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Challenges with Retrieving Transuranic Waste from the Hanford Burial Grounds

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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Challenges with Retrieving Transuranic Waste from the Hanford Burial Grounds

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The U. S. Department of Energy's (U.S. DOE's) Hanford Facility (Hanford) is the largest ongoing environmental cleanup project in the world. Plutonium and other nuclear materials were produced at Hanford for the nation's defense. Suspect transuranic (TRU) waste was retrievably stored in burial grounds awaiting the opening of the Waste Isolation Pilot Plant (WIPP) facility in New Mexico. This paper discusses the challenges with retrieval of this TRU waste at Hanford.

ABSTRACT

The U.S. DOE's Hanford Reservation produced plutonium and other nuclear materials for the nation's defense starting in World War II. The defense mission generated wastes that were either retrievably stored (i.e. retrievably stored waste) and/or disposed of in burial grounds. Challenges have emerged from retrieving suspect TRU waste including adequacy of records, radiological concerns, container integrity, industrial hygiene and safety issues, the lack of processing/treatment facilities, and the integration of regulatory requirements.

All retrievably stored waste is managed as mixed waste and assumed to be TRU waste, unless documented otherwise. Mixed waste is defined as radioactive waste that contains hazardous constituents. The Atomic Energy Act governs waste with radionuclides, and the Resource Conservation and Recovery Act (RCRA) governs waste with hazardous constituents. Waste may also be governed by the Toxic Substances Control Act (TSCA), and a portion may be managed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

In 1970, TRU waste was required to be placed in 20-year retrievable storage and segregated from other waste. Prior to that date, segregation did not occur. Because of the changing definition of TRU over the years, and the limitations of early assay equipment, all retrievably stored waste in the burial grounds is managed as suspect TRU. Experience has shown that some of this waste will be characterized as low-level (non-TRU) waste after assay.

The majority of the retrieved waste is not amenable to sampling due to waste type and/or radiological issues. Key to waste retrieval and disposition are characterization, historical investigation and research, knowledge of past handling and packaging, as well as a broad understanding and application of the regulations.

INTRODUCTION

The Hanford site, located along the Columbia River in southeastern Washington State, is approximately 586-square-miles in size. Beginning in the 1940s with the Manhattan Project, Hanford played a pivotal role in the nation's defense for more than 40 years. Today, under the direction of the U.S. DOE, Hanford is engaged in the largest environmental cleanup project in the world, with a number of overlapping regulatory and technical concerns.

To protect human health and the environment for future generations, TRU waste (e.g., plutonium-bearing waste) is required to be permanently isolated due to the extremely long half lives of the radionuclides. The WIPP in New Mexico is the only facility that accepts this defense-related waste.

Hanford is on target to remove up to approximately 15,000 cubic meters (various types of containers) of suspect TRU waste by the end of 2010. Some of these containers have significant integrity issues from long-term retrievable storage in burial ground trenches.

HISTORY AND PROCESS

Hanford was previously a plutonium production complex with nine nuclear reactors and associated processing facilities. The clean-up and restoration mission today resulted from past defense missions. Hanford played a pivotal role in the nation's nuclear defense for more than 40 years, beginning in the 1940s with the Manhattan Project, and after World War II with Cold War defense missions.

Multiple Hanford facilities were involved in the overall national defense project. Nuclear reactors, including eight single-pass reactors and N-Reactor, irradiated experimental fuel. Research and development was conducted at fuel production and chemical separations' plants such as B Plant, T Plant, U Plant, Z Plant, PUREX, as well as various facilities within the 300 Area.

WASTE DESCRIPTION

The historical processes that manufactured fuel and separated plutonium at Hanford produced many associated wastes (e.g., radiological and chemical). Many of these wastes remain and are included as part of the suspect TRU population being retrieved from the burial grounds.

Much of the waste includes debris-type items such as plastic (gloves, glove bags, greenhouses, personal protective clothing), metal (tools, pipe, cans/lids), rubber (boots, masks, foam, hoses), and cellulosics (brushes, paper, tape, cloth gloves).

In addition, the U.S. government funded research and development projects in the 1960s and 1970s to increase the efficiency and safety of nuclear energy. Hanford's original materials were further recovered, reused, and recycled whenever possible. Off-site facilities conducted fuel studies for the government. Nuclear materials from these off-site facilities were returned to Hanford when the government's program was discontinued. The nuclear materials that were returned to Hanford included fuel rods and various mixed oxides that contained plutonium.

ACCEPTABLE KNOWLEDGE/WASTE DESIGNATION ACTIVITIES

Containers are retrieved at Hanford in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement or TPA) (Ecology et al. 2003) Milestone M-91-40. As part of the retrieval activities, M-91 requires a waste designation be completed for retrievably stored waste in accordance with Washington Administrative Code (WAC) 173-303-070 through 100. To date, designations have been completed for a majority of the waste streams.

The process for the certification of TRU waste destined for WIPP utilizes an acceptable knowledge (AK) process approved by the U. S. Environmental Protection Agency (EPA). AK includes a number of waste characterization techniques such as process knowledge, historical records of analyses, and other sampling and analysis data. A similar process used by WIPP for the suspect TRU waste is used for the retrieved waste at Hanford and includes the following steps:

- AK information is compiled in an auditable record, including a road map for all applicable information.
- Operations of the TRU facilities are described.
- TRU waste generating processes are provided.
- TRU waste management operations and how they correlate to specific waste streams are supplied.

RETRIEVAL OPERATIONS

The first step is to review the existing information from the original burial records. The detail on the record varies and the older records generally tend to have less information. Review of the waste records can provide information on container identification numbers, location in the storage module, physical waste form, container weight, radionuclide, chemical content, and details about the source of the waste (facility and processes that generated the waste). The specific steps or approach to uncovering the containers varies according to the configuration of the trench and the planned extent of the soil removal, etc.

After planning, drums and boxes are retrieved from the burial grounds. The boxes vary in size, shape, and weight and are constructed of different materials (e.g., metal, concrete

and/or fiberglass reinforced plywood). The majority of the containers have soil overburden that must be removed to access the containers. Excavation activities are controlled closely and hand tools are used to supplement the digging, including with access and removal of the plastic and plywood materials covering the containers. Containers are visually inspected and surveyed for contamination and deformities.

A drum assay system is located in the process area (utilizes gamma energy analysis). Assaying the waste at the point of retrieval assists the non-TRU fraction to be segregated from the TRU-fraction. Approximately 60% of the retrieved waste has proven to be non-TRU.

Inspections that identify drum characteristics and influence how the container will be handled during retrieval include the following:

- Dose and radioactive contamination surveys
- Industrial health monitoring (organic vapor surveys, etc.)
- Structural integrity and vent status
- Other conditions (e.g., such as bulging, which could indicate pressurization)

Potentially pressurized drums are evaluated to determine best method and location for installing vents. Retrieval personnel continue to develop innovative measures such as:

- Dart System -- This is a portable unit that straps directly onto a drum, using a pneumatic driver that is remotely activated by wire or radio transmitter. This system penetrates the drum lid without risk of contamination release to install a NucFil[1] filter with an aluminum bronze housing to prevent the possibility of sparking.

- Overpacking -- Most of the retrieved drums require overpacks, which are larger drums that are used to overpack the fragile drums.

- Portable shelter with misting equipment -- This shelter keeps workers safe and more comfortable, and also provides protection from the wind, dust, and contamination.

SAMPLING AND ANALYSIS

Much of the suspect TRU radioactive waste being retrieved from the burial grounds is in the form of contaminated debris such as tools, equipment, and clothing that is not amenable to sampling. Radiological and chemical characterization is primarily developed based on the generating source and the AK process.

[1] Nucfil is a registered trademark of Nuclear Filter Technology, Inc. Corporation, Colorado

A TRU or non-TRU determination is made for the retrieved waste in the field with the use of the assay system. There is a significant portion of the waste that measures as low level waste now based on the change of definition of TRU waste (currently defined as 100 nanocuries per gram versus the previous 10 nanocuries per gram). In earlier years waste was often categorized as TRU as a conservative measure rather than by assay.

Radiography is also used at the Hanford facilities. This is a nondestructive qualitative and quantitative technique that involves X-ray scanning of waste containers to identify and verify waste container contents. Visual examination (VE) constitutes opening a container and physically examining the contents. Radiography and/or VE is used to examine the TRU waste containers. These techniques can detect liquid wastes and containerized gases, which are prohibited by WIPP.

REGULATORY FRAMEWORK

In May 1989, U.S. DOE, EPA, and the Washington State Department of Ecology (Ecology) signed the landmark Hanford Federal Facility Agreement and Consent Order, commonly known as the Tri-Party Agreement (TPA). The TPA outlines legally enforceable regulatory milestones for Hanford cleanup over the next several decades.

On October 23, 2003, a settlement agreement was reached between the U.S. DOE and Ecology that resolved certain issues regarding Ecology's authority over transuranic waste during Hanford Site cleanup. Following public involvement on May 11, 2004, TPA change number M-91-03-01 was approved and incorporated into the TPA.

M-91 established milestones for retrieval of suspect contact-handled and remote-handled (RH) TRU waste and for the treatment of mixed low-level waste. For example, U.S. DOE is required to designate all retrievably stored waste within 90 days of retrieval. This milestone also allows for the use of AK documentation gathered through the certification of TRU waste to support designation of related waste streams.

National Environmental Policy Act

The Hanford Site Solid (Radioactive and Hazardous) Waste Environmental Impact Statement (DOE-EIS-0286) that was prepared under the National Environmental Policy Act (NEPA) addresses the onsite and off-site treatment, storage, disposal, and transportation of the mixed low level wastes. However, the published NEPA Record of Decision was further reviewed and a settlement agreement approved for some activities. A future EIS is expected to include additional Hanford projects.

The operations associated with TRU waste retrieval included two different Environmental Assessments that resulted in findings of no significant impact.

Clean Air Act

The toxic air pollutants and criteria pollutant emissions from Hanford are regulated by the State of Washington Department of Ecology (implemented under WAC 173-400 and WAC 173-460).

The Washington State Department of Health's Division of Radiation Protection (WDOH) regulates radioactive air emissions through delegated authority from EPA and the Washington State legislative authority (implemented under WAC 246-247).

At the local level, the Benton Clean Air Authority was designated authority by EPA for asbestos renovation and/or demolitions, under the national emission standards (under 40 CFR 61, Subpart M).

Retrieval operations include venting, excavating and staging of waste containers. These activities were evaluated with the potential to increase radioactive emissions to the atmosphere. A notice of construction for radioactive air emissions was approved by WDOH, describing these activities and the potential consequences.

The Hanford Site Air Operating Permit issued in accordance with Title V of the Clean Air Act Amendments of 1990, provides a compilation of air requirements both for radioactive and non-radioactive emissions at Hanford (implemented through federal and state programs under 40 CFR 70 and WAC 173-401).

Hazardous Materials Transportation Act of 1975

Hazardous material transportation requirements include the preparation of shipping papers to identify and track hazardous materials, packaging and container design, marking, labeling, performance standards, and employee training programs. Specific requirements relating to mixed waste management activities and the shipment mode used (e.g., rail, aircraft, vessel, and public highway) are followed. Off-site shipments of hazardous materials comply with 49 CFR administered by the U. S. Department of Transportation.

Toxic Substances Control Act of 1976

Containers that contain regulated polychlorinated biphenyls (PCBs) are managed in accordance with TSCA by utilizing both acceptable knowledge and an individual container evaluation process. PCBs are accepted at both the WIPP facility and at specific Hanford onsite facilities.

Resource Conservation and Recovery Act of 1976 as amended by the Hazardous and Solid Waste Amendments of 1984

Requirements for hazardous wastes, including treatment, storage, disposal, and transportation, are addressed by RCRA. The Washington State Department of Ecology has been delegated authority from EPA to administer RCRA through the Hazardous Waste Management Act.

The RCRA strategy involves allowing relocation of waste within the retrieval area. However, once the drums leave the burial ground for transfer, storage, and disposal, the containers are considered actively managed and must meet waste acceptance criteria.

Comprehensive Environmental Response, Compensation, and Liability Act

EPA approved and signed the *Time Critical Removal Action Memorandum for Disposal at the Environmental Restoration Facility (ERDF) of Non-TRU Waste Generated During the M-91 Retrieval Operations at Burial Ground 218-W-4C* (EPA 2004), to accelerate the disposition of wastes stored in drums located in Burial Ground 218-W-4C.

Additionally, an Amendment to the ERDF Record of Decision was approved for treatment and allows disposition of the remaining non-TRU waste to ERDF. The action meets the criteria for initiating an action under CERCLA per 40 CFR 300, *National Oil and Hazardous Substance Pollution Contingency Plan.*

DEFENSE MISSION

TRU waste is eligible for disposal at WIPP if it has been generated in whole or part by one of the atomic energy defense activities listed in Section 10101(3) of the *Nuclear Waste Policy Act of 1982*, which are: naval reactors development, weapons activities, including defense inertial confinement fusion, verification and control technology, defense nuclear materials production, defense nuclear waste and materials by-product management, defense nuclear materials security and safeguards and security investigations, and defense research and development.

FUTURE ACTIONS

Once the waste is retrieved, the plutonium and spent nuclear fuel waste will be safely moved and disposed. Cleanup around the burial grounds will continue for many years and remediation and groundwater projects are planned. U. S. DOE expects that there will be multiple uses of the area in the future, including both U. S. DOE and non-federal missions. Other public and private-sector land uses are also anticipated.

CONCLUSIONS

Initiated in 2003, the retrieval of TRU containers from the Hanford burial grounds continues to face challenges. Operations are occurring in older storage areas and containers are deteriorated or undistinguishable as to container numbers or generators. Many of the containers are covered with soil that must be removed to access the containers. Unique containers include RH wastes, large boxes, tanks, and in some cases stored and/or spent fuels. Some of these containers have poor records and/or markings that are either not visible or no longer there.

Retrieval operations involve the ongoing integration of trained personnel including engineers, chemists, scientists, nuclear safety, health physics, radiation technicians, industrial hygienists, waste professionals, etc. Innovative ideas for worker safety and waste handling have been developed by employees and successfully implemented in the field.

The Waste Retrieval Project operates within a complex regulatory framework while successfully meeting and exceeding many enforceable regulator milestones. Ambitious schedules for safe retrieval continue to be set and achieved.

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