properties, Uses, Storage, and Handling, Dated September, 1994.

D-2(a)(2)(b) Labeling

Each container of HW/MW accepted at an HWMA unit is labeled with the labels (as applicable) shown in Table D-2. A photograph of the labels is shown in Attachment D-2.

Table D-2. HWMA Unit HW/MW Container Labels.

Label Type	Description
EPA Hazardous Waste Label	Identifies generator information and EPA identification and HWNs
MFC Barcode Label	Indicates the HW/MW container number that is included in the IWTS electronic database (or equivalent) and HW/MW inventory maintained by MFC

D-2(a)(2)(c) Handling

HW/MW container handling practices will include the use of trained and qualified rigging and hoisting operators and trained material handling personnel for the placement or removal of HW/MW containers to/from HWMA units. All MFC hoisting and rigging activities (including periodic inspections, load testing, certification, and hoisting and rigging of critical items/loads) will be performed in accordance with the requirements identified in the DOE "Hoisting and Rigging Technical Standard," DOE-STD-1090, the INL Lab Wide Procedure (LWP-6500) Hoisting and Rigging at the INL, and in facility-specific procedures.

Heavy equipment (i.e., forklifts and cranes) used for handling HW/MW containers in HWMA units are selected based on their unique ability to handle a particular size and type of HW/MW container. Typically, all large forklift-handled HW/MW containers will be placed on pallets to facilitate lifting and handling with a forklift without using additional hoisting and rigging tackle. However, in some cases, hoisting and rigging tackle (such as slings, wire rope, shackles, or drum-lifters) may be used. Forklifts and hoisting and rigging tackle used for handling HW/MW containers will be periodically inspected and load tested by qualified personnel.

D-2(a)(2)(d) Container Integrity

Before a HW/MW container is unloaded from the transporting equipment at a HWMA unit, HWMA unit facility personnel will inspect the container for damage, leaks, general appearance, markings, and labeling. A used, new, or reconditioned container will be accepted if HWMA unit facility personnel finds it to be sealed and in good condition (structurally sound, free of leaks). Upon acceptance, the HW/MW

container will be placed in the appropriate HWMA unit storage area (see Attachment D-3 for hazardous waste acceptance checklists). Inspections are documented on the HWMA Unit HW/MW Daily Container Transfer Inspection Form (ref. Attachment 4, Section F, Inspections).

HW/MW movement between buildings within MFC is generally by flatbed semitrailers, truck, or forklift. Container loading and unloading operations are conducted as described in Attachment 6, Section F, Procedures to Prevent Hazards, Section F-4(a).

D-2(a)(2)(e) Waste Placement

In accordance with National Fire Protection Association (NFPA) 101, The Life Safety Code (LSC) for Industrial Occupancies and Occupational Safety and Health Standards (OSHA), a minimum of 3 ft of aisle space is maintained for any means of ingress or egress into a HWMA unit. Placement of containers within the facility in accordance with this minimum aisle spacing requirement ensures unobstructed movement of personnel, fire protection equipment, spill control equipment and decontamination equipment to any area of the facility operation in an emergency.

Adequate aisle space is also maintained around containers to facilitate inspections of the containers and the storage, verification, repackaging and/or treatment areas.

As some HW/MW containers are irregular and nonuniform in size and shape, the number of HW/MW containers in an HWMA units storage area depends on the floor space occupied by the particular HW/MW containers and the secondary containment pallets or pans used (if storing liquids) to elevate containers of liquid HW/MW off the floor.

Container storage may involve stacking of containers of no more than two containers high. No stacking of containers with free liquids is allowed. Adequate aisle space will be maintained around containers to facilitate inspections of the containers. Container stacking may be performed at SCMS (MFC-793C and MFC-793G), and SSB (MFC-703).

SCMS storage configuration is provided in Attachment 1, Section B, MFC Facility Description, Attachment B-13.

SSB storage configuration is provided in Attachment 1, Section B, MFC Facility Description, Attachment B-16.

D-2(a)(2)(f) Maintenance during Storage

After HW/MW containers are placed in a HWMA storage-only unit, they are not opened or handled except when it is necessary to add or remove waste in accordance with IDAPA 58.01.05.008, 40 CFR 264.173(a). In addition, because HW/MW containers are not routinely handled or moved after placement in storage, the likelihood of an accident resulting in container rupture is minimized.

D-2(a)(2)(g) HWMA Unit Decontamination/Cleaning Between Waste Containers

Following verification, repackaging, and/or container treatment, all MW is removed from the HWMA unit where the activity is performed. Following removal of MW, decontamination and/or cleaning will be performed, if necessary. The decontamination and/or cleaning will be conducted consistent with the closure plan closure performance standards. Following this decontamination and/or cleaning future waste managed in the HWMA unit will only acquire the EPA HWNs assigned to the waste and the unit is considered to be free of all hazardous constituents in accordance with IDAPA 58.01.05.005; 40 CFR 261.

D-2(a)(2)(h) Inventory and Accountability

As described in Attachment 2, Section C, Waste Analysis Plan, the IWTS electronic database (or equivalent) is maintained by HWMA unit personnel and includes each HW/MW container received at a HWMA unit. A current inventory is maintained for each HWMA unit. For each HW/MW container, the database includes (but is not limited to) the following information:

- Container’s unique reference number
- Container’s location
- HW/MW description and hazardous constituents
- MW radionuclide composition
- Weight of the HW/MW
- Packaging

- Type of container
- Net and gross volume
- Gross weight
- Generating process
- Storage date.

D-2(a)(2)(i) Container Treatment

HWMA unit personnel conducting container treatment processes are trained and follow established procedures and/or guidelines for each treatment technique. This information will be provided in the WAP or in a HWMA unit-specific procedure. Treatments that may be conducted include absorption, neutralization and/or solidification/stabilization.

The primary neutralizing agents used include nitric acid or sodium hydroxide. The objective is to adjust the pH of the free liquid to a neutral pH. Solidification and stabilization agents used may include Aquaset-II-H and Aquaset II-G. These agents may also be used as a blend. The objective of solidification and stabilization would be to stabilize the material to meet UTS standards. The manufacturer information for these agents is found in Attachment D-4.

These container treatments will enable certain HW/MW to meet HWMA/RCRA UTS and WAC regarding pH, free liquids, and toxic metals. The HW/MW to be treated may contain both solids and liquids; therefore, different treatments will be selected accordingly. The general process is described below.

Container treatment procedures or WAPs will be developed, as required, and used based on bench scale testing results and/or information provided from commercial treatment agent vendors. The HWMA unit-specific treatment procedure will specify treatment process steps such as the amount of treatment agent(s) to be added, required pH, rate and order of HW/MW and treatment agent addition, rate and time of mixing, curing time (if appropriate), temperature control (if appropriate), and any other information important to proper treatment process control or desired outcome.

HWMA unit personnel will conduct the container treatments in accordance with the established treatment procedure or WAP. Container treatment procedures may be performed on the original container unless the original container integrity will not meet the WAC. In this case, the HW/MW will be transferred to a new container. Container size selected will depend on the volume of HW/MW and treatment agents to be added. The selected container will also be compatible with the HW/MW and treatment materials.

Upon treatment completion, treatment effectiveness will be determined in accordance with generator specifications and/or WAPs.

Following treatment, the HWMA unit where the container treatment was performed will be cleaned and inspected if required by facility-specific procedures.

The treatment will be documented in the HWMA unit operating record and may include the following information:

- Original container content code
- Container identification number
- Date of treatment
- Treatment conducted (absorption, neutralization, solidification)
- Treatment procedure or WAP used
- Type and amounts of treatment agents used
- Results of the treatment conducted (pH tests/visual verifications/free liquid test)
- Any additional comments by HWMA unit personnel.

This information will be used to update the applicable database regarding a specific HW/MW container. HW/MW characteristic information on a HW/MW container will be updated to ensure tracking of the initial HW/MW container and account for the final outcome of the container contents.

As an example, information on free liquid absorption process is presented as follows:

Absorption (free liquids). In order to meet a WAC for free liquid, absorbents will be added to absorb the free liquid. The container treatment procedural steps that will be used during the absorption/treatment process are as follows:

— The volume of free liquid to be absorbed will be determined and recorded.

— Adjustment of pH will be performed (if necessary).

— Required amounts of absorption agents will be added in accordance with the treatment procedure.

— The absorbent will be added to the free liquids and mixed in accordance with the method specified in the treatment procedure.

— Treated HW/MW will be visually inspected for signs of free liquids. If no free liquids are present, the treatment will be considered successful. If liquids are present, additional absorbent material will be added and the HW/MW will be remixed in accordance with procedural steps.

The type(s) of absorbent used will vary with the type of liquid and will be selected based on:

— Recommended usage and specifications provided by manufacturers

— Results of bench-scale testing

— Compatibility with the HW/MW.

Compatibility constraints of commercially available absorbents will be observed with the material being treated. No absorbents containing cellulose material will be used. Absorbents may include diatomaceous earth, Aquaset, Petroset, and Super Absorption Polymer (SAP). The manufacturer information for these absorbents is found in Attachment D-4.

D-2(a)(2)(j) Container Management during Verification, Repackaging, and/or Container Treatment

Standardized maintenance and housekeeping operations will be conducted for the HWMA units where container verification, repackaging, and/or container treatment is performed. Startup, operation, and maintenance of commercially available items will comply with the manufacturer's instructions and recommended practices.

Before conducting container verification, repackaging, and/or container treatment activities, there will be checks of the HWMA unit to ensure emergency equipment as identified on the applicable inspection form(s) is available.

D-2(a)(2)(k) Operating Procedures

This section provides a list and brief description of relevant operating procedures used to prevent any releases to the environment from waste handling and container management.

HFEF-OI-6601 (Waste, Equipment, and Scrap Handling at HFEF) provides instructions to establish and implement requirements for handling waste, equipment, and scrap at HFEF. Requirements encompass identification, segregation, characterization, packaging, and documentation of the various waste streams, equipment, and scrap to provide a means for proper disposal or storage.

HFEF-OI-6801 [Hazardous Waste/Mixed Waste (HW/MW) Requirements] specifies requirements for the evaluation and acceptance, receipt, and inspection of hazardous waste and mixed waste at the HFEF.

SCMS-OI-1 (Facility Information and Administrative Requirements) provides a description of the SCMS (including secondary containment, ventilation systems, fire detection and suppression systems and equipment) and scope of shop operations and uses. It also addresses administrative and environmental-safety-and-health requirements applicable to the facility such as requirements for all waste activities in which alkali metals (typically Na and NaK) are being handled or transferred.

SCMS-OI-6 (Materials Characterization, Segregation, and/or Repackaging in the SCMS Enclosure) provides instructions and requirements for characterizing, sizing, segregating, and repackaging radioactively-contaminated equipment and waste in the SCMS enclosure in preparation for treatment, disposal, or continued storage. Waste types include radioactive waste, sodium-bearing waste, non-radioactively-contaminated items, and mixed waste.

SCMS-OI-7 (Water Wash Vessel) provides instructions for operating the water-wash vessel which is used to treat alkali metal bearing wastes using water. This procedure also covers the transfer of liquids to the scrubber tank from drums and containers, and the transfer of liquids from the scrubber tank into drums for additional treatment.

SD-38.1.1 [Treatment, Storage, and Disposal Facility (TSDF) Environmental Compliance] identifies each TSD facility, the applicable environmental requirements for each TSD facility, the method of implementation for each environmental requirement, and the personnel responsible for implementation of the requirements and maintaining the associated operating records. It also identifies all applicable inspection log sheets and describes how inspections, deficiencies, and corrective actions are tracked.

TSD-OI-003 (Drum, Box, or ISC Handling) specifies generic drum or box handling requirements at Treatment, Storage, and Disposal (TSD) facilities. The procedure provides instructions for performing different handling functions associated with 5 to 110 gallon drums and boxes of various sizes, and the load/handling of interim storage containers (ISCs).

TSD-OI-004 (Waste and Material Acceptance for Storage/Treatment and Radioactive Inventory Control) specifies requirements and provides instructions for accepting hazardous waste, mixed waste, and radioactive waste and material from MFC and non-MFC generators at the SCMS and SSB. Specifically, this procedure defines the acceptance criteria for the facilities to ensure that waste or material accepted can be managed in a manner which complies with the operating requirements of the facility and environmental regulations.

D-2(a)(3) Secondary Containment System Design and Operation [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.15(a)(1) and 264.175(a)]

Secondary containment for containers with free-liquids may consist of a portable secondary containment device such as spill pallets, fabricated spill pans, or an overpack depending on the type, size, and configuration of the “free-liquid” container. A SWB may also provide secondary containment. Attachment D-5 provides photographs and example drawings of devices that can be used to provide secondary containment.

Secondary containment may also be provided by seal-welded (lined) or epoxy-coated concrete floors. Two HWMA units (HFEF and SCMS) have lined floors or epoxy-coated floors that provide an impermeable surface and a method to

collect spills of leaks. Seal-welded floors are maintained as secondary containment in HFEF (except in the HBA and HRA) and epoxy-coated floors are maintained as secondary containment at SCMS in the High Bay and Low Bay pit (see floor plan schematics in Attachment 1, Section B, MFC Facility Description).

Both portable and fixed secondary containment devices and floors are designed to have sufficient capacity to contain 10% of the total volume of containers stored within/on the secondary containment, or 100% of the volume of the largest container within its boundary, whichever is greater. Descriptions of secondary containment design, drainage, capacity, run-on, and free-liquid removable specifications for the pallets, pans, and overpacks are provided in the following subsections.

D-2(a)(3)(a) Requirements for the Base or Liner to Contain Liquids [IDAPA 58.01.05.008; 40 CFR 264.175(b)(1)]

Portable Secondary Containment Devices. Spill pallets, pans, and overpacks/boxes, will be used in container areas when the floors in the area do not serve as secondary containment. These devices are constructed of materials that are compatible with the ignitable, reactive, corrosive, toxic metal, and/or listed HW/MW that will be stored in/on the containment system to contain any spilled or leaking free liquids. The materials used in the construction of the secondary containment systems and dimensions, volumes, and capacities are as follows:

Portable Spill Pallets. Typically, portable spill pallets are constructed of translucent high-density polyethylene, which is compatible with a wide variety of HW/MW. The pallets have a support structure and a support grate used to elevate the containers off the base to prevent contact between the container and spilled or leaking HW/MW. The grate allows for visual detection of accumulated liquids during inspections.

Fabricated Spill Pans. Fabricated spill pans are typically constructed of steel. All of the seams will be welded in accordance with approved procedures. The welds will be visually inspected to ensure that the welds are free of cracks and holes. All containers stored in the spill pans will be elevated off the base of the pan to prevent contact between the container and spilled or leaking HW/MW. The spill pans may be designed to have a platform used to support the container and elevate the containers off the base. The platform will be grated to allow for visual detection of accumulated liquids during inspections.

Fabricated Overpacks. Typically, fabricated overpacks are constructed of steel, with continuous welds on the inside. All of the seams will be welded in accordance with approved INL procedures. The welds will be visually inspected to ensure that the welds are free of cracks and holes. The overpacks have cylindrical openings. The overpacks that are currently in use have an annulus filled with lead shot to provide shielding, if necessary. Containers within the overpacks may be elevated off the base.

Fixed Secondary Containment Floors. Lined rooms or storage areas with epoxy-coated floors are located in HFEF and SCMS. The floors in these HWMA units are described below.

HFEF. The HFEF preparation room (PR) and transfer room (TR) are surrounded by a 2-in. tall, 1/8 -in. thick steel curb. A 42-in. high stainless-steel wainscot is installed on the walls and over the curb of the PR/TR. The floor is covered with 3/8-in. thick sheets of steel. The floor and curb/wainscot are seal-welded at the seams and edges to form secondary containment. The 2-in. curb is maintained at the thresholds of the exterior doors. See Attachment D-6 for drawings that detail the PR/TR secondary containment.

The HFEF PR has a drain that is plugged and has a positive shutoff via a valve to maintain secondary containment. The valve is always closed and the drain is plugged whenever there is HW/MW in the room.

The spray chamber is a 7.75 x 9.5 ft and 12 ft high sealed stainless-steel chamber in the decontamination cell. The chamber was originally constructed for use in decontaminating equipment with low-pressure water spray and is provided with an impermeable lining around the base to a height of 22.5 in. The spray chamber was constructed to retain the water used in decontamination, which drains from the chamber through a floor drain to a holding tank. The drain (used in routine spray chamber operations) in the spray chamber floor is blocked off with a drain cover during MW verification, repackaging, and/or treatment operations to provide secondary containment. The drain cover forms a seal with the spray chamber floor and replaces the drain-pad screen basket.

Hinged doors on the east wall of the spray chamber provide a 6 x 12-ft opening into the spray chamber. Each door is opened with an air-operated cylinder and is fitted with a rubber gasket to seal water inside the spray chamber. A series of six air-operated toggle clamps compress the door gaskets and prevent leakage. The spray chamber doors are kept closed during drum unloading and HW/MW verification and are opened only during transfers of drums and bins between the spray chamber and decontamination cell.

As HW/MW is removed from the container, it is either placed onto a stainless-steel examination table (66 x 50 in. with a 2-in. lip) or into a 24 x 18 x 15-in lidded steel auxiliary collection bin.

HW/MW items are not allowed to be left out overnight and must be placed:

— In one of the two collection bins with the lid installed

— Back into the original container

— Into the SWB.

The spray chamber floor cover is a 5-in., diameter, by 2-in. thick steel plate with an attached bale handle and an affixed neoprene gasket. When in place, it forms a tight seal against the drain access lip. The spray chamber is a sealed enclosure that provides internal secondary containment for the HW/MW. See Attachment D-6 for drawings that detail the spray chamber secondary containment.

SCMS. The secondary containment features of the floors in SCMS are described in Subsection D-4, Tank Systems.

D-2(a)(3)(b) Containment System Drainage [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.15(a)(2) and 264.175(b)(2)]

HW/MW containers are stored inside the HWMA units (with the exception of RSWF) and, therefore, do not accumulate liquid from precipitation. Containers with free liquids are elevated within secondary containment. Note: containers may be staged directly on the floor to safely facilitate processing. HWMA unit personnel will be present during these operations.

D-2(a)(3)(c) Containment System Capacity [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.15(a)(3) and 264.175(b)(3)]

Portable Spill Pallets. Portable spill pallets used in HWMA units will be designed/selected to ensure that they contain 10% of the total volume of containers stored on them or 100% of the volume of the largest container, whichever is greater. Several types of spill pallets may be used in HWMA units. An example of a spill pallet that is currently used in HWMA units for 55-gal drums is a four-drum spill skid that has an 8000 lb load capacity. The exterior dimensions of the spill pallet are 51.5 x 51.5 in. and 10 in. tall. The interior dimensions at the bottom are 47 x 47 in. and 49.5 x 49.5 in. at the top. The bottom of each pallet is created to allow forklift access. The deck is 3/4 in. thick. The manufacturer specifications indicate that the pallet has 62 gal sump capacity.

These pallets are used to store 55-gal drums. No more than four 55-gal drums will be placed on the pallet at any one time. Therefore, the 62 gal sump capacity will contain either 10% of the total estimated volume of four 55-gal drums (22 gal) or 100% of the volume of the largest container (55 gal).

Fabricated Spill Pans. Fabricated spill pans used in HWMA units will be designed to ensure that they contain 10% of the total volume of containers stored in the pan or 100% of the volume of the largest container, whichever is greater. Containers will be elevated above the pan base with appropriate structures made of compatible materials.

An example of the interior dimensions of a spill pan are 90 x 216 in. and 4 in. tall. Ten percent (10%) of the volume is reserved for displacement by pallets. The capacity of the spill pan is calculated as shown in Table D-3.

Table D-3. Secondary Containment Capacity of Fabricated Spill Pan.

Secondary Containment	Dimensions
Interior dimensions of spill pan	90 × 216 × 4 in. (tall)
Containment volume of spill pan	(90 in)(216 in)(4 in)(1 gal/231 in^3) = 336 gal
Volume displaced (by pallet)	0.10 × 336 gal= 33.6 gal
Available capacity of spill pan	336 gal - 33.6 gal = 302.4 gal

This fabricated spill pan would have sufficient capacity to provide secondary containment of containers with a total volume of 302.4 gal (90% of 33.60 gal) or a single container holding a waste volume of up to 302 gal.

Fabricated Overpacks. Fabricated overpacks that may be used in HWMA units during the solidification process (for a 55-gal drum) are designed to ensure that they contain 100% of the volume of the container for which they provide secondary containment. Below is an example of dimensions and capacity of an overpack.

SWB. SWBs may also be used as secondary containment vessels. The capacity of an SWB when used as secondary containment vessel is 570 gal. Typically, the SWBs will be loaded within ten (10) days of transfer out of a HWMA unit. When used as a secondary containment vessel, the SWBs will be limited to containment of less than the volume of the SWB. Operation protocol at the HWMA units enables removing any free liquids resulting from leaks and spills.

For long-term storage, the SWB will be equipped with an interior support structure of sufficient height to allow for container elevation above the volume of a spill of 100% of the contents of the largest container plus the volume of liquid displaced by the interior grating or support structure. The capacity of an SWB when used as a secondary containment vessel is calculated as shown in Table D-4.

Table D-4. Secondary Containment Capacity of SWB.

Containment	Capacity
Total SWB volume	570 gal
SWB internal height	36.7 in.
SWB gal per inch of floor space	570 gal/36.7 in. = 15.5 gal/in.
Capacity of the largest stored container	55 gal
Estimated volume of liquid displaced by support structure	20%

Based on the information in Table D-4, the minimum height of the support structure is 4.3 in., as calculated below:

- 55 gal/15.5 gal/in. + 0.2 (55 gal/15.5 gal/in.) = 4.3 in.

To accommodate for a margin of error, a support structure will be used in the bottom of the SWB.

D-2(a)(3)(d) Control of Run-On [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.15(a)(4) and 264.175(b)(4)]

The likelihood of run-on into the secondary containment pallets, pans, and overpacks used for containment of HW/MW in HWMA units is controlled by elevation. The topography of the area where the HWMA units are located is high relative to its surroundings and drains away from the facility (Attachment 1, Section B, MFC Facility Description). Additional elevation above ground level is provided by the secondary containment platforms and/or supports. Elevation and secondary containment measures will effectively ensure all HW/MW containers are kept from contact with standing liquids.

D-2(a)(3)(e) Removal of Liquids from Containment Systems [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.15(a)(5) and 264.175(b)(5)]

Several measures will ensure that the secondary containment pallets, pans, and overpacks will not overflow because of spills, leaks, or accumulation of precipitation. The capacity of the pallets, pans, and overpacks will be sufficient to contain 10% of the volume of the containers within their boundary (if there are more than one) or 100% of the volume of the largest container, whichever is greater. The accumulation of run-on and precipitation in the secondary containment pans is prevented because of their physical location in the enclosed HWMA unit's storage areas.

In the unlikely event that liquids accumulate in the secondary containment pans, they can be identified during the daily and weekly inspections.

For example, in SCMS, because of the potential for corrosive liquids spills or leaks and because water reacts with the ignitable and reactive HW/MW that will typically be stored in HWMA units (Na and sodium-potassium alloy [NaK], which form sodium hydroxide [NaOH] and potassium hydroxide [KOH], respectively), pH measurements will be used to determine if the water is chemically contaminated. If the pH is determined to be < 2 or >12.5, it will be neutralized. Any spill materials will be packaged in drums and stored at HWMA units until further disposition.

D-2(a)(4) Test for Free Liquids [IDAPA 58.01.05.012; 40 CFR 270.15(b)(1)]

The presence or absence of free liquids in the HW/MW stored/to be stored in the HWMA units may be documented on an IWTS Profile or equivalent (ref. Attachment 2, Section C, Waste Analysis Plan). Certification will be made through analysis of the HW/MW or process knowledge and will be required by the HWMA unit's personnel prior to HW/MW acceptance.

D-2(a)(5) Container (without free liquid) Storage Drainage [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.15(b)(2) and 264.175(c)]

HW/MW containers are stored inside the HWMA units (with the exception of RSWF), and, therefore, do not accumulate liquid from precipitation. Containers without free liquids are elevated. Note: containers may be staged directly on the floor to safely facilitate processing. HWMA unit personnel will be present during these operations.

D-3 Basic Treatment System Description

This subsection provides basic system descriptions for HW/MW container and/or tank treatment systems (fixed in-place components) used to perform routine treatment processes. One of MFC's HWMA units has a fixed container and/or tank treatment system—SCMS. The treatment system for SCMS is discussed in Subsection D-3(a), SCMS Treatment System Descriptions.

D-3(a) SCMS Treatment System Descriptions

A floor diagram showing the location of each of the treatment systems within SCMS is provided in Attachment 1, Section B, MFC Facility Description, Attachment B-13. A process flow diagram, piping and instrumentation diagrams (P&IDs) for each system, and photographs and drawings of the systems components, are provided in the specified attachment(s) as shown in Table D-5.

Table D-5. Basic System Descriptions.

System	Permit Application Attachment(s)	
	Process and Instrumentation Diagrams	Photos/Drawings
SCMS Process Flow Diagram	D-7	–
Standard Process and Instrumentation Symbols	D-8	–
Piping and Instrumentation Diagram	D-9	–
Water Wash System	D-9	D-10 though D-16
Scrubber Water System	D-9	D-17 through D-20
Carbonation System	D-9	D-21 and D-22
Solidification System	D-9	D-23
Ventilation System	D-9	–
Service Water System	D-9	–
Carbon Dioxide System	D-9	–
Steam and Condensate System	D-9	–
Compressed Air System	D-9	–
Nitrogen System	D-9	–
Argon System	D-9	–

D-3(a)(1) Water Wash System

Ignitable and reactive characteristics of the HW/MW (typically Na and NaK) are deactivated in the water wash system. The water wash system is designed to perform the following deactivation processes:

— Deactivation of bulk ignitable and reactive HW/MW placed inside the water wash vessel (WWV) and or liquid HW/MW transferred to the WWV from the melt/drain and transfer feed container (Na and NaK)

— Deactivation of residual ignitable and reactive HW/MW remaining in closed containers that have been drained or emptied

— Deactivation of residual ignitable and reactive HW/MW contained in or remaining on debris, components, piping, open tanks, or other types of debris

— Deactivation of HW/MW accumulated from miscellaneous containers on-Site

— Aggregate HW/MW from multiple containers or tanks.

Process. In the WWV, the ignitable and reactive characteristics of HW/MW are deactivated in a controlled process (via water reaction/water washing) where the ignitable and reactive HW/MW reacts with air and water, ultimately forming a hydroxide solution (OH) by the following reaction (as shown for Na):

- Direct Water Reaction

$$Na + H_2O \rightarrow NaOH + 1/2H_2$$

- Direct Air Reaction

$$2Na + 1/2O_2 \rightarrow Na_2O$$

The hydroxide solution produced from the direct reaction with water drains into the scrubber water tank. Airborne reaction products from the water reaction are advanced through the water wash scrubber via a 3000 cfm air flow where the airborne particles combine with water droplets to form a hydroxide solution by the following reaction (as shown for Na):

- $Na_2O + H_2O \rightarrow 2NaOH$

The water wash system basically consists of a WWV and a ventilation system. The WWV contains the ignitable and reactive HW/MW water, and ignitable and reactive waste-air reactions and resulting hydrogen-air reaction. The WWV protects personnel from these reactions and from heat; corrosive, ignitable, and reactive HW/MW burns; and radioactive contamination. The ventilation system consists of a venturi scrubber with a liquid separator, moisture separator, air heater, two banks of high efficiency particulate air (HEPA) filters, exhaust fan, and direct-to-atmosphere vent. The exhaust fan draws an air flow of 3000 cfm through the WWV, diluting the gaseous vapor reaction products.

The aqueous solutions generated from bulk, residual, and debris treatment operations are drained to the scrubber water tank by gravity flow through a 2-in. drain line from the center of the bottom head.

Airborne reaction products from deactivation of ignitable and reactive HW/MWs are drawn from the WWV through the venturi scrubber, moisture separator, and HEPA filters before being released to the SCMS exhaust stack. A direct-to-atmosphere vent line from the WWV is incorporated as an alternative for venting hydrogen in the event the exhaust fan fails during operation. The height of this atmospheric vent and numerous bends within the exhaust system minimize the possibility of HW/MW release. The water wash system is not allowed to operate when this backup system is in operation; treatment is secured immediately. In the event this vent is opened, operators will be notified by (1) an audible alarm that sounds on the SCMS control panel, (2) the very loud operation of the air-operated valves, and (3) an indication of normal exhaust differential pressure/flow changes.

Water is injected into the air stream through spray nozzles upstream of the venturi scrubber. The scrubbing action takes place as the water is sprayed into the air stream as it is accelerated through a venturi. The water containing the dissolved particulate/vapor is then removed by the downsteam liquid separator contained in the water wash scrubber.

Air and liquid flow through the flooded elbow into the bottom of the separator. The air and liquid mix passes into a cyclonic-entrainment separator that exerts centrifugal and gravitational forces to separate the liquid and air. The liquid flows out of the separator through the bottom drain, and the scrubbed air flows up through the water wash scrubber.

The moisture separator and air heater are installed downstream of the scrubber to reduce moisture condensation in the HEPA filters. They are both installed in the same housing. The heater is designed to raise the temperature of 3000 cfm of air a minimum of 10°F. Increasing the air temperature raises the dew point; thereby, reducing condensation in the HEPA filters.

There are two banks of HEPA filters downstream of the air heater to serve as final collection for smoke and airborne particulate contamination. The HEPA filters will remove particulates with a 99.97% efficiency for particle sizes 0.3 microns or larger.

The two banks of filters are arranged in parallel, with manually-operated isolation dampers upstream and downstream of each bank. Only one filter bank will be in operation at a time. The other bank will be in standby for use if the operating filter plugs up or fails. Switching to the standby filter bank will normally be done when the filter differential pressure exceeds the operating limit of 5 in. H_2O.

The water wash system exhaust fan is located outside of the SCMS, at ground level, on the south side of the SCMS Low Bay. The exhaust fan is rated to deliver 3000 cfm at this altitude.

The WWV has automatic dampers to isolate it from the normal ventilation system, and to open a vent to the atmosphere outside the building if the fan fails during operation. If ventilation flow is stopped because of fan failure or plugging of HEPA filters, a pitot-static tube in the fan discharge provides a signal to the pressure switch. The pressure switch will deenergize solenoid valves in the air lines to their respective dampers, the normal inlet and outlet dampers will close, and the emergency vent damper will open.

Venturi Scrubber and Liquid Separator. The venturi scrubber is used to remove reaction product smoke and other particulates from the ventilation air stream. It is designed to remove the smoke resulting from burning 50 lb/hr sodium in air, assuming that all the burned sodium results in smoke and is in the form of sodium monoxide (Na_2O). The scrubber is specified to have an efficiency of 97% for a particle size of 0.37 micron, regardless of composition. A drawing of the venturi scrubber is provided in Attachment D-14.

The venturi and separator are constructed of Type-304 stainless steel for resistance to corrosion by the hydroxide solution.

Instrumentation on the scrubber includes a locally-reading thermometer on the air outlet line and differential pressure sensor across the filter. The differential pressure indicator is mounted on the water wash ventilation gauge panel on the wall south of the instrumentation and control (I&C) panel. The I&C panel is located west of the scrubber.

Moisture Separator. The moisture separator is constructed of stainless steel and contains a knitted pad of stainless-steel mesh, about 2 ft^2 x 4-in. thick. It is capable of removing 99.9% of the entrained moisture when operating under conditions recommended by the manufacturer. The moisture that collects in the pad agglomerates into larger droplets and drains by gravity through the vent line back to the liquid separator. A drawing of the moisture separator is provided in Attachment D-15.

The air heater consists of a Type 316 stainless-steel, finned-tube assembly, heated by steam from the building steam system.

There are locally indicating thermometers at the inlet (D11-TI-111) and outlet (D11-T1-114) of the heater to monitor the air temperature rise.

HEPA Filters. Each filter bank contains four filters; each filter is 2 ft^2 x 1-ft. deep. The filter banks are contained in "bagout" housings that are designed so that the filters may be removed into plastic bags without exposure to the atmosphere. Drawings of the HEPA filter process ventilation system are provided Attachment D-16.

Instrumentation for the filters includes differential pressure indication and high differential pressure alarms across each bank of filters. The indicators are located on the water wash ventilation gauge panel and the alarms activate the "Water Wash System Abnormal" alarm on the SCMS High Bay I&C panel.

Exhaust Fan. The fan is a single-suction, squirrel-cage blower, constructed of carbon steel. It is driven by a 50 HP, 480 V, 3 phase, totally-enclosed motor. Discharge from the fan is routed to the SCMS building ventilation exhaust stack, where it joins the 10,000 cfm exhaust flow from the SCMS High Bay Area.

D-3(a)(2) Scrubber Water System

The scrubber water system receives aqueous liquid solutions from HW/MW treatment operations performed in the water wash system and/or aqueous carbonate solutions from the deactivation of corrosive HW/MW in the carbonation system.

The scrubber water system supplies or transfers solutions to the following:

- The venturi scrubber for the removal of airborne reaction products resulting from the deactivation of ignitable and reactive HW/MW in the water wash system
- The WWV for treatment of container residuals and debris treatment operations in the WWV
- The carbonation vessel for deactivation of the hydroxide solutions and conversion to their carbonate form
- The solidification system for solidification/stabilization prior to disposal.

Process. During HW/MW treatment operations performed in the water wash system, all the solutions that drain from the WWV and from the venturi scrubber go directly to the scrubber water tank. The scrubber pumps take suction from the tank and supply the solution back to the venturi scrubber or to the WWV for residual deactivation operations. Recirculating the scrubber water tank solution reduces the amount of liquid requiring further treatment by reducing the makeup water requirements and by evaporating water and concentrating the solution.

The scrubber tank solution can be recirculated until a maximum equivalent hydroxide concentration of 15 wt% is reached.

The equivalent hydroxide concentration in the scrubber water is measured continuously when the system is in operation. The readout for the meter is a digital volt meter, calibrated in % NaOH, located on the SCMS High Bay I&C panel.

The scrubber water tank sampler is installed above the SCMS Low Bay Pit grating in a stainless-steel enclosure. The scrubber water sampler provides a hard piped means of sampling the scrubber water directly, with a minimal potential for leakage or spills.

D-3(a)(3) Carbonation System

The corrosive characteristics of HW/MW that require deactivation (pH ≤2 or ≥12.5) following and/or prior to additional treatment processes include:

— Hydroxide solutions produced in the SCMS water wash system

— Containerized liquid corrosive HW/MW received at SCMS.

These corrosive solutions or liquids can be deactivated by carbonating the hydroxide solution with CO_2 in the SCMS carbonation system or by neutralizing the hydroxide solution or corrosive liquids with nitric acid. Carbonation or neutralization will be performed to within an acceptable pH range ($2 < pH < 12.5$) to deactivate the corrosive characteristic and/or to obtain the optimum pH for subsequent solidification/stabilization of the carbonated/neutralized solutions. The manufacturer information for the agents used is found in Attachment D-4.

Process. The carbonation system utilizes some components of the scrubber water system to supply solutions to the carbonation vessel.

Deactivation of ignitable and reactive HW/MW in the water wash system generates hydroxide solutions that drain to the scrubber water tank. This hydroxide solution is

then recirculated and used in the water wash system until a maximum 15 wt% hydroxide concentration is attained. The carbonation of the hydroxide solution begins by transferring the solution from the scrubber water tank to the carbonation vessel using the scrubber pump(s).

The hydroxide solution in the scrubber water tank is recirculated through the bottom of the carbonation vessel at a rate of approximately 1 gpm, where it is contacted with finely divided gaseous CO_2, introduced through a sintered metal sparge element of 10 μm porosity. The CO_2 reacts with the hydroxide solution by the following reaction:

- $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$

The recirculated solution gravity drains from the carbonation vessel back to the scrubber water tank. A combination of the mass of CO_2 delivered and the carbonation vessel pressure and temperature provides an indication of hydroxide to carbonate conversion completion. Sampling and analysis from the scrubber water tank confirms the conversion of hydroxide solution to a carbonate solution of pH > 2 and < 12.5.

In addition to the carbonation system, neutralization can be used for deactivating the corrosive liquids generated in the WWV. Corrosive liquids are neutralized by adding a precalculated amount of acid or base (i.e., nitric acid or sodium hydroxide) as a neutralizing agent. The amount of neutralizing agent will be based on the pH of the corrosive material and desired final pH.

D-3(a)(4) Solidification System

Solutions or liquids that may require solidification or stabilization prior to disposal can be solidified or stabilized in the SCMS solidification system (typically in, but not limited to, 55-gal drums). Solidification or stabilization of the solutions will be performed, as necessary, to meet UTS and/or disposal facility WAC criteria (free liquid tests).

Solutions or liquids that may require solidification or stabilization include:

— Non-HWMA/RCRA solutions resulting from the deactivation of ignitable, reactive, and/or corrosive HW/MW

— Toxic metal-contaminated HW/MW.

The solidification or stabilization procedure, and the type and amount of solidification or stabilization agent used, is based on the analysis of a representative sample of the non-HWMA/RCRA waste or toxic metal-contaminated HW/MW solution taken prior to the solidification or stabilization treatment process and one of the following:

— An approved WAP and a treatment procedure for a specific HW/MW stream

— Recommended usage and specifications provided by agent manufacturers based on bench-scale testing for a particular HW/MW stream.

Solidification and stabilization agents may include natural materials such as vermiculite, silicates, clays, or synthetic materials such as absorbent polymers. Examples of agents used include Aquaset II-G and Aquaset II-H. The manufacturer information is found in Attachment D-4.

Solidification Station. The solidification station is used to treat prefilled containers or accommodate transfer operations to place materials within new containers for treatment. The station consists of an enclosure (glovebox), a variable speed/position mixer, and a hydraulic lift platform. Containers requiring treatment are placed within a shielded overpack (ref. example provided in Attachment D-24) and raised into position under the mixer. The mixer is operated and the solidification/stabilization agent is added. The container is inspected for free liquid and, if required, a sample is taken. The treated container is then removed from the solidification station (ref. Attachment D-23).

Process. The solidification station can receive liquids from the following sources:

— Scrubber water tank

— Demineralized water line

— External transfer line

— CO_2 system.

The solidification station also has additional lines that can be adapted for use in other HW/MW transfer operations. Containers requiring treatment are placed within a shielded overpack and raised into position under the mixer by the hydraulic lift platform. The containers are then connected to the solidification station using a bag-in sleeve system. The mixer is operated at varying speeds and elevations within the container using a disposable blade apparatus. Waste, liquids, treatment

chemicals, and solidification/stabilization agents are added as required for treatment based on waste form development bench-scale testing. The container is inspected for free liquid and, if required, a sample is taken. The treated container is then removed from the solidification station.

D-3(a)(5) Support Systems

The support systems for the operation of SCMS are described in the following subsections.

D-3(a)(5)(a) Ventilation System

The major components of the SCMS ventilation system are a 10,000-cfm exhaust fan, a 350-cfm auxiliary exhaust fan, one 3000-cfm roof exhaust fan, two main HEPA filter banks, an exhaust stack, and associated ductwork and dampers (ref. Attachment D-16).

Building 793 Main Exhaust Fan. The main exhaust fan is located on the south side of the SCMS Low Bay.

The fan takes suction from the SCMS High Bay and the SCMS Low Bay through two main HEPA filter banks. The fan discharges to the outside atmosphere through the building exhaust stack.

The fan suction line branches in the SCMS Low Bay to draw air through two main HEPA filter banks. The first bank consists of eight 1000-cfm filters mounted in a box frame in the south wall of the SCMS High Bay. The other main filter bank consists of four 1500-cfm HEPA filters in a bagout housing mounted on the wall just west of the first bank.

There are two branches of ductwork to the inlet plenum of the bagout set of filters that provide exhaust from specific areas of the SCMS High Bay. The branches are identified as the upper-level exhaust duct and the lower-level exhaust duct.

The upper-level exhaust duct takes suction through three inlets in the extreme overhead of the SCMS High Bay. This flowpath is provided to remove any flammable vapors that may accumulate as a result of processing operations. The lower-level exhaust duct circles the SCMS High Bay on the south, west, and north sides.

There are eight inlets to the lower-level duct; four along the south wall and four along the north wall. These inlets are provided to connect flexible exhaust tubing for local area contamination control.

Auxiliary Exhaust Fan. There is a small, 350-cfm auxiliary exhaust fan in the SCMS Low Bay, which is configured in parallel with the main fan.

Exhaust Stack. The main SCMS exhaust stack is mounted on a concrete foundation just south of the SCMS Low Bay. It is a free-standing stack, 3 ft 6 in. in diameter and 48-ft. tall. The main and auxiliary exhaust fans and the water wash ventilation fan all discharge through the stack.

There is an isokinetic flow tube near the top of the stack to provide a sample of the exhaust air to a stack monitoring system. The stack monitor is located in the SCMS Low Bay and monitors for gross beta and alpha particulate activity.

Roof Exhauster Fan. A 3000-cfm roof exhauster fan is located on the peak of the SCMS High Bay roof. This fan is normally operated only during warm weather to cool the building.

Outside Air Supply. Outside air enters the SCMS High Bay through an air-inlet filter bank located high on the wall in the northeast corner. The filter bank comprises standard furnace filters and is used to limit dust entering the building.

There are thermostatically controlled electric heating coils in the SCMS High Bay air inlet to preheat the air in the winter.

Air is supplied to the equipment in the SCMS Low Bay by an externally mounted swamp cooler through an internal distribution duct along the south wall.

D-3(a)(6) Service Water System

Two separate water supplies make up the SCMS service water system. Demineralized water and potable water are supplied to the SCMS through underground piping. Both systems enter the building in the southeast corner of the SCMS Low Bay (ref. Attachment D-9).

Demineralized water comes from the EBR-II power plant purified water supply system at a pressure of about 80 psig. The line is routed to the SCMS High Bay where it supplies two hose outlets located on the south wall.

Demineralized water supplies SCMS tank treatment processes that require pure water.

Potable water is supplied by galvanized-steel piping from the main water line at a pressure of about 100–110 psig. At the point of entry into the SCMS Low Bay, this pressure is reduced to about 45 psig for distribution throughout the building.

D-3(a)(7) CO_2 System

Carbon dioxide (CO_2) gas can be used at SCMS to deactivate hydroxide solutions in the carbonation system (ref. Attachment D-9). Gaseous CO_2 can be supplied by the CO_2 manifold located in the SCMS High Bay by three portable liquid CO_2 dewars.

D-3(a)(8) Steam and Condensate System

Steam is supplied to the SCMS at 50 psig from a local boiler installed in the MFC 793 Annex. It is routed to the southwest corner of the SCMS High Bay where it supplies steam to the Water Wash Exhaust Air Heater. A relief valve provides overpressure protection.

The steam is drained through steam traps. All condensate is discharged to the building's industrial waste drain.

D-3(a)(9) Compressed Air System

Compressed air is supplied to the SCMS by two air compressors. One is the main plant/breathing/process-instrument compressor that supplies most of the loads. The other is a small auxiliary instrument air compressor (ref. Attachment D-9).

The main air compressor is housed in a small shed on the southwest side of the SCMS Low Bay. It supplies air (at 110 psig) throughout the SCMS for the following uses:

— Hose outlets for general plant air use in the SCMS High Bay

— Water wash system ventilation flow control and pneumatically operated ventilation valves on the water-wash tank.

The auxiliary instrument air compressor is located inside the SCMS Low Bay near the south wall. The compressor supplies air (at 20 psig) to the following:

— Carbonate retention vessel level indicator

— Main building exhaust fan outlet damper controls

— Thermostat control for the building supply air preheat coils.

D-3(a)(10) Nitrogen System

In the SCMS facility, nitrogen gas is typically used for purging and inerting when working with Na or NaK (ref. Attachment D-9).

D-3(a)(11) Fire Suppression System

In case of small Class A, B, C, or D fires, portable fire extinguishers of CO_2, dry chemical, and Met-L-X types are placed in the facility for personnel use. Silica sand and carbonate are also available in these areas for personnel use on Na or NaK fires.

D-4 Tank Systems [IDAPA 58.01.05.012; 40 CFR 270.16]

D-4(a) SCMS Existing Tank Systems

SCMS presently contains two connected tank systems—the water wash system and the scrubber water system—that are considered to be existing tank systems in accordance with the definition in IDAPA 58.01.05.004 and 40 CFR 260.10 and the preamble in 51 Federal Register (FR) 25446, Section IV.B.4, *Design and Installation of New Tank Systems*. These tanks systems were built in 1980, installed in 1981, and put into service as HW/MW (or materials) storage or treatment tank systems prior to the promulgation date of the regulations (July 14, 1986).

These two existing tank systems—the water wash system and the scrubber water system—meet secondary containment requirements in accordance with IDAPA 58.01.05.008 and 40 CFR 264.193 as described in Subsection D-4(b). The secondary containment has been:

- Designed, installed, and operated to prevent any migration of HW/MW or accumulated liquid out of the systems to the soil or groundwater
- Designed to detect (or allow detection of) releases of HW/MW and accumulated HW/MW until the collected material is removed
- Constructed and lined with materials that are compatible with the HW/MW placed in the tanks systems and have sufficient strength and thickness to prevent failure
- Constructed of a base that is sufficient to provide support to the secondary containment system
- Provided with leak detection capability (inspections) that will detect the failure of either the primary or secondary containment or the presence of any release of HW/MW or liquids in the secondary containment within 24 hours
- Sloped to drain and remove liquids resulting from leaks or spills.

D-4(a)(1) Assessment of Existing Tank System Integrity [40 CFR 270.16(a), 264.191]

Because these two tank systems meet the definition of an *existing tank system with secondary containment*, they do not require a written assessment of their integrity. However, information on the tank systems and ancillary equipment has been provided in this subsection.

The feed and ancillary systems for the water wash system and the scrubber water system are shown in Table D-6.

Table D-6. Existing Tank System Feed and Ancillary Systems.

Water Wash System	
Systems	Water Wash Vessel
Feed System(s)	Ventilation System Service Water System
Ancillary System(s)	Scrubber Water System Nitrogen System Argon System Compressed Air System Steam and Condensate System
Scrubber Water System	
Systems	Scrubber Water Tank
Feed System(s)	Water Wash System Carbonation System Service Water System
Ancillary System(s)	Compressed Air System Water Wash System Carbon Dioxide System Ventilation System Carbonate Retention Vessel Solidification System

The water wash system and the scrubber water system tanks and ancillary equipment have been designed, and have the structural integrity, to contain the hazardous characteristics of HW/MW processed in the systems. Inspection and

testing (preventative maintenance checks) of the water wash system and the scrubber water system conducted on a routine basis are detailed in SCMS-specific procedures. These preventative maintenance checks are performed in accordance with SCMS operating procedures. Major deficiencies and repairs are noted in the SCMS operating record.

The design standards (basis) to which the water wash system and the scrubber water system tanks and ancillary equipment (components) were constructed are provided below:

WWV. MFC has been reacting ignitable and reactive HW/MW (consisting mainly of Na/NaK) in the WWV since installation of the unit in 1981. The limits of flammability and detonability of hydrogen in air were important in designing the system and determining the operating limits. The flammability limits define the hydrogen/air concentration that will burn. This concentration ranges from 4 to 75 percent by volume of hydrogen in air. Within these limits, the lower-order explosions, called deflagration, can occur. The detonation limits define the hydrogen/air concentration that can result in high-order explosions. The detonation limits are from 18.3 to 59 percent by volume of hydrogen in air.

Both classes of explosion cause a sudden increase in pressure in a confined space. A detonation, involving a greater energy release, results in a theoretical pressure rise of 1464 psig, while a deflagration would result in a calculated pressure rise of 86 psig. Designing a vessel to contain the maximum theoretical pressure rise would be impractical and prohibitively expensive. Therefore, the WWV design was based on the pressure rise of a deflagration.

The air intake to the WWV is essentially open to atmosphere, with only the differential pressure caused by the exhaust fan to keep pressure surges inside. A sudden overpressure could blow back through the air intake. The WWV burn pan is administratively controlled to contain a maximum amount of ignitable and reactive HW/MW at any one time, but never to exceed 156 gallons/day. A detailed engineering evaluation is written and maintained in the facilities operating record to document the maximum amount of ignitable and reactive HW/MW that can be treated in the WWV at any one time and determine needed safety and administrative limits. These limits are implemented through operating procedures to prevent over pressurization of the WWV. Deactivation procedures are written to limit the rate of the reaction and therefore the rate of hydrogen generation.

The WWV is a vertical cylindrical tank with dished top and bottom heads. It is about 10 ft in diameter and 12 ft high. It is constructed of Type-304 stainless steel for corrosion resistance.

The WWV design was based on the pressure rise of a hydrogen deflagration explosion, not a detonation explosion. It was hydro-tested to 86 psig instead of the 75 psig (1.5 x design pressure) specified by the code to withstand the maximum hypothetical pressure of a hydrogen deflagration. It normally operates at or near atmospheric pressure since it is always vented to the atmosphere through the normal or emergency vent system. All internal structural welds were ground flat and the inside of the tank was polished to make the water wash easier. All welds were made in accordance with applicable welding code requirements. Prior to daily operation, visual inspections of all parts of the water wash system are conducted to detect for signs of damage and leakage.

An equipment access nozzle on top of the WWV consists of a flanged section of 36-in. pipe projecting vertically from the center of the top head. The opening is sealed with a blank flange bolted in place during deactivation operations. The exhaust vent line is a 12-in. pipe exiting off the side of the equipment access nozzle. The inlet vent line is 12-in. pipe entering into the side of the WWV about 2 ft from the bottom and on the opposite side from the exhaust line.

There is a personnel and equipment access door on the side of the WWV, near the bottom. It is oblong in shape, 2.5 x 4 ft. It swings inward to open and may be operated from the inside as well as the outside. It is closed by six manually operated lever closures and sealed with a neoprene gasket. The door has a 4-in. circular viewing port in a gasketed-flanged mounting. The port is made of tempered glass and rated to withstand a pressure of 150 psig.

An angle-iron flange is welded to the WWV surrounding the door to seal an external change room to the WWV.

Removable floor grating is installed near the bottom of the WWV to provide a working platform for personnel and equipment/components/debris. It is made of Type-304 stainless steel and has a working load rating of 150 lb/ft^2.

There are four penetrations in the WWV for spray lances, spaced 90° apart, and about 3.5 ft above the floor grating. Each lance consists of a spray gun, piping, and a spray nozzle. The spray gun valve is outside the WWV, from which the spray is controlled and directed. The pipe penetrates the wall through a flanged ball and socket joint, which is bolted to a mating flange and welded to the WWV wall. This arrangement allows the nozzle to swivel through an included angle of 80° in any direction. The inlet to the spray gun is a stub-pipe with a quick disconnect coupling, to which a water hose is connected. The section of spray pipe inside the WWV is about 30 in. long. It terminates in a spray nozzle and contains a check valve to prevent blowback in case of an explosion in the WWV.

There are two viewing ports adjacent to two spray lances for observing the interior of the WWV during deactivation operations. The glass is contained in a flanged housing with cushioning gaskets, that is bolted to a mating flange welded to the WWV wall. They are 6 in. in diameter and made of tempered glass designed to withstand a pressure of 150 psig.

There is a 12-in. flanged penetration into the WWV on the south side near the top. Its purpose is to route air lines and electrical power to the WWV for maintenance work. The cover flange for this penetration contains bulkhead fittings for tubing and the valve operator for the drip-pan drain valve.

The interior of the WWV is lighted by two explosion-proof light fixtures mounted inside the top head. They are powered from the 110 VAC lighting panel.

The only instrumentation directly associated with the WWV is a locally-reading thermometer and a pressure gauge on the outlet vent line on top of the WWV.

Venturi Scrubber. The venturi scrubber was designed to remove the smoke that results from burning 50 lb of ignitable and reactive HW/MW per hour, assuming that all of the burned HW/MW results in smoke, and remove particulates with a mean particle size of 0.37 micron at an efficiency of 97% or greater.

The venturi and separator are constructed of Type-304 stainless steel for resistance to corrosion by the hydroxide solution. The venturi is a convergent/divergent nozzle of rectangular cross section, about 14 in. wide. It has a manually-operated damper that varies the throat opening from 1 in. to a maximum of 2 in. The velocity/pressure-drop across the venturi is determined by the position of the damper. The design maximum pressure drop is 38 in. H_2O at 3000 cfm.

Instrumentation on the scrubber includes a locally-reading thermometer on the air outlet line and differential pressure sensor across the venturi. The differential pressure indicator is mounted on the water wash ventilation gauge panel on the wall south of the I&C panel. The I&C panel is located west of the scrubber.

Moisture Separator. The moisture separator was designed to remove 99.5% of the entrained moisture in the off-gas stream and is made of stainless-steel materials that are resistant to the 25% concentrations of hydroxide solutions.

Air Heater. The air heater was designed to raise the off-gas air temperature a minimum of 10°F. This rise in air temperature precludes the condensation of moisture in the HEPA filters.

The air heater consists of a Type-316 stainless-steel, finned-tube assembly. It is heated by approximately 15 psig steam from the building steam system. Steam flow to the heater is controlled by a manual globe valve. Condensate drains from the heater through a steam trap to the building drain main.

There are locally indicating thermometers at the inlet (D11-TI-111) and outlet (D11-T1-114) of the heater to monitor the air temperature rise.

HEPA Filters. The HEPA filters were designed to remove particulates with a 99.97% efficiency. Dual banks of filters were installed to assure continuous operation in the event of filter failure or excessive fume loading.

Scrubber Water Tank. This tank was designed to provide scrubber solution recirculation capabilities. This provides minimization of corrosive radioactive liquid HW/MW.

Scrubber Water Tank and Pumps. The scrubber water tank and pumps are located in the SCMS Low Bay Pit in the SCMS Low Bay. The pumps are piped in parallel configuration with common suction and discharge lines. Normally, one pump is operating with the other in standby. All valves in the system are manually operated with the exception of the automatic makeup water supply to the scrubber water holding tank. The system piping is Type-304 stainless steel with welded connections.

The transfer piping to the fixed and removable solidification units are also Type-304 stainless steel with welded connections. Isolation valves are manually operated stainless-steel gate valves.

The scrubber pumps are manufactured by March Co., Model TE-7R-MD. The pump is a magnetically coupled 15-gpm centrifugal pump, hermetically sealed unit with no physical connection between the motor and pump shaft. The motor is a 3/4 Hp, single-phase, 120 VAC, 60 Hz, explosion proof, induction motor. Since no shaft penetrates the pump case, the possibility of leakage through the shaft is eliminated. All wetted parts of the pump are stainless steel except a ceramic spindle and washer.

The scrubber water tank is a 350 gal, vertical, cylindrical tank with conical top and bottom heads. The maximum administrative capacity of the scrubber water tank is 300 gal. It is constructed of Type-304 stainless steel for corrosion resistance. It is vented to the atmosphere through the vent line to the carbonate retention vessel line and, therefore, not subjected to pressure. The tank has three separate level probes, for level control, indication, and high-level alarm.

Scrubber Water Sampler. The scrubber water sampler consists of stainless-steel lines and valves and a 300-cc stainless-steel sample chamber. The sample chamber is fitted with quick-disconnects to minimize any leakage during sampling. The scrubber pumps provide the flow upward through the sampler and then returns it to the scrubber water tank.

There is a pressure gauge (D21-PI-109) on the common discharge line from the pumps and a thermometer (D21-TI-112) and flowmeter (D21-FI-115) in the line at the venturi scrubber. Flow to the scrubber is regulated with a manual ball valve upstream of the flowmeter.

D-4(a)(2) External Corrosion Protection [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(e) and 264.192(f)]

The WWV and scrubber water tank are constructed of stainless steel for resistance to corrosion and are designed to hold aqueous solutions. The WWV is located above ground inside the SCMS High Bay. The scrubber water tank is elevated off the floor of the SCMS Low Bay Pit. External corrosion is not a factor of concern as the external surfaces of the WWV and scrubber water tank are not in contact with soil or water.

D-4(b) New Tank Systems [IDAPA 58.01.05.012; 40 CFR 270.16]

SCMS presently contains one tank system—the carbonation system—that is considered to be a new tank system in accordance with the definition in IDAPA 58.01.05.004 and 40 CFR 260.10, and the preamble in 51 FR 254.46, Section IV.B.4, *Design and Installation of New Tank Systems*. This tank system was built in 1994, installed in 1995, and put into service as a HW/MW (or materials) storage or treatment tank system after the promulgation date of the regulations (July 14, 1986). As a result, a written assessment of the tank system was conducted. A copy of the assessment is provided in Attachment D-25. Information on the assessment is provided below.

D-4(b)(1) Assessment of New Tank System Integrity [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(a) and 264.192(a)]

Feed and ancillary systems associated with the carbonation system are identified in Table D-7.

Table D-7. New Tank System Feed and Ancillary Systems.

Carbonation System	
Systems	Carbonation Vessel
Feed System(s)	Scrubber Water System Carbon Dioxide system
Ancillary System(s)	Water Wash System Service Water System Solidification System Compressed Air System

The written assessment on the carbonation system (ref. Attachment D-25) identifies the following:

— Design standards according to which the tank and auxiliary equipment were constructed

— Hazardous characteristics of the HW/MW being handled

— Design considerations to ensure:

- Tank foundations will maintain the load of a full tank
- Tank systems will withstand the effects of frost heave.

The tank assessment provides information on the structural integrity and suitability of the tank system for handling HW/MW and has been reviewed and certified by an independent, qualified, registered professional engineer.

The carbonation vessel is a 30-gal, stainless-steel tank with a conical bottom. It is classified as a new tank system and has been assessed, certified, and tested in accordance with IDAPA 58.01.05.018 and 40 CFR 264.192. This tank has been inspected for weld breaks, punctures, corrosion, and cracks. None were found. The tank is not coated. The original supports are being used. This tank is not subject to flotation, dislodgement, or frost heaving. The tank is bolted to the concrete floor. The anchors are sufficiently strong to prevent horizontal motion during design-basis seismic events or inadvertent disturbances. In addition to the anchors, tipping is precluded by the platform base-to-tank height aspect. The tank has been successfully hydrostatically leak tested to 25 psig. Operating pressure is not expected to exceed 10 psig.

Carbonation vessel pressure is relieved directly to the water wash scrubber, which operates at a negative pressure. Pressure is also monitored during carbonation operations. Hydroxide level is limited by the normal recirculating path—the carbonation vessel overflows to the scrubber drain. Flow and level are monitored through sight tubes in the vent and overflow drain. After carbonation, the tank is verified empty through the overflow drain sight tube.

A thermocouple and pressure gauge are installed to monitor tank temperature and pressure during the carbonation process.

Carbon dioxide (CO_2) gas is supplied from the CO_2 system.

D-4(b)(2) External Corrosion Protection [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(e) and 264.192(f)]

The carbonation vessel is constructed of stainless steel for resistance to corrosion and is designed to hold aqueous solutions. The vessel is located above ground inside the SCMS High Bay. External corrosion is not a factor of concern because the external vessel surfaces are not in contact with soil or water.

D-4(b)(3) Description of Tank System Installation and Testing Plans and Procedures [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(f) and 264.192(b), (d), and (e)]

The carbonation system is considered a new tank system. Installation and testing plans and procedures for the carbonation system are described below. An independent, qualified, registered professional engineer, trained and experienced in the proper installation of tank systems, inspected and certified that proper installation and testing of this system was completed prior to commencement of HW/MW treatment in the carbonation system (ref. Attachment D-25).

The inspections and testing for the carbonation vessel included the following:

- A visual inspection, inside and outside, of the carbonation vessel
- A visual inspection of components, piping and monitoring devices (such as pressure, flow, level, and temperature gauges)
- Integrity and leak tests
- Determination of the presence of weld defects, punctures, scrapes of protective coatings, cracks, corrosion, and other structural damage or inadequate construction/installation.

Flow tests using compressed air and water were performed, simulating conditions anticipated for carbonation. The vessel was successfully hydrostatically leak tested at 25 psig. Operational pressure is not expected to exceed 10 psig.

The tank has four legs that are bolted to four extension legs, which are anchored to the concrete floor. The anchors and bolts are sufficiently strong to prevent horizontal motion during design-basis seismic events or inadvertent disturbances. Tipping is precluded by the platform base-to-height aspect.

Ongoing inspection and testing (preventative maintenance checks) of the carbonation system, along with the existing tank system inspections and testing, are conducted on a routine basis and are recorded on SCMS operating logs. Major deficiencies and repairs are noted in the SCMS operating record.

D-4(b)(4) Dimensions and Capacity of Each Tank [IDAPA 58.01.05.012; 40 CFR 270.16(b)]

There are three HWMA/RCRA-regulated tanks associated with the existing and new tank systems. The following subsections describe the dimensions and capacities of each tank in the systems.

D-4(b)(4)(a) Water Wash System—Water Wash Vessel

The WWV is a vertical, cylindrical tank with dished top and bottom heads. It is approximately 10 ft in diameter by 12 ft in height with a calculated volume of 817 ft^3 (6112 gal). The administratively controlled capacity of the WWV is 90 gal.

D-4(b)(4)(b) Scrubber Water System—Scrubber Water Tank

The scrubber water tank is a vertical, cylindrical tank with conical top and bottom heads. It is approximately 3 ft 6 in. in diameter by 4 ft 10.25 in. in height with a calculated volume of 46.8 ft^3 (350 gal). The administratively controlled capacity of the scrubber water tank is 300 gal.

D-4(b)(4)(c) Carbonation System—Carbonation Vessel

The carbonation vessel is a vertical, cylindrical tank with a conical bottom. It is 1 ft 6 in. in diameter by 3 ft 3 in. in height with a calculated volume of 30 gal.

D-4(b)(5) Description of Feed Systems, Safety Cutoff, Bypass Systems, and Pressure Controls [IDAPA 58.01.05.012; 40 CFR 270.16(c)]

The following subsections describe the WWV, scrubber water tank, and carbonation vessel feed systems, safety cutoffs, bypass systems, and pressure controls (ref. Attachment D-9).

D-4(b)(5)(a) Water Wash System

Air flow is provided to the WWV by the ventilation system. Manual control is provided by throttling the outlet valve for the on-line HEPA filter to maintain air flow at 3000 cfm through the ventilation system as the system resistance changes because of HEPA filter loading. The WWV has automatic dampers to isolate it from the normal ventilation system, and vent to the atmosphere outside the building in the event that the fan fails during operation. The normal inlet damper and the outlet damper are air-to-open and spring-to-close. The emergency vent damper is spring-to-open and air-to-close type. If ventilation flow is stopped because of fan

failure or plugging of HEPA filters, a pitot-static tube in the discharge line of the fan provides a signal to pressure switch D11-PS-114. The pressure switch will deenergize solenoid valves D11-VS-15, -16, and -17 in the air lines to their respective dampers. The normal inlet and outlet dampers will close, and the emergency vent damper will open.

In order for dampers VR-15 and VR-17 to open, and VR-16 to close on fan startup, it is necessary to bypass the velocity-pressure switch, PS-114, until ventilation flow is established. This is done through a 30-second time delay circuit that is activated when the fan is started.

Service water is supplied to the WWV for ignitable and reactive HW/MW deactivation operations. Water is supplied at a pressure of about 80 psig. Operating procedures restrict adding additional water to the vessel as long as any water is standing in the drip pan.

D-4(b)(5)(b) Scrubber Water System

All the hydroxide solution that gravity drains from the WWV and from the venturi scrubber goes directly to the scrubber water tank. The scrubber pumps take suction from the tank and pump the hydroxide solution back to the venturi scrubber or to the WWV for residual deactivation operations. Water or hydroxide solutions are recirculated in this manner until the hydroxide concentration reaches 15 wt%, then it is pumped to the carbonation system for deactivation operations. Reusing the scrubber water in a recirculating system reduces the amount of liquid requiring treatment. Water for the initial fill and makeup to the scrubber water tank comes from the service water system through an automatic makeup valve.

The scrubber water tank is vented to the atmosphere through the vent line into the carbonate retention vessel; therefore, it is not subjected to pressure. The tank has three separate level probes for level control, indication, and high-level alarm. The level control probe has two setpoints that feed a level control switch. At the low setpoint, the switch opens a solenoid valve in the service water line to the tank. When water reaches the high level setpoint, the switch closes the solenoid valve, shutting off makeup flow to the tank. The level indicator probe generates a linear signal to feed a meter, calibrated 0–100% on the SCMS High Bay I&C panel. The alarm probe closes a switch on high level in the tank to actuate an alarm on the SCMS High Bay I&C alarm panel.

There is a pressure gauge on the common discharge line from the pumps, and a thermometer and flowmeter in the line to the venturi scrubber. Flow to the scrubber water tank is regulated with a manual ball valve upstream of the flowmeter.

During the transfer of the hydroxide solution for reacting the container residuals and/or debris in the WWV, or during transfer of carbonate solution to the solidification system, an operator will be positioned at the isolation valve for isolation of the system in case of an emergency.

D-4(b)(5)(c) Carbonation System

The scrubber water system supplies the hydroxide solution to the carbonation vessel. Typically up to a 15 wt% hydroxide solution is fed to the carbonation vessel at approximately 10 gpm and 28 psig. Gaseous CO_2 is introduced into the carbonation vessel through a sintered metal sparge element of 10 μm porosity.

The vessel temperature is continuously monitored during carbonation operations by an installed thermocouple. The vessel temperature is administratively controlled so as not to exceed 190°F during carbonation operations.

The carbonation vessel overflows continuously to the scrubber water tank during carbonation operations. If the vessel were to overfill, the solution would flow through the vent line, which would again drain to the scrubber water tank.

The carbonation vessel pressure is not expected to exceed 10 psig and is relieved through the vent line to the water wash scrubber. Vessel pressure is monitored during carbonation operations by an installed 0–15 psig pressure gauge.

Carbonation vessel flow and level are monitored through installed sight tubes located in the vent and overflow lines. The CO_2 gas supply is pressure controlled by an installed pressure regulator and flow controlled by an installed adjustable flow meter.

D-4(b)(6) Diagram of Piping, Instrumentation, and Process Flow [IDAPA 58.01.05.012; 40 CFR 270.16(d)]

The P&IDs are provided in Attachment D-9. A Standard Piping and Instrument Symbols and Lettering Legend is provided in Attachment D-8.

D-4(b)(7) Containment and Detection of Releases [IDAPA 58.01.05.008; 40 CFR 264.193]

Secondary containment systems are provided for all HWMA/RCRA tank systems in SCMS. Drawings of and specifications for the secondary containment are provided in:

- Attachment 1, Section B, MFC Facility Description Attachment: B-13, Floor Plans Schematic Showing Facility Arrangement and Maximum Storage Capacity
- Attachment D-26, Drawing of SCMS Low Bay Pit.

Leak detection will be performed by daily visual inspections of the tank systems and their designated secondary containments. Personnel who perform the inspections will be trained in accordance with the SCMS HWMA unit specific procedures. The extensive nature of this training program ensures that inspectors will recognize the makeup and source of hazardous material leakage that could occur from SCMS tank systems.

Response to spills that may occur at SCMS is addressed in Attachment 7, Section G, Contingency Plan.

D-4(b)(8) Plans and Description of the Design, Construction, and Operation of the Secondary Containment System [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(g) and 264.193(b) through (f)]

Specifications, drawings, and vendor data related to the secondary containment for existing and new tank systems located at SCMS are provided as described in Subsection D-3(a).

Structurally, the walls and floor of secondary containments are designed to resist the following forces:

- Dead loads (such as tank, tank contents, concrete, and steel liner)
- Soil pressure on external wall surfaces
- Hydraulic pressure that would occur on the walls and floor should the tank contents leak in the secondary containment
- UBC Zone-2 seismic forces.

The ground-water level in the MFC area is 640 ft or more below the surface and was not considered a factor in the design of the secondary containment pits because of its depth. SCMS is constructed such that the surface drainage is routed away from the structure. Consequently, water is kept from reaching the soil/gravel below the foundations and secondary containment pits. This alleviates the problem of frost heaves or decreased soil strength due to saturation.

All SCMS tank systems and secondary containment systems are inside the SCMS buildings and are constructed in such a manner that surface drainage is routed away from the structures and run-on and infiltration of precipitation is prevented.

All secondary containment was inspected when installed to ensure that it was free of cracks or gaps. The water wash system, scrubber water system, and carbonation systems are situated within the secondary containment so the secondary containment prevents HW/MW from coming into contact with surrounding soil.

None of the SCMS tank system secondary containments are equipped with a leak detection system. Therefore, leak detection will consist of daily visual inspections of the secondary containment by SCMS facility personnel during operation of the tank systems. Records of the daily inspections will be maintained as part of SCMS operating records. Response actions to spills or leaks of HW/MWs are detailed in Attachment 7, Section G, Contingency Plan.

D-4(b)(8)(a) Tank Age Determination [IDAPA 58.01.05.008; 40 CFR 264.193(a)]

The two tanks associated with the existing tank system, the WWV and scrubber water tank, were built and installed in 1980 and 1981, respectively. Receiving reports and as-built drawings document the age of the two tanks used in the systems (see Attachments D-11, D-18, and D-27).

D-4(b)(8)(b) Requirements for Secondary Containment and Leak Detection [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(g) and 264.193(b) and (c)]

The HWMA/RCRA tank systems in SCMS have secondary containment as described below:

Water Wash System and Carbonation System. The WWV and the carbonation vessel sit above a reinforced concrete floor in the SCMS High Bay area. The floor has been sealed with a corrosion-resistant epoxy paint to provide an impermeable surface and prevent migration of HW/MW. The floor in the SCMS High Bay has a 2-in. curb and was designed and installed to have a minimum floor

loading of 1500 psf (ref. Attachment D-28). The reinforced concrete below the vessels is sloped (east and west) to allow drainage of spilled HW/MW to floor drains located on the east and west side of the vessels. The floor drains are routed to the SCMS Low Bay Pit located in the SCMS Low Bay (ref. Attachment D-26). A valve is installed in the floor drain line that will direct any spilled HW/MW to the SCMS Low Bay Pit or to a collection container (drum) located in the SCMS Low Bay Pit. The Low Bay Pit acts as an external vault for both the WWV and the carbonation vessel. The maximum amount of HW/MW within the WWV and the carbonation vessel at one time is 90 and 30 gal, respectively.

The SCMS Low Bay Pit has a floor with a 1.5-in. slope design (southwest to northeast) and has been sealed with corrosion-resistant epoxy paint. The vault and joints are sealed to a point 0.5 ft above the floor of the SCMS Low Bay Pit. The 300-gal scrubber water tank and the 4,272-gal empty carbonate retention vessel (non-HWMA) are located in the Low Bay Pit. The scrubber water tank, as the permitted and only tank in the pit for HW/MW, must be within secondary containment that holds more than 100% of its volume.

The Low Bay Pit can readily contain approximately 438 gal of HW/MW, which is greater than 100% of the volume of the scrubber water tank at 300 gal. The secondary containment volume of the SCMS Low Bay Pit is determined by accounting for 0.5 ft of epoxy up the wall and subtracting the displacement caused by the carbonation vessel. The calculation for the available secondary capacity of Low Bay Pit is shown in Table D-8.

Table D-8. SCMS Low Bay Pit Secondary Containment Capacity.

Capacity Derivation	
Dimensions of Low Bay Pit	17 x 13 x 6 ft (tall)
Volume of Low Bay Pit	(l) x (w) x (h) = V 17 x 13 x 0.5 ft = 110.5 ft^3; 826 gal
Volume displaced by carbonate retention vessel	(π) x (r^2) x (h) = V 3.14 x $(11.5/2)^2$ft x 0.5ft = 51.9ft^3; 388 gal
Available secondary capacity of Low Bay Pit	V pit up 0.5 ft - V vessels= secondary capacity 110.5 ft^3 – 51.9 ft^3 = 58.6 ft^3 or 438 gal

No volume displacement was considered for the scrubber water tank, which sits in the SCMS Low Bay Pit, because it is elevated approximately 0.5-ft off the floor by footings. A sump and electric sump pump are located in the northeast corner of the SCMS Low Bay Pit. This sump pump can be routed to discharge to a collection container (drum) or to the carbonate retention vessel (used only for non-HW/MW leaks or spills). The floor drain piping (primary piping), as well as the drains from the WWV, are within secondary piping, which is also routed to the SCMS Low Bay Pit. If a spill occurred, this routing of the floor drains to the SCMS Low Bay Pit, the floor being sloped away from the vessels, and the sump pump would meet the requirements in IDAPA 58.01.05.008 and 40 CFR 264.193(c)(4) for secondary containment drainage and removal within 24 hours. The WWV is accessible for daily inspections while in operation. This daily inspection meets the requirements of IDAPA 58.01.05.008 and 40 CFR 264.193(c)(3) for leak detection.

Scrubber Water System. The scrubber water tank sits above a reinforced concrete floor in the north end of the SCMS Low Bay Pit located in the SCMS Low Bay. The SCMS Low Bay Pit has a floor with a 1.5-in. slope design (southwest to northeast, ref. Attachment D-23) that has been sealed with a corrosion-resistant epoxy paint that acts as secondary containment and as an external vault for the scrubber water tank. The sloped floor in the SCMS Low Bay Pit allows for spills of HW/MW from the scrubber water tank to drain to the northeast corner. This design feature provides for leak detection for the scrubber water tank through daily visual inspection while in operation. The vault and joints are coated to a point 0.5 ft above the floor of the SCMS Low Bay Pit so that the vault can readily contain a maximum volume of approximately 438 gal of HW/MW which is >100% of the volume of the scrubber water tank (300 gal).

Capacity calculations are provided in Table D-8. A sump and electric sump pump are located in the northeast corner of the SCMS Low Bay Pit. This sump pump can be routed to discharge to a collection container (drum). If a spill occurred, the collection of HW/MW in the SCMS Low Bay Pit and the sump pump would fulfill the requirement in IDAPA 58.01.05.008 and 40 CFR 264.193(c)(4) for secondary containment drainage and removal within 24 hours. The daily inspections performed for the SCMS Low Bay Pit meets the requirements of IDAPA 58.01.05.008 and 40 CFR 264.193(c)(3) for leak detection.

D-4(b)(8)(c) Requirements for External Liner, Vault, Double-Walled Tank or Equivalent Device [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(g) and 264.193(d) and (e)]

Volume calculations show that the SCMS Low Bay Pit, which acts as secondary containment for SCMS tanks used for HW/MW treatment and storage (WWV, carbonation vessel, and the scrubber water tank), will provide sufficient volume to contain 100% of the volume of the scrubber water tank and all piping that could drain into the SCMS Low Bay Pit. All the secondary containment (curbing, sealed floors, and pits/vaults) in SCMS are constructed in such a manner that surface drainage is routed away from the structures and run-on, and infiltration of precipitation is prevented.

D-4(b)(8)(d) Secondary Containment and Leak Detection Requirements for Ancillary Equipment [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(g) and 264.193(f)]

SCMS High Bay floor drain piping, as well as drains from the WWV, carbonation vessel, and water wash scrubber are within secondary piping, which is routed to the SCMS Low Bay Pit. This provides leak detection capability and secondary containment for below ground piping associated with the tank systems. All other ancillary equipment associated with the water wash system, scrubber water system, or carbonation system is accessible for daily visual inspections while in operation. Daily inspections will be performed and the inspection logs will be maintained as part of the SCMS operating record. Response actions to spills or leaks of HW/MWs are detailed in Attachment 7, Section G, Contingency Plan.

D-4(b)(9) Controls and Practices to Prevent Spills and Overflows [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(I) and 264.194(b)]

Controls and practices to prevent spills and overflows include the following:

— Process equipment design controls

— Operational administrative limits for tank filling

— Instrumentation that monitors for overfilling.

Monitoring is performed by facility personnel on duty during operations and during daily inspection of the tank systems. A brief description of relevant operating procedures used to prevent spills and overflows from tank systems is listed below:

SCMS-OI-1 (Facility Information and Administrative Requirements) provides a description of the SCMS (including secondary containment, ventilation systems, fire detection and suppression systems and equipment) and scope of shop operations and uses. It also addresses administrative and environmental-safety-and-health requirements applicable to the facility such as requirements for all waste activities in which alkali metals (typically Na and NaK) are being handled or transferred.

SCMS-OI-7 (Water Wash Vessel) provides instructions for operating the water-wash vessel which is used to treat alkali metal bearing wastes using water. This procedure also covers the transfer of liquids to the scrubber tank from drums and containers, and the transfer of liquids from the scrubber tank into drums for additional treatment.

Overfilling controls for the tank systems are described in following subsections.

D-4(b)(9)(a) Scrubber Water System

When the scrubber water system is in operation, the “makeup” to the scrubber water tank (service water or hydroxide solution from the WWV) is monitored and controlled by three separate level probes for level control, indication, and high-level alarm. The level control probe has two setpoints that feed a level control switch. At the low setpoint, the switch opens a solenoid valve in the service water supply line to the tank. When water reaches the high-level setpoint, the switch closes the solenoid valve, shutting off makeup flow to the tank. The level indicator probe generates a linear signal to feed a meter, calibrated 0–100%, on the SCMS High Bay I&C panel. The alarm probe closes a switch on high level in the tank to actuate an alarm on the SCMS High Bay I&C alarm panel. Readings on the local level indication for the scrubber water tank are required every half-hour during HW/MW processing. There is a pressure gauge on the common discharge line from the pumps, and a thermometer and flowmeter in the line to the venturi scrubber. Flow to the scrubber is regulated with a manual ball valve upstream of the flowmeter.

D-4(b)(9)(b) Carbonation System

When the carbonation system is in operation, hydroxide solution from the scrubber water tank flows into the conical bottom of the carbonation vessel and fills the carbonation vessel until it overflows at the outlet line on the side of the vessel. The vessel level is maintained at the outlet line location on the side of the vessel as the solution flows back to the scrubber water tank. Level indication is provided by the sight tube connected to the vessel outlet on the side of the vessel. A freeboard area is maintained in the vessel above the outlet line. This freeboard area is vented to the

water wash venturi scrubber, so any vessel overfill would flow through the vent line and return to the scrubber water tank.

D-5 Miscellaneous Units [IDAPA 58.01.05.08 and 012; 40 CFR 264.601 and 270.23]

RSWF is presently the only HMWA unit at the MFC considered to be a miscellaneous unit. This section, therefore, only includes information on RSWF.

D-5(a) Description of Miscellaneous Units [IDAPA 58.01.05.012; and 270.23 (a)(1)]

A general description of the RSWF facility, and photographs and schematics of RSWF are provided in Attachment 1, Section B, MFC Facility Description. More details of the RSWF are provided in the following subsections.

D-5(b) Environmental Performance Standards for Miscellaneous Units [IDAPA 58.01.05.08; 40 CFR 264.601]

RSWF is located, designed, constructed, operated, and maintained in a manner that will ensure protection of human health and the environment. The prevention of any releases that may have adverse effects on human health or the environment due to the migration of MW stored in RSWF to the ground water, air and/or soil is described in the following subsections.

The potential pathways for the release of hazardous waste constituents from RSWF stored waste are the air and soil. The hypothetical causes of a release to the soil would require a breach of the liner from corrosion due to long-term undetected cathodic protection failure in combination with a waste container failure. The hypothetical causes of a release to the air are sodium-water reactions leading to sodium combustion and a hydrogen explosion. The release to the air would also have to be initiated by corrosion or some general failure of the waste containment system. All of these mechanisms require multiple mechanical failures and repeated long-term failure of the inspection and monitoring program to indicate a loss of cathodic protection.

Another potential cause of a release is equipment failure leading to dropping a waste container during waste transfer operations.

There are many features engineered into the RSWF design to prevent releases that may affect human health or the environment due to the migration of MW in the soil, air or ground water. The design features of the facility or physical characteristics of the area are described in Section D-5(m), Migration of Waste Constituents.

In addition, a soil corrosivity mapping of the site was performed in 1989 and revealed that the soil was mildly to moderately corrosive and that impressed current cathodic protection was needed to adequately protect the waste.

In June 1989, an independent corrosion engineering firm (CH2M Hill, Boise, ID) performed soil corrosion mapping of the RSWF. The electrical resistivity of the soil was measured by the Wenner four pin method. The tests consisted of 90 soil resistivity measurements at average depths of 2.5, 5.0, 7.5, 10.0, and 15.0 ft. Both average and layer resistivity calculations were made from these measurements. See Attachment D-29 for Field Testing Report.

The soil corrosivity mapping and soil corrosivity analysis made on soil as part of the 1988 liner removal indicated that the worst case soil is in the corrosive range. This corresponds to a corrosion rate of as much as 0.06 inches per year. Therefore, if the cathodic protection system were to completely fail in its protection of liners, no more than 0.06 inches/year of corrosion would be expected. This represents just less than a maximum of 25% penetration through the 0.25 in. wall thickness of a liner in a years time. In general, the RSWF soil ranges from mildly to moderately corrosive based on the ranking. This corresponds to a corrosion rate of 0.02 to 0.06 in./year. Based on these results, the corrosion engineers recommended that an impressed cathodic protection system be installed on all RSWF liners.

D-5(c) Miscellaneous Unit Waste [IDAPA 58.01.05.08; 40 CFR 264.601(a)(1), 264.601(b)(1), 264.601(c)(1)]

MFC was involved in numerous experiments in support of the Liquid Metal Fast Breeder Reactor (LMFBR) Development Program, which is no longer being conducted. Experiments in the LMFBR program resulted in solid waste consisting of reactor and coolant loop components that are contaminated with elemental sodium and NaK. These wastes are primarily metal parts that were in contact with, and are therefore, contaminated with reactive metals. The sodium and NaK contamination causes the HW/MW designation because these reactive metals are characteristic hazardous wastes due to reactivity and ignitability.

The processes that currently generate these wastes include hot cell operations and tests, and laboratory testing. The majority of the waste currently in the RSWF is from hot cell operations and tests. These wastes consist of subassembly hardware contaminated with sodium, Fuel Cycle Facility wastes (1964-1969), and routine wastes such as sodium-contaminated facility hardware that is no longer useful or required.

The hazardous constituents currently stored in RSWF include elemental sodium, sodium-potassium alloy (NaK), lead, barium, cadmium, and chromium. With the Fuel Conditioning Facility and the Hot Fuels Examination Facility generating waste from remote-handled reactor fuels research and other hot cell activities the waste may contain arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. The physical and chemical properties of these constituents are shown in Table D-9.

Table D-9. Physical and chemical properties of constituents that may be present at RSWF.

Hazardous Constituents	Atomic Weight	Boiling Point (°F)	Water Solubility	Specific Gravity	Melting Point (°F)
Sodium	23	1621	reacts	0.968	208
NaK	36	1443	reacts	0.847	12
Arsenic	75	1135	0	5.73	1508
Barium	137	2984	reacts	3.51	1337
Cadmium	112	1409	0	8.64	609
Chromium	52	4842	0	7.20	3375
Lead	207	3163	0	11.35	621
Mercury	201	673	0	13.55	-37.97
Selenium	79	1263	0	4.81	423
Silver	108	4014	0	10.5	1.763

A summary of each type of waste stored in RSWF including when, where it was generated, and volume is shown in Table D-10.

Table D-10. Summary of waste types stored at RSWF.

Waste Stream ID	**Waste Stream Name**	**Dates**	**Facility/ Origin**	**Volume (M3)**
CH-ANL-180RH	SODIUM -MLLW Remote Handled	1965 - 2009	MFC	25.95
CH-ANL-182RH	SODIUM POTASSIUM NaK Remote Handled	1981 - 1997	MFC	0.5
CH-ANL-716 RH	MLLW Remote Handled	1969 - 2006	MFC	2.06
CH-ANL-241Ta	MTRU Remote Handled	2008 - 2009	MFC	0.78

Sodium is ignitable and reactive and carries the RCRA hazardous waste codes D001 and D003. NaK is reactive and carries the D003 RCRA code. Lead, except when

used for shielding in the containers, carries the RCRA code D008 for toxicity. The RCRA codes for cadmium and chromium are D006 and D007 for toxicity.

The majority (by number of liners) of the HW/MW presently stored in the RSWF is hazardous because of the presence of elemental sodium.

The NaK alloys used in the LMFBR program were liquid at ambient temperatures. NaK, a liquid metal, is the only liquid stored in the RSWF. Procedural restrictions on the placing of liquids (other than NaK) in the RSWF containers have been enforced since the facility first began accepting waste. At ambient temperatures, elemental sodium (208°F melting point) and lead are solid. In addition, cadmium and chromium are solid including any of the other potential hazardous constituents listed above.

In addition to the HW/MW, the RSWF also stores accountable nuclear material and radioactive waste. These materials are also stored in separate liners from the HW/MW. The waste does not contain hazardous constituents or have hazardous characteristics as defined in 40 CFR 261.

The hazardous constituents are safely contained by the waste containment system of the RSWF, as long as the integrity of the containers is maintained. The hazardous constituents and the solid waste hardware associated with the constituents are fully compatible with the stainless steel and carbon steel waste containers.

The inner waste containers with Na/NaK were packaged in an inert atmosphere isolating the HW/MW from moisture and oxygen, which reduces the concern for over-pressurization of the containers and generation of gases. In addition, no absorbents are used with Na/NaK. There is a potential for ambient water vapor to be converted to hydrogen when the lid is welded on. To mitigate hydrogen gas production procedures and practices are in place to provide assurance the liners are free of visible moisture prior to use. If moisture is identified a pump or vacuum is used to remove any moisture from the liner or the liner is air dried. If unable to remove visible moisture, the liner is simply not used. Prior to opening a liner an evaluation is performed to determine if a liner contains a hazardous atmosphere. The liner may be purged prior to opening in a controlled manner in accordance with operational procedure RSWF-OI-002.

The potential for migration of waste is addressed in Section D-5(m).

The waste stored at RSWF is tracked by grid location (i.e., X Y coordinates). Each liner has a welded alpha numeric designation located on the cover of the liner that

corresponds to the grid location. The alpha numeric designation is used in IWTS as the container barcode.

D-5(d) Containment System [IDAPA 58.01.05.08 and 012; 40 CFR 264.601(b)(2) and 270.23 (a)(2)]

The containment system in RSWF consists of rows of sealed carbon-steel pipes, referred to as liners, buried vertically in the ground in bored holes such that the top of the liners protrude approximately 4 in. above ground. Photographs and schematics of the liners are provided in Attachment 1, Section B, MFC Facility Description.

Prior to placing the liners in the storage area, several feet of gravel and soil was placed in the liner area and graded to slope gently from the centerline to the parallel sides, which were banked with gravel. This grade promotes run-off, reducing percolation, maximized operating days, and also serves to prevent run-on into the area from normal or anticipated abnormal events. A drawing showing elevation contours of the RSWF has been added as Attachment D-30. This drawing also shows the drainage systems in place at RSWF.

The RSWF is designed with a grid of approximately 27 rows spaced approximately 12 ft apart with approximately 50 liners per row. The liners are arranged on approximate 6-ft centers in the rows. The volume capacity, based on the size of the waste containers that are placed in storage, is approximately 53,000 gal. This assumes that approximately 1,320 of the liner sites are usable for MW storage at the RSWF. See Attachment D-31 for the current liner configuration drawing, which is a detailed plan view of the RSWF showing the identification grid, liner types, the year the liners were installed, and the status of each liner or location (e.g., full, empty, unusable, removed, etc.).

The installation method for the liners has provided for stability of the liners and past operating experience has demonstrated that the liners will stay in place as discussed in the following paragraphs.

The liner locations are prepared by drilling approximately 24, 32, 34, or 38 in. diameter holes into the ground and centering a 16, 24, 26, or 30 in. diameter steel pipe, respectively, in the hole. Approximately 2 in. of sand slurry was placed in the bottom of each hole and around the sides of the liners. The sand slurry was backfilled in place in layers no greater than 48 in. thick. Each layer was vibrated to ensure that the fill completely surrounded the liner and that there were no voids. The soil beneath the liners was undisturbed. The sand slurry in essence holds the liner in

place, since it provides a solid monolith surrounding the liner in the ground. The sand slurry has also shown to prevent subsidence around the sides and tops of the liners.

The first 30 standard liners installed in 1964 had welded hemispherical bottoms. Frost heaves caused the empty liners to lift out of the ground, so the design was changed to incorporate a base plate welded to the bottom with an outside diameter 2 to 3 in. larger in diameter than the liner. Operational experience has shown that the oversized base plates serve as a very effective anchor and makes it impossible that a liner would move vertically without the occurrence of an unusual and unanticipated event. The early hemispherical-bottom liners were all removed from the RSWF.

Past experience has shown that excavation down to the base plate is required to remove a liner from the ground. An early attempt to remove a liner from the ground without first excavating around it showed that a pulling force of approximately 48,000 pounds did not move the liner.

The height of the top of the liners above ground surface was specified at approximately 4 in. for the following reasons; 1) Empty liners too close to the ground surface are susceptible to surface water, 2) The protrusion of the liner above the ground facilitates access for welding the liner lid in place and 3) Liners too far above the ground surface could be hit by the forklift used to place or remove material into or from a liner.

MW is first containerized into one of two inner container systems referred to as HFEF-5 cans and SLSF cans. After placing the container system in the liner, shielding is provided by placing a 30 in. concrete or 6 in. steel shield plug in the liner and welding it to the top of the liner, as applicable. This configuration is illustrated in the photographs provided in Attachment 1, Section B, MFC Facility Description.

D-5(d)(1) Carbon-Steel Installed Liners

There are primarily three standard size liners used in RSWF. They are 16, 24, and 26 in. in diameter. Descriptions of the liners follow.[4] Fabrication drawings of each liner type are found in Attachment D-32.

[4] Liners and inner container systems dimensions are approximate sizes.

16-in. Diameter Liners. These are the standard liners used for MW storage in the RSWF and are sized to accept an inner container system referred to as the HFEF-5 can. These 16-in. liners are constructed of either schedule-10 carbon steel and 16 in. in diameter by 12.33 ft, or schedule-40 carbon steel and 10 ft long with a 19-in. diameter oversized base plate welded to the liner bottom. They are sealed with a concrete shield plug/lid assembly welded into the top of the liner.

24-in. Diameter Liners. These liners were sized, fabricated, and installed to accept the first generation 16-in. liner and inner container referred to as a "paint can," in which MW was stored prior to 1978. These 24-in. liners are constructed of Schedule-10 carbon steel and are 24 in. in diameter by 13.67 ft long, with a 26-in. diameter base plate. The 24-in. liners containing MW have a carbon-steel shield plug assembly welded into the top.

26-in. Diameter Liners. These liners are also used for MW storage in the RSWF and are sized to accept an inner container system referred to as the SLSF can. These 26-in. liners are constructed of 0.25-in. thick carbon steel and are 26 in. in diameter by 13 ft long, have a 28-in. diameter base plate, and are closed with a welded 6-in. carbon-steel plug.

Nonstandard liners include one 60-in. diameter by 10.8 ft long liner that was constructed to store an EBR-II cold trap and two 48-in. diameter by 3.81-ft long liners that were constructed to store EBR-II nuclide traps.

All the liners are protected from corrosion by a cathodic protection system described in Subsection D-5(d)(4). A schematic of the cathodic protection system is provided in Attachment 1, Section B, MFC Facility Description. The soil in the liner area provides passive radiation shielding that, in conjunction with radiation shield plugs placed in the top of the liners, provides shielding to protect human health and the environment.

Liner lids are sealed by welding a shield plug/plate in place. Lids are welded in place (as directed by operating procedure RSWF-OI-001) in accordance with the INL Welding Manual, and a visual inspection is performed of the final weld for cracks, through fusion, and undersized weld.

Two other types of liners with diameters of 24 and 30 in. were designed with flanged lids that are gasketed/bolted in place. The flanged 24-in. liners contain non-HW/MW, low level waste only. The 30-in. liners are maintained empty. They were installed to be available as overpacks during previous 24-in. liner relocation activities.

Each liner is subjected to leak testing after construction and prior to installation to ensure that it is free of cracks and gaps. These tests are performed prior to the liner being placed in the ground. Hydrostatic tests are conducted after the bottom plate is welded on. If leaks are detected, the liner is repaired and retested until it passes.

In order to ensure the structural integrity of the liners, they are fabricated in accordance with ASME standard codes and procedures. This includes specified welding procedures, tolerances, and grades of material. All of the liners are fabricated of carbon steel. Carbon steel and stainless steel are compatible with the MW stored in the RSWF. See Attachment D-32 for the liner drawings that specify welding and material fabrication details.

D-5(d)(2) Inner Containers

MW was first containerized in one of three types of inner container systems referred to as paint cans, HFFF-5 cans, or SLSF cans (nuclide traps and cold traps are not placed into HFEF-5 or SLSF cans). The type of inner container system used depends on when it was loaded and the type and radiation levels of the MW generated. Each of these inner container systems is described below. Photographs with illustrations of each inner container are provided in Attachment 1, Section B, MFC Facility Description.

Paint Cans. This inner container, used between May 12, 1964, and June 26, 1978, consists of a mild steel pail, 72 in. high and 11.25 in. in diameter. The lower section of the container was fabricated from 20-gauge steel tube with a welded side seam and bottom. The upper section was a bottomless standard 5-gal steel pail body (22 gauge) attached to the lower section with a circumferential weld. The container was closed with a standard 16 lug foam-rubber gasketed cover and placed into the original 16-in. liners. All of the 16-in. liners that contain these “paint cans” were extracted from the ground and placed within new, cathodically protected, 24-in. liners.

Smaller commercial pails may or may not have been placed inside the paint cans. These pails are 10.25 in. ID and are 10, 12, and 24 in. high to accommodate various sizes and quantities of waste.

Both the 72 in. waste container and the small pails were subjected to a series of drop tests to establish their resistance to rupture. In these tests, the large waste container was loaded with heavy scrap metal or with small pails loaded with scrap and was dropped from various heights onto soil or a steel plate. These tests demonstrated that

the small pails might collapse partially, but would not rupture or open, and the large container would deform slightly, but not rupture or open.

HFEF-5 Cans. This inner container system consists of an inner and outer container. The inner container is placed inside the outer container, which is seal-welded shut and placed in the RSWF liners for storage. The inner container, constructed of carbon steel, is the hot cell waste receptacle. It is a cylindrical, 14-gauge carbon-steel (AISI 1010-1020) container, 59.125-in. long by 11.60-in. in diameter. It is closed by a 0.375-in. thick lid fastened to a bolt ring in the top of the container by six cap-head bolts. The outer containers are the out-of-cell containers and are used to prevent the spread of contaminants from the inner container to the environment. It is a cylindrical, 14-gauge, Type-304 stainless-steel container, 73.5-in. long by 12.75-in. in diameter.

HFEF/S and HFEF/N containers were earlier versions of HFEF-5 cantainers. These containers had similar dimensions as HFEF-5 containers and were discontinued in 1987. Waste packaged into the HFEF/S and HFEF/N are still being managed at RSWF.

SLSF Cans. This inner container system is constructed like the HFEF-5 can, except that it is larger in diameter. It is a cylindrical, 11-gauge Type-304 or -308 stainless-steel container, 20.76 in. in diameter by 122.00-in. long. It is closed by a 1.5-in. thick lid fastened to a bolt ring in the top of the container by six cap-head bolts. In addition to using the SLSF inner can, three 45-gal stainless-steel cans are also used as the inner waste storage containers. They are 14 gauge, 21 in. in diameter by 32-in. long, and are closed with a 0.375-in. thick lid fastened to a bolt ring in the top of the container by 10 cap-head bolts. The SLSF outer container is a cylindrical, 11-gauge carbon-steel (AISI 1010-1020) container, 22.25 in. in diameter by 134.5-in. long. It is closed by a 1.5 in. thick lid that is seal-welded in place.

In addition, the bulk sodium storage container was placed inside the SLSF outer container for storage. The bulk sodium storage container is a cylindrical, type 304 stainless steel (0.25 in. wall) container, 17.5 in. ID by 32.875 in. long. The container cover is welded in place.

Nonstandard Containers. An EBR-II primary cold trap was placed directly in a specially designed 60-in. liner. The cold trap serves as the container for the waste sodium in it. Double containment is provided for the MW by the cooling jacket around the vessel. This jacket was drained of bulk MW and all pipes and fittings sealed prior to its placement in storage. Only residual MW that could not be drained or blown from the jacket remains.

EBR-II nuclide traps were placed directly into two specially designed 48-in. liners. The nuclide trap serves as the container for the waste sodium it contains. Double containment is provided for the MW by the jacket around the vessel and by additional metal welded around each of the nuclide traps.

The SLSF warm vapor trap is stored in its own special container. The container has a top section that is cylindrical, 12.25 in. ID by 7.25 in. high, and constructed of 0.25 in. type 304 stainless steel. The top section rests on an oval-shaped vessel that has a major axis of 12.25 in. ID and a minor axis of 7.00 in. ID. This vessel is also constructed of 0.25 in. type 304 stainless steel and is 24.13 in. high (interior dimension). The transition piece between the top and bottom sections was fabricated from 0.5 in. type 304 stainless steel.

The bottom section of the container holds the warm vapor trap and the top section holds the cover shield. The bottom section has an approximate volume of 3.76 ft3, which represents the waste containment volume of the vessel. The cover shield, which contains approximately 225 lbs of lead, provides radiation protection for personnel working in the RSWF. A second cover shield, which contains an additional 190 lbs of lead, is seal-welded on the top of the container, providing closure of the vessel.

In addition, containers containing thermocouple rods and other rods from the decommissioning of the EBR-I reactor are located in two original 16-in liners in the RSWF. No details are known about the containers within the original 16-in liner other than its steel construction and the use of lead, presumably as a shield plug. The two original 16 in liners have been relocated and placed into a catholically protected 24-in liner.

Originally five 30-in. liners were installed at RSWF as a contingency when the relocation of the original 16-in. liners into 24-in. liners occurred. If inspection of the 16-in. liners revealed evidence of corrosion that penetrated the entire wall thickness, then the 16-in. liners would be placed into a 24-in. liner and then into a 30-in. liner in order to have two levels of containment. These five liners were never used for contingency and are presently used for storage. Additional 30-in. liners allow for storage, relocating, and ease of accessing the 24-in. liners pending shipment. Concrete pads are utilized parallel to the 30-in. liners to enable access in mud and/or snow.

D-5(d)(3) Liner Radiation Shielding

The type of container shielding provided has varied over the history of RSWF. Shielding for most of the paint cans placed in the original 16-in. liners (now located in 24-in. liners) was provided by gravel. After the paint cans were placed into a liner, the liner was backfilled with gravel. This provided approximately 70 in. of gravel between the top of the paint can and the top of the liner. A 0.5-in. steel plate was then welded on the top of the liner to seal the containment.

Fabrication drawings of the various shield plug types are included in Attachment D-33. A summary of the shielding provided for the liners is listed below:

- Presently shielding for the 16-in liner is provided by a shield plug constructed of 30 in. of concrete and a 1/2-in. welded steel plate.
- The 24-in liners have either ½-in. steel plate welded shut; 6-in carbon steel shield plug welded shut. This shielding is based on the radiation reading.
- The 26-in liners have a 6-in carbon steel shield plug welded shut. Some of the original 26-in liners contain steel encased lead shield plugs welded shut.
- The 48-in liners have a carbon steel plate welded shut.
- The 60-in liners have ½ in. carbon steel plate welded shut.

D-5(d)(4) Cathodic Protection System

The liners are the final barrier between the MW container and the environment in the RSWF. The integrity of the liners provides assurance against the release and migration of MW into the soil, ground or surface water, or air. In order to ensure containment of the waste, each liner is protected against external corrosion by an impressed current cathodic protection system.

There are two basic mechanisms by which steel in contact with soil corrodes. One mechanism is called electrolytic corrosion. This corrosion results from stray direct current from an outside source picked up by metals in the soil. At the point where the current leaves the metal, corrosion occurs. This type of corrosion is not a consideration at the RSWF because of its remote location.

The second mechanism is called galvanic corrosion. This type of corrosion is self-generating. It arises from differences in electrical potential when metal is placed in the soil. The potential differences can develop from various nonuniformities including variation in soil properties. These nonuniformities can be variations in soil moisture, oxygen concentration, or soil resistivity. When an electrical potential develops, it provides the driving force for the flow of current. A flow of current from one structure to another will corrode the structure that acts as the anode.

The most effective method of protection against galvanic corrosion is called active or impressed current cathodic protection. It operates by passing direct current from impressed current anodes installed in the soil to the adjacent liners, which become cathodes. The liners in a given row are wired to one another and to the rectifiers on the ends of the row, making the liners the cathodes. Attachment D-34 contains the engineering drawing of the RSWF cathodic protection system. This drawing includes details of the cathodic protection system, including how the wires are welded to the liners. An illustration of the cathodic protection system is provided in in Attachment 1, Section B, MFC Facility Description. An external source of power is used to make the liner cathodic. The induced current ensures a current path from the replaceable sacrificial anodes to the liners (cathode) protecting the liner from galvanic corrosions. This type of protection is provided for all of the liners in the RSWF. Additionally, further safeguarding of the liners from the corrosive effects of the surrounding soil is provided by a 4-in. layer of noncorrosive sand slurry backfilled into the annulus between the liner and the soil at the time of liner emplacement. This will effectively prevent the liners from directly contacting the soil, thereby minimizing liner corrosion.

The cathodic protection system for the RSWF was designed by independent qualified corrosion engineers, under subcontract to MFC. The design was completed under the supervision of a registered professional engineer.

The basis for the design was the result of field testing at the RSWF that was also performed by the independent corrosion engineer. This testing was performed to determine the resistivity of the soil in which the liners are buried. Ninety soil resistivity measurements were made at 5 average soil depths (2.5, 5.0, 7.5, 10.0, and 15.0 ft). These data were used to generate soil resistivity contour plots for each of the average soil depths.

The field testing also included cathodic protection design tests done on the existing 16-in. liners to determine the current required for protection. In order to provide a margin of safety, the design criterion used for protection was the current required to obtain a structure to soil potential of –1.00 volts. Engineering design margins add

conservatism to the design to account for such things as variable soil conditions, specifying size (e.g., rectifier and wire sizing), and procuring system components.

The adequacy of the cathodic protection system was demonstrated from 1993 to 2001 through the use of 12 4½-in. corrosion surveillance tubes (now known as radiation monitoring tubes) that were inspected by nondestructive methods (i.e., ultrasonic examination, which is no longer required). The results of the wall thickness measurements from the corrosion surveillance tubes indicated that general corrosion is not occurring. This is supported in the 2001 Corrosion Assessment Report for the Cathodic Protection System of the RSWF, dated October 10, 2001, see Attachment D-35. In addition, a 16-in liner is pulled every 4 years for corrosion surveillance (beginning in September 1997). The liner pull examination includes a visual surface inspection and ultrasonic thickness measurements of the entire length of the liner every 1-in. at 45 degree intervals. The results of the liner pulls show that general corrosion is also not occurring. The overall conclusion is that the impressed current cathodic protection system and surrounding sand slurry are effectively protecting the liners from external corrosion. The cathodic protection system is operated and maintained to recommended industry standards.

The collected liner-to-soil potentials are reviewed by engineering to ascertain that each liner meets the cathodic protection action level of -0.85 volt and is therefore protected from corrosion. The liners to soil-potential reading are performed annually to identify wiring failures and to account for voltage potential changes as anodes are used up or as soil-moisture condition change. If a liner exhibits less than -0.85 volt potential (i.e., less negative than -0.85 volt) with respect to the soil, the rectifier output will be increased or necessary repairs made. A liner-to-soil potential greater [i.e., less negative] than -0.85 volts direct-current does not mean that the cathodic protection system is not operating, but does indicate that operational adjustments or preventative maintenance is required.

D-5(e) Site Air Conditions [IDAPA 58.01.05.08 and 012; 40 CFR 264.601(c)(4) and (5), 270.23 (b)]

The characteristics of the near-surface wind regime at the MFC can best be described using a graphical display called a wind rose. A wind rose is an effective method of showing joint wind speed and direction frequency distributions at a glance. The wind rose for MFC is presented in Volume 3 of the HWMA/RCRA Part B Permit for the Idaho National Laboratory, Exhibit B-6, page B-16. The diagram indicates that winds are generally out of the southwest. The climate at MFC is semi-arid high dessert. Average annual precipitation is 8.00 inches (MFC data period spans 1994 through 2014). The maximum monthly precipitation occurred in June

2009 (4.51 inches). There were five months during the 20 year period between 1994 and 2014 with no precipitation. The average maximum monthly temperature is for July (88.3 degrees) and the average minimum monthly temperature is for January (6.7 degrees). Two to four 2-week or longer droughts occur during the July to November period. Two to three thunderstorm days occur during the summer months.

The RSWF consists of a fenced area used for subsurface storage of remote handled mixed waste. Sealed carbon-steel liners are buried vertically in the ground in bored holes such that the top of the liners protrude approximately 4 inches above ground. A 30 inch concrete or 6 inch steel shield plug is placed in the liner and the plug is welded to the top of the liner. There are no permanent buildings. Therefore high wind gusts, dust devils, wildfire winds, etc. have very little effect on the RSWF structures. The exposed portion of the liners (~4 inches) is inspected quarterly for cracks, severe corrosion, and deterioration.

D-5(f) Prevention of Air Emissions [IDAPA 58.01.05.08 and 012; 40 CFR 264.601(c)(2), 270.23(a)(2)]

A complete description of the INL site air conditions is provided in INL HWMA/RCRA Permit Application, Volume 3 (General Information for INL Waste Management Units – DOE/ID-10131)].

D-5(g) Operating Standards [IDAPA 58.01.05.08; 40 CFR 264.601(c)(3), 270.23(a)(2)]

This section describes how the RSWF will be operated to prevent any releases that may affect human health or the environment due to the migration of MW in the ground or surface water, soil, or air.

The operating instructions, requirements, and responsibilities for current operations at RSWF are included in operating procedures. The list of the procedures for general operations, waste placement and retrieval at RSWF, including a summary of these procedures is listed below:

RSWF-OI-001 (Storage Operations) provides operating instructions for waste placement or transfer of containers from HFEF or FCF to RSWF storage liners using the HFEF-5 and HFEF-14 casks.

RSWF-OI-002 (Retrieval of Material from 16-in, 24-in., and 26-in. liners) provides operating instructions for opening of liners in preparation for retrieval and transfer.

RSWF-OI-003 (Material Acceptance for Storage) specifies requirements and provides instructions for accepting mixed waste (MW), radioactive waste, and radioactive material (e.g., spent nuclear material, accountable material) for storage at RSWF.

RSWF-OI-004 (Administrative Requirements/Process for Material Transfers) describes the overall administrative requirements/process used by RSWF Management for approving material-transfer activities at the RSWF to ensure that proposed transfers are covered by safety documentation and receive the appropriate level of approval.

RSWF-OI-006 (Maintenance and Surveillance Requirements) is to document the various surveillance requirements associated with maintaining the overall integrity of RSWF. These requirements apply to the storage liners, the ground they are buried in, and the cathodic protection system. This procedure also addresses the activities, procedures, and documentation used to satisfy these requirements.

RSWF-OI-007 (Remote-Handled Waste Transfer) is used to transfer waste containers from RSWF liners via open-air transfer, to an Interim Storage Container (ISC) for removal from RSWF.

RSWF-OI-010 (Retrieval of Loaded Liners) provides instructions for retrieval of a previously-excavated loaded liner from RSWF free-air into a Facility Transfer Container (FTC) and preparing the loaded FTC for transport from RSWF.

RSWF-OI-011 (Retrieval of an SLSF Canister From A 26-IN. RSWF Liner) provides instructions for opening a RSWF liner, retrieving a Sodium Loop Safety Facility (SLSF) waste can from the RSWF liner, performing a free-air transfer of the SLSF to a Facility Transfer Container (FTC), and preparing the loaded FTC for transport from RSWF.

RSWF-OI-012 (Excavation of Loaded Liners) provides instructions for excavating a loaded liner at the RSWF and welding a lifting lug to the liner so that it can be retrieved per RSWF-OI-010, “Retrieval of Loaded Liners.”

D-5(g)(1) Inner Container Handling

Once a MW inner container system is placed in an RSWF liner, the liner is not handled or opened for the addition or removal of MW. The liners and inner containment system is seal-welded closed. This effectively ensures that the inner container system is kept closed during storage. Because of the radioactivity associated with the MW, the inner container system will never be opened at RSWF, but would be transported to a hot cell for opening.

D-5(g)(2) Inner Container Transport

MW inner container systems are transported from other MFC facilities in a top-load, bottom discharge transport cask using a 25-ton forklift. To unload the cask, it is set on a shield ring that extends approximately 4 in. into the liner. A photograph showing this transport cask loaded on the forklift and positioned over a liner is provided in Attachment D-36.

The HFEF-5 and SLSF can inner container systems have a cable attached to its cover to allow the inner container system to be lowered into the liner. The upper end of this cable is attached to the bottom of the 30-in. concrete shield plug and left in place in the liner. The stored inner container system can be retrieved by removing the shield plug, securing the cable, and hoisting the container into a suitable cask. See Attachment 1, Section B, MFC Facility Description, Attachment B-11 for a diagram showing the lifting equipment, including the cable and shield plug lifting eye.

If a forklift fails during MW transfer, the cask could be transferred to a trailer and returned to the generating MFC facility. MFC also has backup cranes in the event of an equipment failure affecting a crane.

If a forklift or equipment failure occurs during MW transfer and results in a cask and/or inner container system drop, the inner container system, by design, is protected from damage and potential release of MW. The inner container system is designed to withstand the worst case drop scenario.

If an inner container system were actually dropped, it would be removed and returned to the generating MFC facility for repackaging. If it was unretrievable, it would be approximately centered in the liner and steel shot would be poured into the liner to provide shielding. The liner shield plug would be welded in place and the 16-in. liner would be pulled and placed in a 24-in. liner in accordance with an approved liner relocation procedure.

D-5(g)(3) Inner Container Loading and Damage Prevention

The MW is placed in the liners at RSWF using heavy equipment. The potential exists for damage to liners and the cathodic protection as a result of transfer operations. The potential for damage is minimized, however, by exercising preventive measures during normal facility operations. The facility is walked down after all transfer operations to ensure integrity of the systems.

The liners are protected from the heavy equipment by having the equipment straddle the liners into which the MW inner container system is being placed. Therefore, the equipment tires are several feet from the liner. In addition, all of the heavy equipment in the facility has sufficient clearance above the top of the liner. By procedure, if there is a concern about damaging a liner, prior to a MW transfer, the equipment operators load the transfer cask onto the transfer vehicle and drive the route to where the inner container system will be placed. Along the way, a second operator inspects to ensure that the ground is stable and there are no obstructions. If problems are found, they would be remedied before the actual transfer takes place.

If a liner were an obstruction, for example, enough additional back-fill would be added and compacted around the liner to ensure adequate clearance.

Beginning in 1995, concrete pads were poured parallel to new liners installed in the E, F, and H rows (ref. Attachment D-31). These liners will be used when access to liners in other rows is hampered by mud and/or snow. The concrete will prevent damage to the liners and cathodic protection system.

The cathodic protection system cables are also protected by straddling the liner row. The only part of the cathodic protection system that is above ground, and, therefore vulnerable, is the CADweld™ or connection attaching the negative lead cable to the liner. To further protect the weld and to obtain a better weld, a metal tab is attached to the front of the liner. The only other components of the system that are above ground are located at the fenceline and away from heavy equipment paths.

The design of the cathodic protection system protects the underground wiring from the heavy equipment. The trenches in which the wiring is laid were initially backfilled with sand and then native soil, which is compacted with a tamper. In addition, the placement of the wire in the trench minimizes the potential for damage. The negative lead wire is run horizontally to liners at a depth of 2-3 ft. The wire is then run vertically directly up the front of the liner to the connection point. This design minimizes stress on the wire from heavy equipment driven over the site.

The liners are exposed to loadings from soil and adjacent traffic. The capacity of the liners to withstand these loadings and the effect of corrosion on this capacity was evaluated by an independent professional engineer. The stresses in the liner due to the applied loads, assuming the liner was structurally sound, were found to be very low. The stresses were estimated at 500 psi in bending and 40 psi in shear, which are much less than the accepted values for A53 steel of 24,000 psi for bending and 14,000 psi for shear (Association of Iron and Steel Engineers Manual, Section 1.5, Allowable Stresses). Even with a 90% metal loss due to corrosion, the liners would have sufficient strength to resist collapse resulting from soil loads.

D-5(g)(4) Liner Removal

Liners are removed from the ground per operating procedures by first locating and cutting the cathodic protection lead wire. The soil surrounding the entire length of the liner is then excavated using an auger and/or vacuum excavator. Lifting eyes or another type of lifting device is then welded onto the liner to attach the rigging equipment.

D-5(h) Site Hydrogeologic Conditions [IDAPA 58.01.05.08 and 012; 40 CFR 264.601(a)(2),(3),(4), 264.601(b)(3),(5), 270.23(b)]

The RSWF is located in the Snake River Plain, which is a long, broad depression 300 miles long by up to 70 miles wide bordered on either side by mountains. RSWF is located on the eastern portion, which is a succession of basaltic lava flows of thicknesses from 10 to 100 feet interbedded with unconsolidated cinders, breccia and sediments. The total depth of the layered structure is at least 1500 ft. The ground surface of the area consists generally of composite layers of interbedded volcanic rock and sedimentary material, which includes alluvium, alluvial fan deposits, lakebed and playa deposits, and wind-blown deposits. This material varies in depths and is only a few feet deep covering bedrock in most areas. The sandy soils are characterized as having high ion-exchange characteristics. The principal ground water feature is the Snake River Plain aquifer, which is a continuous body of ground water underlying most of the eastern Snake River Plain. The aquifer consists of saturated basalt flows and sedimentary inter-beds. Most permeable zones appear to occur along the upper and lower edges of the basalt flows, which have large irregular fractures, fissures and voids. The depth to the aquifer is approximately 675 feet at the RSWF. Ground water in the unsaturated zone between the land surface and the aquifer seeps through the voids and cracks in and between layers of basalt and sedimentary material.

Twenty-nine test borings were made to depths ranging from 6 to 90 feet when the RSWF site was prepared as a storage facility. The results of the borings showed that an irregular lava surface lies between 8 and 23.5 feet below grade, with the shallow zone lying on the northwest edge of the fenced area. The average depth to lava is 15 feet. Ground water was not encountered in any of the exploratory borings.

The RSWF site is at an elevation of 5120 feet and 12 miles from the bed of the Big Lost River, which is at an elevation of 5042 feet. The Big Lost River is the closest surface water source to the RSWF. The flow of water in the Big Lost River is intermittent and associated with spring run-off. Because of the distance, elevation differences, and size of the Big Lost River, the RSWF is not considered to have any potential impact on the water quality of the Big Lost River.

The RSWF area is elevated several feet above the surrounding land surface. The elevation slopes off from 5120 feet in the center of the facility to 5117 feet at the fence line. The surrounding land within 300 feet of the facility is at a lower elevation than the fence line. Furthermore, prior to placing the liners in the RSWF storage area, several feet of gravel and soil were placed over the storage area and graded to slope gently from the centerline to the parallel sides, which were banked with gravel. This grade promotes run-off, reduces percolation in the area of the RSWF, and also serves to prevent run-on into the area.

In June 1989, an independent corrosion engineering firm (CH2M Hill, Boise, ID) performed soil corrosion mapping of the RSWF. The electrical resistivity of the soil was measured by the Wenner four pin method. The tests consisted of 90 soil resistivity measurements at average depths of 2.5, 5.0, 7.5, 10.0, and 15.0 feet. Both average and layer resistivity calculations were made from these measurements. In general, the RSWF soil ranges from mildly to moderately corrosive based on the ranking defined by the US Bureau of Standards, see Table D-11. This corresponds to a corrosion rate of 0.021 to 0.061 inches/year.

Table D-11. Corrosion rates of steel in soil and soil corrosion classes.

Corrosion Class	Soil Resistivity (Ω/cm)	Corrosion Rate (inches/year)
Noncorrosive	>10,000	0.005
Mildly Corrosive	2,000 to10,000	0.021
Moderately Corrosive	1,000 to 2,000	0.061
Corrosive	500 to 1,000	0.10
Very Corrosive	<500	0.137
From M. Romanoff, Underground Corrosion, Circ. 579. National Bureau of Standards (U.S.) 1957.		

D-5(i) Site Precipitation [IDAPA 58.01.05.08; 40 CFR 264.601(b)(4)]

A complete description of the INL site precipitation is provided in the INL HWMA/RCRA Permit Application, Volume 3 (General Information for INL Waste Management Units – DOE/ID-10131)].

D-5(j) Ground-Water Usage [IDAPA 58.01.05.08; 40 CFR 264.601(a)(5)]

A complete description of the INL ground-water usage is provided in the INL HWMA/RCRA Permit Application, Volume 3 (General Information for INL Waste Management Units – DOE/ID-10131)].

D-5(k) Surface Waters [IDAPA 58.01.05.08; 40 CFR 264.601(b)(6),(7)]

A complete description of the INL surface waters is provided in the INL HWMA/RCRA Permit Application, Volume 3 (General Information for INL Waste Management Units – DOE/ID-10131)].

D-5(l) Area Land Use [IDAPA 58.01.05.08 and 012; 40 CFR 264.601(a)(6), 264.601(b)(9), 270.23(b)]

A complete description of the INL site area land use is provided in the INL HWMA/RCRA Permit Application, Volume 3 (General Information for INL Waste Management Units – DOE/ID-10131)].

D-5(m) Migration of Waste Constituents [IDAPA 58.01.05.08; 40 CFR 264.601(a)(7)]

The sequence of events that could lead to a release of hazardous constituents to the soil start with a failure of the liner. The failure of a liner could proceed by spot corrosion leading to a pinhole penetration in the short-term or general corrosion resulting in liner collapse in the long-term scenario. Liner failure could also result from a loss of the integrity of the weld between the bottom plate and the liner pipe. The liner breach then requires that water leak into the liner through the penetration corroding the waste container resulting in a water Na/NaK reaction or a slow release of TC constituents out of the liner.

During the spring months or after a period of heavy rain, the soil around a liner could become saturated with water. If water were to leak into the liner, corrosion of the waste container could then occur. In the case of previously single contained waste, this would be corrosion of the former 16 in. liner. In the case of doubly contained waste, this would be corrosion of the outer waste container. However, the stainless steel waste containers used since 1978, are corrosion resistant because of their chromium content. Therefore, penetration of the former 16 in. liners and inner waste containers of pre-1978 waste packages is much more credible.

After many years, additional corrosion to the 16 in. liner could penetrate this layer of containment. This would allow the penetration of water to the exterior of the final waste containment barrier. After corrosion and penetration of the final level of containment, water could reach sodium or NaK.

The products of the sodium-water reaction are sodium hydroxide (NaOH) and hydrogen (H2). Similarly, the products of the NaK-water reaction are NaOH, potassium hydroxide (KOH), and H2. Depending on the amount and geometry of sodium in the waste container, H2 generation could be significant and perhaps a flammable mixture of H2 and O2 could result. The production of a flammable mixture would depend on the formation of a water seal and the liner penetration being at the bottom of the liner. A water seal could form if the soil were saturated with water. This would allow the H2 to collect in top of the liner. If a water seal did not form, the hydrogen would diffuse back through the penetration in a matter of days. If the geometry of the sodium and availability of water were such that the reaction proceeded rapidly, sufficient heat could be generated to ignite the sodium (250°F ignition temperature). If the sodium were to react and combust, the H2 could also ignite (1100°F ignition temperature). The ignition of the H2 could result in a small explosion that is limited by the availability of O2. The quantity of O2

available is limited because the waste containers were loaded and sealed in the inert (argon) atmosphere of the MFC hot cells.

In the worst case, an explosion resulting from ignition of hydrogen gas in the liner could rupture the liner and forcibly disperse hazardous and radioactive material into the surrounding soil or into the air. If the rupture and dispersion were limited to the soil, it would be dispersed only a short distance from the liner. However, migration of the constituents could then proceed. The dispersion through the air could be much more widespread and could potentially reach the MFC site. However, because of the remote location of the RSWF it is highly unlikely that the contamination would reach populated areas.

Without the forced rupture of a container due to an explosion of hydrogen gas, the release and migration of radioactive or hazardous waste constituents would be limited to the soil, which would proceed very slowly. All of the waste constituents of concern exist as solids. Even the NaK in the RSWF would be converted to a solid upon reacting with soil-water. Sodium or NaK migrating from a liner would spontaneously react with soil moisture, oxygen, and carbon dioxide to deactivate the reactivity characteristic and form nonhazardous substances (NaOH, KOH, NaO_2, $NaCO_3$, etc.).

The formation and ignition of a flammable H2-O2 mixture is a highly improbable event whose occurrence depends on a sequence of improbable events. First, the ground water level must rise above the elevation of a leak in the liner and be maintained while the sodium-water reaction occurs. If the water level should drop below the elevation of the hole, the H2 would escape harmlessly into the environment. The ground water level at the RSWF has never been observed in the range of depths that a liner occupies (0-13 feet). The second improbable event is the ignition of a flammable mixture. In order for an 1100°F source to occur as the result of sodium combustion, the heat would have to be maintained. Since the sodium at the RSWF is associated with and in contact with metal parts, the heat would more likely be conducted away by the metal and dissipated. Other potential ignition sources such as electrical discharges and volcanic activity are so improbable that they may be disregarded.

Another potential cause of a release is equipment failure leading to dropping a waste container during waste transfer operations. An equipment failure during waste transfer resulting in a container being dropped, is mitigated by the container design. The container is designed to withstand the worst case drop scenario. The worst case drop is defined as the longest possible drop of a waste container. This event could

occur with a waste container in its fully lifted position in the cask in place over a liner. A failure of the hoisting equipment or tackle at that stage would result in a maximum vertical drop of 13 ft (12 ft liner depth, plus 1 ft cask clearance). A drop test on a fully loaded waste containment package was performed to demonstrate the ability to survive the 13 ft drop. In the test a waste package containing 600 lbs of simulated waste material was dropped into an existing empty liner at the RSWF. The acceptance criteria for the test was maintenance of the integrity of at least one level of containment as verified by a pressure leak test.

The outer waste container survived the drop test maintaining at least one level of containment. The inner container received minor damage, but a portion of the weld on the bottom plate failed and slight deformation occurred. The diameter of the outer container was maintained; therefore, the package could be retrieved from the liner. The 16 in. liner also survived the test without structural damage.

If a drop were to actually occur into a liner, the container would be removed and returned to HFEF for repackaging. A Contingency Plan is also available in the unlikely event that a waste containment package was so damaged that it could not be retrieved. The package would be approximately centered in the liner and steel shot would be dumped in the liner to provide shielding. The liner shield plug would be welded in place and the 16 in. liner would be pulled and placed in a 24 in. liner per the liner relocation procedure.

There are many features engineered into the RSWF design to prevent releases that may affect human health or the environment due to the migration of MW in the ground water, soil or air. These features include the following:

— Impressed current cathodic protection for liners

— Protective 4-in. layer of noncorrosive sand slurry between the liners and the surrounding soil

— Multiple containment layers for MW[5]

— Quality assurance of liners (pressure testing, inspection, installation inspection, etc.)

[5]. From 1965 to 1978, the MW was placed into a paint can which was placed into an original 16-in. liner. The 16-in. liners were relocated and placed into new cathodically protected 24-in. liners. The viability/integrity of this containment varies depending on the contents of each of these levels of containment. Post 1978, the MW was placed into an inner HFEF-5 can or SLSF can, which was placed into an outer HFEF-5 can or SLSF can, and then the double container was placed into a new cathodically protected 16-in. or 26-in. liner.

- Arid climate
- Facility elevation with respect to surrounding surface and ground-water sources.
- Site geology
- Remote location.

An important feature is the cathodic protection system. A properly designed and operated impressed current cathodic protection system virtually eliminates liner corrosion by soils surrounding the liners. The proper operation of the system is ensured by regular inspection and a preventative maintenance corrosion monitoring program. With liner corrosion eliminated, almost all credible release scenarios are eliminated. As long as the liner integrity is maintained, it is a formidable barrier against the release of material to the soil or air.

Additional assurances against releases are provided by the protective layer of noncorrosive sand backfill surrounding the liners and the integrity of the inner container and liners used to store the MW.

While the cathodic protection system is designed to protect the liners, it is possible that residual moisture or soil encrustation on the inner containers could create corrosion on the internal wall of the liner. The environment within the liner provides a finite source of corrosive media, is less diverse, and, therefore, corrosive processes are more predictable than those occurring on the outside of the liner. Corrosion/pitting predictions based upon S. F. Mughabghab and T. M. Sullivan, "Evaluation of the Pitting Corrosion of Carbon Steels and Other Ferrous Metals in Soil Systems," Waste Management, 9, pp. 239-251, 1989, indicate no penetration for at least 50 years. This event can result in a detectable level of hydrogen in the liner. As such liner atmosphere is tested and purged as necessary before opening the liner for waste removal.

The climate and elevation of the facility are mitigating features against a release migrating off-Site. The RSWF climate is semi-arid high desert with a low average annual rainfall (about 8 in.). The RSWF site is at an elevation of 5120 ft and 12 miles from the bed of the Big Lost River, which is at an elevation of 5042 ft. The Big Lost River is the closest surface-water source to the RSWF. The area is also on relatively high ground. The elevation slopes off from 5120 ft in the center of the facility to 5117 ft at the fenceline. The surrounding land within 300 ft of the facility is at a lower elevation than the fenceline (ref. drawing in Attachment D-30). In

addition, a facility drainage system, consisting of drainage culverts located on the north, east, and west sides of the facility, and at specific locations within the facility, provides for general runoff and diversion of surface water from the facility to the surrounding desert. These features serve to isolate the facility from major sources of surface water.

The primary available sources of water are precipitation and ponding from rapid snow-melt, which are both intermittent and limited due to the climate. The RSWF cathodic protection system was designed and has proven to adequately protect the liners from corrosion for the RSWF soil and surface water conditions. Saturating the soil environment in fact increases the effectiveness of the impressed current cathodic protection system. Additionally, pooling of water at the surface of the liners also provides for the transfer of cathodic protection current to the exposed steel (Ref. Attachment D-30 for a discussion of the impact of saturated soil conditions on the cathodic protection system by the corrosion expert who is very familiar with the RSWF). The primary driving force for MW migration is percolation of soil-water through the unsaturated zone. Percolation is minimized by the slope of the RSWF, which promotes run off. Therefore, even if an undetected release were to occur, the migration of hazardous constituents to off-Site locations or into water supplies during the life of the facility is unlikely.

The soil of the INL is typically high in clay and silt content. As a result, the soil has a very low vertical hydraulic conductivity, approximately 0.01 ft/day, which should retard the downward migration of potential vapor or liquid contaminants. In addition, the clay may retard the migration of radionuclides and metals through adsorption. Because the RSWF is approximately 675 ft above the water table and is higher in elevation than potential surface-water sources, it is well isolated from major sources of water. Therefore, the migration of hazardous constituents to off-Site locations for incorporation into the root zone of crops and other vegetation or into water supplies during the life of the facility is highly improbable.

D-5(n) Evaluation of Risk to Human Health and the Environment [IDAPA 58.01.05.08; 40 CFR 264.601(a)(8), (9), 264.601(b)(10), (11), 264.601(c)(6), (7)]

There are many features engineered into the RSWF design to prevent releases of MW that may affect human health or the environment due to the migration of MW in the ground water, soil, or air. The geology, topography, and climate of the site and the engineering design of the facility combine to minimize the risk to human health and the environment from the hazardous constituents stored there. In

addition, a comprehensive inspection and monitoring program is used to ensure that the waste is being adequately protected (ref. Attachment 4, Section F, Inspections).

An important mitigation against a loss of integrity of the RSWF MW liner is cathodic protection. Cathodic protection is the most effective available means of protecting steel in contact with soil from the effects of galvanic corrosion. A properly designed and operated impressed current cathodic protection system virtually eliminates external liner corrosion[6]. Galvanic corrosion is further minimized at the RSWF by completely surrounding the liners with noncorrosive sand at the time of emplacement. With corrosion on the liner exterior eliminated, credible release is virtually eliminated. As long as the liner integrity is maintained, it is an effective barrier against the release of material to the ground water, soil, or air.

The RSWF cathodic protection system was designed by corrosion engineers under the supervision of a State of Idaho-registered professional engineer. The corrosion engineers also provided the proper operating parameters for the system to provide maximum protection.

Cathodic protection is a well developed technology for which an extensive amount of operating experience and operating standards exists. The proper design, operation, and maintenance of cathodic protection systems has been documented by the National Association of Corrosion Engineers in a Recommended Practice (National Association of Corrosion Engineers Standard RP-02-85, Item No. 53056). The RSWF cathodic protection system conforms with all of the recommendations of this standard and the recommendations of the independent designers.

The proper operation of the cathodic protection system is assured through a monitoring or preventative maintenance and inspection program. The inspections will ensure that the cathodic protection system is operating and the monitoring or preventative maintenance will evaluate the effectiveness of the system. The inspection and preventative maintenance schedule and methods were developed based on the recommendations of the NACE Standard, IDAPA 58.01.05.08; 40 CFR 264 tank regulations, and the recommendations of the system designers. The monitoring program was devised to detect any potential inadequacies in the facility design that could lead to a loss of waste containment.

The integrity of liners is built in and verified prior to being placed in service through inspections and a pressure test. The liners are manufactured in accordance with site

[6]. Uhlig, H.H., Corrosion and Corrosion Control: An introduction to Corrosion Science, 3rd Edition, 1985, John Wiley & Sons, inc., p. 217.

fabrication drawings. The liner is hydrostatically tested and failed liners are repaired and retested. After an inner container system is placed in the liner, the cover is welded closed. Quarterly the exposed portions of the liners are visually inspected for cracks, corrosion and deterioration. However, snow conditions may render some or all liners unavailable for inspection.

In order to provide additional assurances against a release since 1978, the MW is contained within multiple layers of confinement within the liner. By providing multiple layers of confinement between the MW and ground water, soil, or air, the probability of a release is very low.

The climate and elevation of the facility are also mitigating features. The RSWF climate is semi-arid high desert. Average annual rainfall is about 8 in. at the Central Facilities Area of the INL with about 50% falling as snow. The RSWF site is at an elevation of 5120 ft and 12 miles from the bed of the Big Lost River, which is at an elevation of 5042 ft. The Big Lost River is the closest surface water source to the RSWF. The area is also on relatively high ground. The elevation slopes off from 5120 ft in the center of the facility to 5117 ft at the fenceline. The surrounding land within 300 ft of the facility is at a lower elevation than the fenceline.

Because the RSWF is higher in elevation than potential surface-water sources and is higher than the surrounding terrain, it is isolated from major sources of water. The primary available sources of soil-water are precipitation and ponding from rapid snowmelt, which are both intermittent and limited due to the climate. The primary driving force for contaminant migration is percolation of soil-water through the unsaturated zone. Therefore, even if an undetected release were to occur, the migration of hazardous constituents to off-Site locations or into water supplies where human health would be at risk is unlikely.

The principal ground-water feature of the INL is the Snake River Plain Aquifer, which is a continuous body of ground water underlying most of the eastern Snake River Plain. The aquifer is an important source of water to the State of Idaho and contamination of the aquifer by RSWF waste constituents would pose a risk to human health. However, the depth to the aquifer is approximately 675 ft at the RSWF. The risk to human health and the environment from contaminating the aquifer is very small because of the following factors:

— Depth to the aquifer

— Limited supply of water for transporting waste constituents

— Quantity of MW in an individual liner

— Large volume of the aquifer

— Engineering barriers to a release.

The risk to human health and the potential for damage to domestic animals, wildlife, and crops is also minimized by the remote location of the facility. The RSWF is located on the INL, which is described in detail in the INL HWMA/RCRA Permit Application, Volume 3 (General Information for INL Waste Management Units – DOE/ID-10131)]. The INL boundaries extend for approximately 39 miles (north to south) and 36 miles (east to west). Approximately 95% of the area has been withdrawn from the public domain with the remaining 5% controlled by the DOE. The population density within 20 miles of the RSWF in any direction is less than 10 persons/square mile.