TRANSURANIC 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 transuranic 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

---

1. Definition: What is transuranic waste?

Transuranic (TRU) waste consists of materials contaminated with artificially-made radioactive elements, such as solid sludge or clothing, tools, rags, residues, soil, and debris. These elements are all heavier than uranium (with a higher atomic number than uranium which is 92), hence the name “trans” or “beyond” uranium, and may include neptunium (Np), plutonium (Pu), and americium (Am). Depending on the element, the half-life, or time it takes for the radioactivity to decrease by half, will vary. TRU waste is

further restricted to waste material contaminated with TRU isotopes with a half-life greater than 20 years and a contamination by mass of greater than 100 nano curies per gram.[1]

There are two main categories for TRU waste depending on composition and handling. *Remote-Handled TRU waste* (RH-TRU) contains high levels of gamma radiation, making it unsafe for people to handle up close. The second type of TRU waste is categorized as *Contact-Handled TRU waste* (CH-TRU). Relative to RH-TRU, the CH-TRU emits less gamma radiation and can be handled directly by people. Although the CH-TRU waste gamma radiation is significantly less, protective clothing and equipment are still used to provide additional safety barriers for workers. RH-TRU and CH-TRU also have alpha-emitting radioactive elements that are primarily an inhalation hazard.

2. Source: Where did TRU waste that is in Idaho come from?

Most of the stored TRU waste at the Idaho National Laboratory (INL) came from the Rocky Flats Plant that was located in Jefferson County, Colorado, approximately 16 miles from Denver.[2] The other inventory of TRU waste at INL comes from the Materials and Fuels Complex, Idaho Nuclear Technology and Engineering Center (INTEC), Naval Reactors Facility, Advanced Test Reactor Complex, and several small generators from around the country such as from the Monsanto Corporation. The majority of newly generated CH-TRU and RH-TRU waste comes from nuclear fuel research and development activities at the Materials and Fuels Complex.

3. Quantity: How much TRU waste is in Idaho?

As of December 31, 2016, there were 20,800 cubic meters (4.7 million dry gallons) of contact-handled TRU waste stored above ground at INL, which accounts for 48% of the total CH-TRU waste stored at different DOE sites across the country. Additionally, there are 290 cubic meters (66,000 dry gallons) of remote-handled TRU waste stored at INL, which accounts for 13% of the total RH-TRU waste stored at different DOE TRU waste generator sites. INL and the Hanford site in Richmond, WA, house the greatest volume of CH and RH waste in the US. Originally, there was an estimated 65,000 cubic meters of above-ground, retrievably-stored TRU waste at INL. The volume has decreased by almost 70% of the original amount through processes employed by the Advanced Mixed Waste Treatment Project (AMWTP) and the RH-TRU Program at the INTEC facilities.

In addition, as of 2006, 5.69 acres of the Subsurface Disposal Areas containing TRU waste were targeted for exhumation in the Accelerated Retrieval Project (ARP). The reasons for this are described below.

[1] The ^{239}Pu isotope, for example, has a half-life of 24,100 years and waste contaminated with ^{239}Pu with a concentration of more than 100 nano curies per gram is considered a TRU waste. In contrast, the ^{241}Pu isotope has a half-life of 14.4 years and waste contaminated with ^{241}Pu alone would not be considered TRU waste.

[2] From 1952 until the early 1990s, the Rocky Flats Plant was a manufacturing facility that fabricated components for nuclear weapons such as plutonium triggers. A secondary purpose of the Rocky Flats Plant was recovery of plutonium from retired nuclear weapons. The plant operations generated a significant amount of TRU waste that was shipped to INL. The waste shipments commenced in 1954 and continued until 1989. The Rocky Flats Plant ceased weapon components fabrication in 1992 and was renamed the Rocky Flats Environmental Technology Site. Environmental cleanup activities and regulatory closure was achieved in 2006.

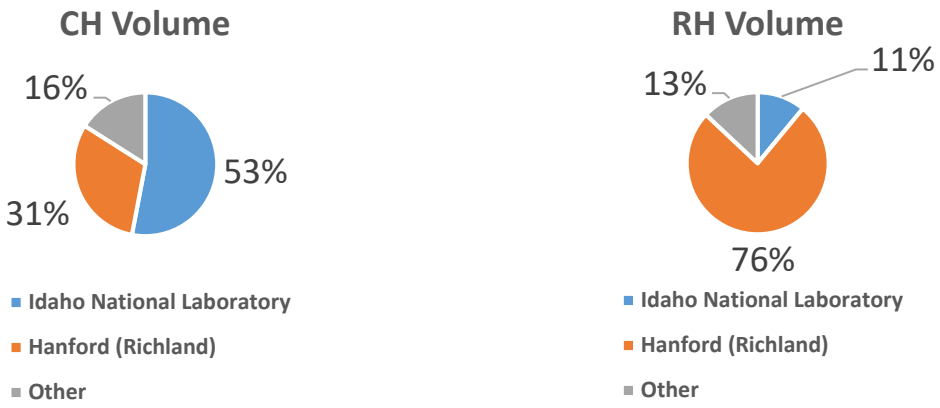

Fig 1. Distribution of TRU waste volume at DOE sites. *Source:[4].*

4. Storage: How is TRU waste stored?

From 1954 until 1970, CH-TRU waste received by INL from the Rocky Flats Plant was permanently buried at the Radioactive Waste Management Complex (RWMC). Within the RWMC, the waste was buried below the ground surface in pits and trenches in a location known as the Subsurface Disposal Area (SDA).

Fig 2. Newly placed drums and boxes of transuranic waste at the RWMC, circa. 1971. The drums and boxes would soon be covered with soil to form a protective berm. *Source: [6].*

After 1970, the US Atomic Energy Commission Immediate Action Directive (IAD) 0511-21 required that plutonium-contaminated waste be separated from other types of waste. In addition, if TRU waste were to be buried, it had to be placed in readily-retrievable containers. The concern was that TRU waste elements

remain radioactive for many years, and scientific research suggested that TRU waste be disposed within a deep geological repository. During this time, while the certification of the geological repository Waste Isolation Pilot Plant (WIPP) was pending, waste received at INL was placed in retrievable, above-ground storage on an asphalt pad and covered with 4-5 feet of overburden material (dirt).

To address concerns described above, exhumation of a specified volume and acreage of the TRU waste buried within the SDA (refered to as targeted waste) prior to 1970 began in 2004 and is still in progress. In 2006, 5.69 acres of the Subsurface Disposal Area containing buried TRU waste were targeted for exhumation in the Accelerated Retrieval Project (ARP), which further requires that at least 7,485 cubic meters of buried targeted TRU waste be exhumed, repackaged, and shipped out of the State of Idaho. The ARP waste exhumation process is approximately 88% complete in terms of required acreage, and approximately 80% complete with respect to shipping the minimum volume of exhumed and repackaged, targeted TRU waste, with over 6,000 cubic meters now shipped out of the state. Figure 7 shows the typical targeted waste exhumation and inspection process.

Between 1970 and the early 1990s, approximately 65,000 cubic meters of waste was placed in above-ground retrievable interim storage. In the mid-1990s, the environmental requirements were revised again, requiring that TRU waste to be stored in Resource Conservation and Recovery Act (RCRA)-compliant storage modules with an impervious concrete floor with an epoxy sealant.[3] The retrieval process for this above-ground waste began in 2005 and was completed in 2017. Figure 3 shows workers retrieving waste drums from the above-ground asphalt storage pad. Figure 4 shows CH-TRU waste in storage as well as typical examples of the waste in drums. A small portion of the original above-ground, 65,000 cubic meters, was stored in facilities at INTEC as RH-TRU waste and was also retrieved and processed. Figure 5 shows typical hot cell activities at INTEC processing RH-TRU waste. During the retrieval processes and subsequent treatment at AMWTP or INTEC, nearly 70% of the waste was shipped out of Idaho to the WIPP. Figure 6 shows typical waste emplacement at WIPP.

CH-TRU waste awaiting offsite disposal is primarily stored within steel drums with sizes varying from 55-gal to 100-gal. RH-TRU waste is stored in 55-gal drums and placed in shielded overpacks awaiting shipment.

Fig 3. Retrieval of TRU waste. *Source: [21].*

[3] The Resource Conservation and Recovery Act is a law created by Congress which gives authority to the Environmental Protection Agency and provides a framework for appropriate management of hazardous and non-hazardous solid waste.

Fig 4. TRU waste in white 55-gal steel drums that are certified and ready to ship to the WIPP *(left), Source: [21].* Simulated waste inside steel drums *(right), Source: [22].*

Fig. 5 RH-TRU Waste Processing at INTEC. *Source: [23].*.

Fig 6. TRU waste disposed underground at WIPP. *Source: [22].*

Fig 7. Targeted Waste Exhumation and Inspection Process at ARP. *Source: [23].*.

5. Risks: What are the risks associated with TRU waste?

For the past 65 years, the main concern with radioactive constituents from the TRU waste in Idaho has been in potentially contaminating the Snake River Plain Aquifer. If a container is breached, the surrounding soil can be contaminated, and the radioactive particles can move into the Aquifer. Since all the CH-TRU waste has been retrieved from interim storage and awaits shipment to the WIPP, the issue has been mitigated for retrievably-stored waste. Risk from the SDA will be further mitigated when exhumation of buried targeted TRU waste is complete in 2020.

6. Agreements: How does the 1995 Settlement Agreement and the 2006 Agreement to Implement apply to TRU waste?

According to the 1995 Settlement Agreement between the State of Idaho, U.S. Navy, and the U.S. Department of Energy (DOE) the retrievably stored transuranic waste, subject to the 1995 Settlement Agreement and stored at INL, was to be shipped out of Idaho by a target date of December 31, 2015 and no later than December 31, 2018. The 2006 Agreement to Implement between the State of Idaho and U.S. DOE outlines a clean-up plan for the buried TRU waste, requiring that DOE remove a specified amount of the buried, targeted TRU waste from the SDA and ship it out of the State. The current contract milestone for completion of exhumation is August 30, 2020. All the shipments of TRU waste are intended for the Waste Isolation Pilot Plant (WIPP), located in New Mexico, currently the only geological repository licensed for this type of nuclear waste disposal. Portions of the waste found not to be TRU waste are shipped to other radioactive waste disposal facilities, principally in Utah and Nevada.

7. Agreements: What is the status of TRU waste related to the Settlement Agreement and Agreement to Implement?

In 2014, WIPP shut down for almost three years after two unrelated accidents occurred underground within the repository.[4] The subsequent shut-down period prevented Idaho Cleanup Project (ICP) from shipping waste to WIPP. Although WIPP reopened in 2017 and ICP was the first site to resume shipments in April 2017, the deadline for shipping all Settlement Agreement TRU waste out of Idaho by December 31, 2018, as well as annual requirements for shipping Agreement to Implement targeted waste, were not met. ICP has been making efforts to treat and package all the remaining Settlement Agreement waste. Currently the waste is being shipped out at an average rate of eight shipments per week to WIPP with the Settlement Agreement waste as a priority.

[4] The first accident was a fire involving a vehicle and the second was the breaching of a waste drum that released airborne radioactivity.

8. REFERENCES

[1] 1995 Settlement Agreement. (n.d.). Retrieved April 12, 2018, from http://www.deq.idaho.gov/media/550338-1995_Settlement_Agreement.pdf

[2] Anderson, S., Hobbes, T., Jines, A., Lattin, W., Lusk, G., & Ziemianski, E. (2011). *The Operational Importance of Radiological Improvements in Remote Handled Transuranic Waste Processing at the Idaho Cleanup Project - 11055* (Publication).

[3] Brown, N. (2018, February 21). DOE Expects to Miss Transuranic Waste Deadline. *Post Register*. Retrieved May 10, 2018, from http://www.postregister.com/articles/news-daily-email-todays-headlines/2018/02/21/doe-expects-miss-transuranic-waste-deadline.

[4] DOE. (2018). *Annual Transuranic Waste Inventory Report - 2018* (Rep. No. DOE/TRU-18-3425 Rev. 0).

[5] DOE. (2016). *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (Rep. No. DOE/WIPP-02-3122).

[6] DOE Office of Environmental Management. (2015, October 29). EM Cleanup Crew Nears Finish at Idaho Transuranic Waste Storage Facility. Retrieved May 9, 2018, from https://www.energy.gov/em/articles/em-cleanup-crew-nears-finish-idaho-transuranic-waste-storage-facility

[7] DOE Office of Environmental Management. (n.d.). Idaho National Laboratory. Retrieved May 8, 2018, from https://www.energy.gov/em/idaho-national-laboratory

[8] DOE Office of Environmental Management. (2017, March 15). Transuranic Waste Retrieval at Idaho's AMWTP Now Complete. Retrieved May 11, 2018, from https://www.energy.gov/em/articles/transuranic-waste-retrieval-idaho-s-amwtp-now-complete

[9] DOE. (n.d.). The Department of Energy's Rocky Flats Plant: A Guide to Records Series Useful for Helath-related Research. Retrieved May 8, 2018, from https://ehss.energy.gov/ohre/new/findingaids/epidemiologic/rockyplant/waste/intro.html

[10] Government Accountability Office. (1999). *Nuclear Waste Information on DOE's Interim Transuranic Waste Storage* (United States, Government Accountability Office).

[11] Government Accountability Office. (2007). *Nuclear Waste Plans for Addressing Most Buried Transuranic Wastes Are Not Final, and Preliminary Cost Estimates Will Likely Increase* (United States, Government Accountability Office).

[12] Idaho Completion Project. (2005). *Historical Background Report for the Rocky Flats Plant Waste Shipped to the INEEL and Buried in the SDA from 1954 to 1971* (Rep. No. ICP/EXT-04-00248 Rev. 1). Idaho Falls, ID: North Wind.

[13] Idaho National Engineering and Environmental Laboratory. (1999). *Advanced Mixed Waste Treatment Project Final Environmental Impact Statement* (Vol. 1, Rep. No. DOE/EIS-0290). Idaho Falls, ID.

[14] Idaho National Engineering and Environmental Laboratory. (2003). *Acceptable Knowledge Document for INEEL Stored Transuranic Waste - Rocky Flats Plant Waste* (Rep. No. INEL-96/0280 Rev. 3). Idaho Falls, ID.

[15] INL. (2013). *Idaho National Laboratory 2015-2023 Ten Year Site Plan Developing and Maintaining the INL Infrastructure* (Rep. No. DOE/ID-11488). ID.

[16] Idaho Site Cleanup by the Numbers. (2017, Jun.). Retrieved March 5, 2018, from *https://www.energy.gov/em/downloads/idaho-site-cleanup-numbers*.

[17] National Research Council. (2002). *Characterization of Remote-Handled Transuranic Waste for the Waste Isolation Pilot Plant: Final Report*. Washington, DC: The National Academies Press. https://doi.org/10.17226/10492.

[18] Nelson, R., Patterson, R., & VanLuik, A. (2015). *The February 2014 Accidents at WIPP - 15024 (What Happened and What We Know About Why)* (Rep.). Carlsbad, NM.

[19] Nuclear Regulatory Commission. (2017, May 1). Backgrounder on Plutonium. Retrieved April 26, 2018, from https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/plutonium.html

[20] Nuclear Regulatory Commission. (2017, April 10). Transuranic waste. Retrieved April 20, 2018, from https://www.nrc.gov/reading-rm/basic-ref/glossary/transuranic-waste.html

[21] Zimmerman, J. (2016, September). *Status of Idaho Transuranic Waste Program*. Speech presented at National Cleanup Workshop.

[22] INL/Michael Connelly, (n.d.).

[23] Idaho Clean-up Project, (n.d).