REMOTE-HANDLED MIXED LOW-LEVEL WASTE

Produced for the Leadership in Nuclear Energy (LINE) Commission and residents of the State of Idaho by the Energy Policy Institute with contributions and review by Idaho National Laboratory, Fluor Idaho, and Boise State University.

Summary

This report on remote-handled mixed low-level waste is part of a series of technical reports that was completed on nuclear waste and spent fuel. Special emphasis is on the relevance of the topics for Idaho.

Table of Contents

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1. Definition: What is remote-handled mixed low-level waste?

Remote-Handled (RH) refers to nuclear waste that emits radiation which can penetrate container walls and human skin, making it unsafe for people to handle. One method of classifying radioactive waste as RH is by measuring the radioactivity or dose equivalent rates, such as Roentgen Equivalent Man (rem) or Sieverts (Sv).[1] RH waste has a dose rate greater than 200 mrem/hr (millirem per hour). Waste types

[1] Radioactivity is the amount of ionizing radiation released and dose is a measure of the amount of radiation. Absorbed dose is related to medical effects to the human body.

categorized as RH require remote-handling equipment and thick shielding to protect workers who are retrieving, treating, packaging, and transporting the waste.

Low-level waste (LLW) is characterized by what it is not. LLW is a class of radioactive waste that is not spent nuclear fuel (SNF), high-level waste (HLW), uranium mill tailings, or transuranic waste (TRU). This means that waste not meeting the criteria for any of those waste classes falls under low-level waste. However, low-level waste does not necessarily correlate to low radioactivity. Low-level waste typically consists of items such as protective clothing, rags, and other equipment or tools that have become radioactive through exposure to radiation. The level of radioactivity in low-level waste can range from natural levels to very high levels, such as those found in nuclear reactor parts.

Remote-handled mixed low-level waste (RH-MLLW) consists of low-level waste that contains chemically hazardous constituents according to the federal Resource Conservation and Recovery Act of 1976 (RCRA) and successive amendments.[2] The characteristics of hazardous constituents are ignitability, corrosivity, reactivity, and toxicity (40 CFR Part 261). The primary radiological constituents in RH-MLLW may include isotopes of the following elements: uranium, low concentrations of plutonium and other transuranic elements (elements with a higher atomic number than 92), cesium, and cobalt. Cesium and cobalt decay at a much faster rate than many uranium or transuranic isotopes.[3]

2. Source: Where did remote-handled mixed low-level waste that is in Idaho come from?

Research activities and defense-related missions generated the mixed low-level waste stored at the INL today.[4] Mixed waste was also generated at other DOE sites and commercial facilities around the United States and sent to INL for interim storage awaiting disposal.

3. Quantity: How much remote-handled mixed low-level waste is there?

According to the 2016 Idaho National Laboratory Site Treatment Plan, there are 43 cubic meters of RH-MLLW in storage at INL. There are 285 cubic meters of MLLW total in storage and awaiting treatment at INL. RH-MLLW accounts for 15% of all MLLW in interim storage at the site. Treatment is required for waste that contains hazardous constituents before the waste can be properly disposed.

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[2] RCRA was established to address the issues of growing volumes of waste, protect human health, protect the natural environment, and ensure proper waste management. RCRA authorizes states to regulate hazardous waste through their own programs, if approved by the Environmental Protection Agency (EPA). Idaho has been authorized by the EPA to regulate hazardous waste.

[3] The time for cesium-137 isotope to lose 50 percent of its radioactivity, known as the half-life, is approximately 30 years. Cobalt-60 has a half-life of approximately 5 years. Uranium and plutonium have half-lives up to thousands of years depending on the isotope.

[4] Historically, Idaho National Laboratory (INL) has performed nuclear research to advance nuclear technology to support the nation's energy needs. Nuclear reactor construction and testing at INL began in 1951 with the Experimental Breeder Reactor I (EBR-I). Nuclear reactor testing continued after the EBR-I with 52 reactors, including EBR-II, having been constructed and operated. INL continues to operate three nuclear reactors including the Advanced Test Reactor.

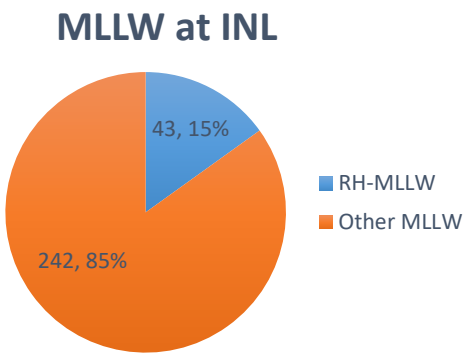

Fig 1. Amount of RH-MLLW volume at INL. *Source: [3].*

4. Storage: How is remote-handled mixed low-level waste stored?

Over several decades, waste has been periodically placed in interim storage at the Materials and Fuels Complex.[5] Currently there are 645 containers of RH waste at the Materials and Fuels Complex. Out of the 645 containers of RH waste, 178 are RH-MLLW. The waste containers are in cylindrical storage vaults, called liners, sealed with carbon-steel pipes, and buried vertically. Figure 3 shows an example of various containers inside buried liners. The liner sizes range from 16 to 60 in. for the outside diameter.

Fig 2. Remote-handled waste storage at the Radioactive Scrap Waste Facility. *Source: [5].*

[5] The Materials and Fuels Complex was originally the Argonne National Laboratory – West.

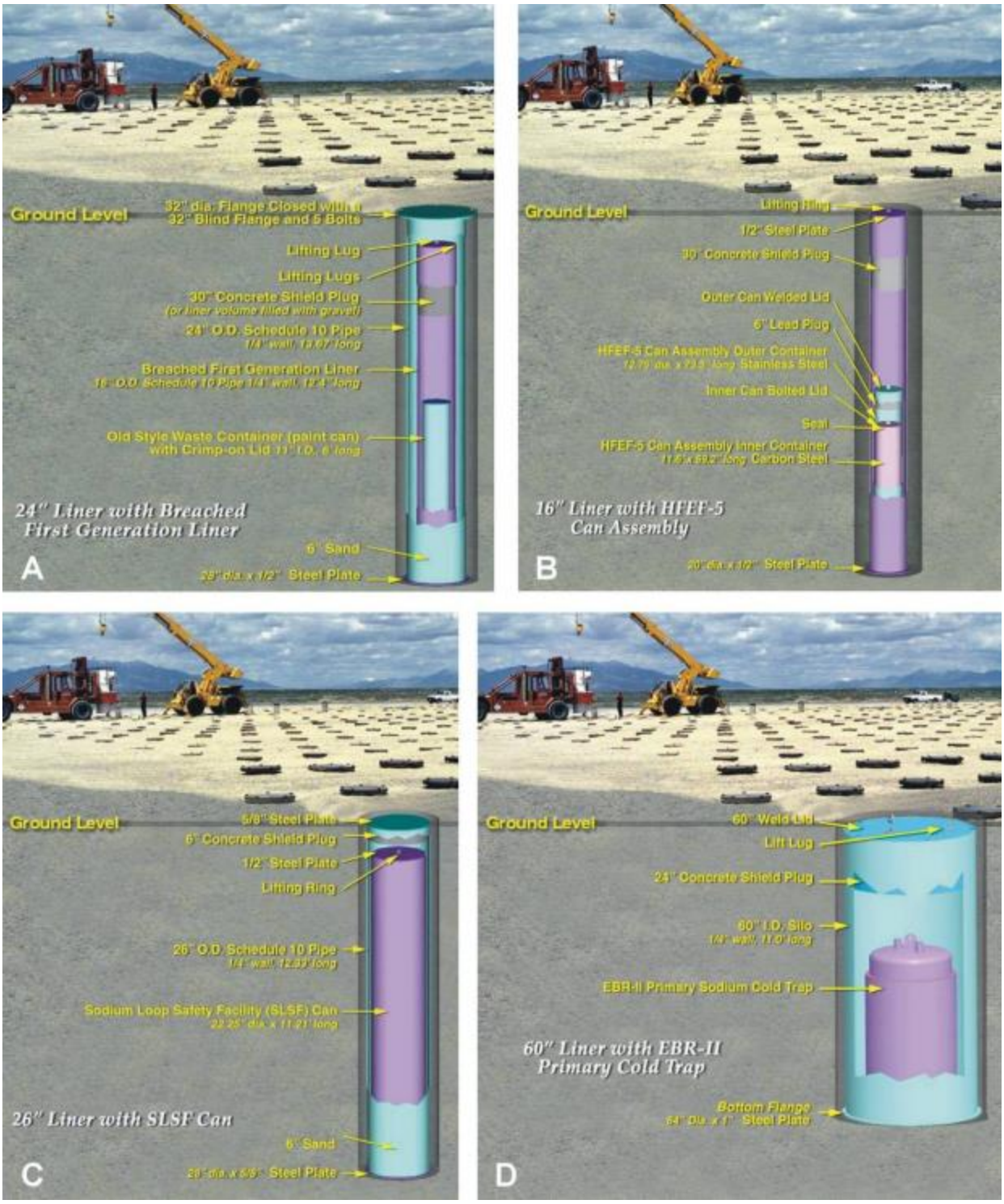

Fig 3. Radioactive Scrap Waste Facility storage liner configurations. *Source: [5].*

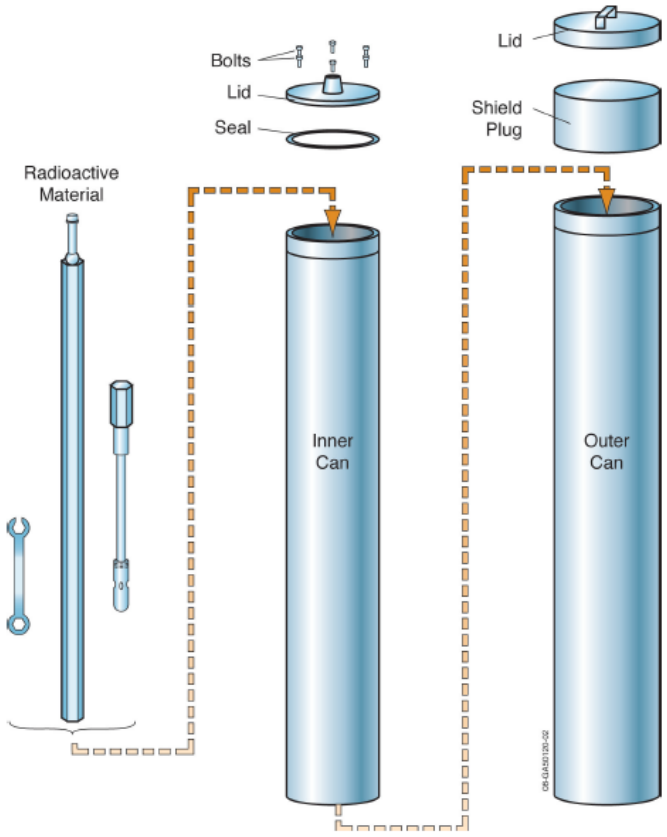

Fig 4. Radioactive Scrap Waste Facility storage can configurations. *Source: [11].*

5. Risks: What key risks are associated with remote-handled mixed low-level waste?

Many activities must take place before RH-MLLW can be disposed. Waste that is in interim storage must first be retrieved from its storage location. Depending on the final disposal pathway, the waste must be treated to meet the requirements and waste acceptance criteria for the destination. Greater than 90% of the INL RH-MLLW is contaminated with elemental sodium and requires treatment prior to disposal. After approval for shipment, the waste must be loaded and transported to the disposal facility, where the waste is then placed in the disposal facility.

A major issue with RH-MLLW is potential radiation exposure to workers throughout the handling process. Unlike contact-handled waste, RH-MLLW radiation penetrates materials and requires extreme care when handling. To avoid direct exposure or inhalation of airborne radioactive particles, engineering controls, procedures, and protective equipment are utilized to ensure proper handling and protection by workers.

6. Destination: Where will RH-MLLW be disposed?

According to the 2016 Idaho Site Treatment Plan, the goal is to dispose RH-MLLW at the Nevada National Security Site (NNSS, Figure 5).[6] MLLW from the INL will be disposed in the Mixed Waste

[6] The NNSS is located 65 miles from Las Vegas and covers 1,360 square-miles. Beginning in 1951, the NNSS became a location where the United States conducted nuclear weapons testing. Testing ceased in 1992 after the U.S. agreed to sign the Nuclear Test Ban Treaty. Since the treaty, the NNSS primary mission is to keep remaining weapons safe, focus on global and homeland security programs, and conduct environmental management.

Disposal Unit at the NNSS Area 5 Radioactive Waste Management Site. Some RH-MLLW will be disposed at licensed commercial facilities in Texas and Utah. The selection of the disposal site is dependent on the specific waste acceptance criteria and associated cost for disposal of a waste stream at each facility.

Fig 5. The Nevada National Security Site. *Source: [13].*

7. Settlement Agreement: How does the 1995 Settlement Agreement apply to the remote-handled mixed low-level waste?

RH-MLLW is not subject to the 1995 Idaho Settlement Agreement. The Site Treatment Plan, a statutorily-required document enforced by the Idaho Department of Environmental Quality (DEQ), establishes the enforceable framework in which DOE will treat or otherwise meet RCRA Land Disposal Restrictions (LDR) for all covered mixed wastes currently in storage and to be generated or received in the future pursuant to RCRA.

8. Status: What is the status of the remote-handled mixed low-level waste?

The RH-MLLW at INL is properly stored and monitored in accordance with applicable regulations and the Site Treatment Plan. The current disposition plan for the 43 cubic meters of RH-MLLW is to process and treat it to meet land disposal restrictions for the non-radioactive portion either in on-site facilities or in off-site commercial treatment, storage, and disposal facilities properly authorized, permitted, and licensed to treat the waste. Following any required treatment, the waste will be disposed in the appropriate facilities authorized to accept the treated waste.

9. REFERENCES

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