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Managing Hanford's Legacy, "No-Path-Forward" wastes to Disposition

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

U.S. DEPARTMENT OF ENERGY
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Managing Hanford's Legacy, "No-Path-Forward" Wastes to Disposition

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ABSTRACT

The U.S. Department of Energy (DOE) Richland Operations Office (RL) has adopted the 2015 Vision for Cleanup of the Hanford Site. This vision will protect the Columbia River, reduce the Site footprint, and reduce Site mortgage costs. The CH2M HILL Plateau Remediation Company's (CHPRC) Waste and Fuels Management Project (W&FMP) and their partners support this mission by providing centralized waste management services for the Hanford Site waste generating organizations.

At the time of the CHPRC contract award (August 2008) slightly more than 9,000 m^3 of waste was defined as "no-path-forward waste." The majority of these wastes are suspect transuranic mixed (TRUM) wastes which are currently stored in the low-level Burial Grounds (LLBG), or stored above ground in the Central Waste Complex (CWC). A portion of the waste will be generated during ongoing and future site cleanup activities.

The DOE-RL and CHPRC have collaborated to identify and deliver safe, cost-effective disposition paths for 90% (~8,000 m^3) of these problematic wastes. These paths include accelerated disposition through expanded use of offsite treatment capabilities. Disposal paths were selected that minimize the need to develop new technologies, minimize the need for new, on-site capabilities, and accelerate shipments of transuranic (TRU) waste to the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico.

INTRODUCTION

Initially, a comprehensive list of waste with no defined disposal path was developed. This list included approximately 9,120 m^3 of suspect TRU wastes, the majority of which was legacy waste stored in both below-ground and above-ground retrievable storage areas on the Hanford Central Plateau. Once identified the wastes were consolidated into seven groupings based on:

- waste activity and dose
- special nuclear material (SNM) content
- waste configuration

- transportation and treatment requirements and capabilities
- regulatory, technical, and economic mandates for waste disposition

These waste groupings are shown in Figure 1. These wastes groupings include: 2,950 m^3 of contact handled (CH) TRU, lower-gram SNM in large containers; 4,280 m^3 of CH-TRU, medium-gram SNM in large containers; 970 m^3 of CH-TRU, higher-gram SNM in large containers; 420 m^3 of remote handled (RH) TRU, lower-gram SNM, low-dose wastes; 130 m^3 of RH-TRU, medium- to high-gram SNM, medium-dose wastes; 158 m^3 of RH-TRU high-activity wastes; and 240 m^3 of miscellaneous small-volume waste packages.

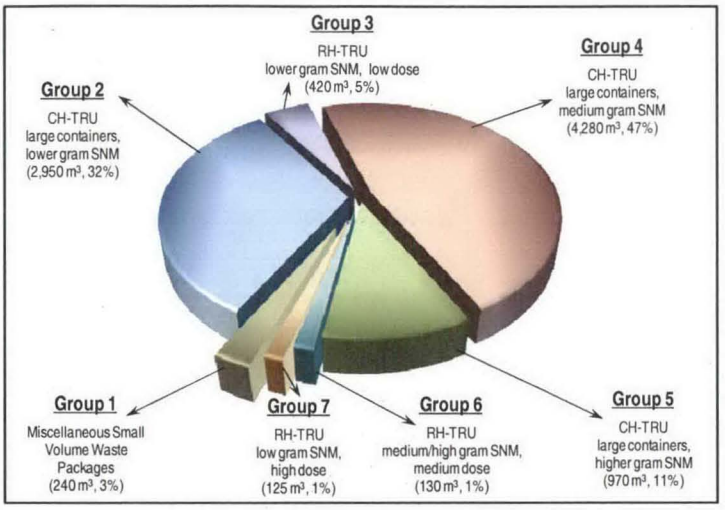

Fig 1. "No-Path-Forward" waste was consolidated into waste groupings based on waste characteristics and configurations.

IDENTIFYING COMPLIANT PATHWAYS FOR DISPOSITION

The overriding consideration in identifying pathways for disposition of the subject waste was compliance with the requirements imposed by the Resource Conservation and Recovery Act (RCRA); the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); the Tri-Party Agreement (TPA) between the State of Washington, the DOE, and DOE Order 435.1 which mandates the management of radioactive wastes on DOE sites. In addition, due to the possible need to transport these wastes on public conveyances and access commercial processing capabilities, consideration was given to both the Nuclear Regulatory Commission (NRC) and Department of Transportation (DOT) requirements for managing wastes of this type.

An analysis was completed to identify a compliant disposition pathway for each of the waste groupings. This analysis identified the following three disposal pathways:

1. **Item by item management** – This approach would be used for the group 1 and 7 wastes (365 m^3). Wastes in this grouping include a number of miscellaneous unique, small waste containers that will be dispositioned through a variety of treatment paths, waivers, and variances. This also includes wastes with very high dose rates (e.g. Cs/Sr capsules) that may require extended on-site storage until a disposition site is available.
2. **Commercial Treatment** - Wastes for which commercial offsite treatment capabilities exist and could be accessed with minimal or no modification to the commercial facility's Safety Basis (Groups 2, 3, and 4 – 7,650 m^3)
    - CH-TRU, large container
    - RH-TRU
    - Low to medium gram SNM
    - Low dose

3. **Modified on-site capabilities** - Wastes that cannot be easily managed offsite, but that can be managed with modifications to on-site capabilities (Groups 5 and 6 – 1,100 m^3)
    - CH-TRU, large containers
    - RH-TRU
    - Medium to high gram SNM
    - Medium dose

A final step in the analysis was to propose necessary tasks and an implementation schedule to disposition each of the wastes by identifying increasingly robust options for waste disposition. Implementation includes:

- Evaluating the feasibility of disposal options for the high-activity waste.
- Proof-of-Concept activities to demonstrate the ability to use commercial treatment of CH-TRU waste in large containers, with low SNM content.
- Working with offsite commercial facilities to expand their treatment envelope.
- Evaluating the disposition of the remaining inventory of "no-path-forward waste" through expansion of currently planned on-site capabilities (e.g., next generation retrieval project, alpha caisson project).
- Initiating a permanent RH-TRU loading facility.

The final disposition for the wastes will be in WIPP for TRU and TRUM wastes, the mixed low-level wastes (MLLW) will be disposed of on-site in the Environmental Restoration Disposal Facility (ERDF), and the Mixed Waste Disposal Trenches (MWDT). It is possible that a small volume of the wastes will be acceptable for disposal in commercial off-site facilities.

SPECIAL-CASE WASTES

Since 1997 more than 10,000 m^3 of Hanford special-case wastes (Groups 1 and 7) have been managed to disposition using an item-by-item approach. These special-case wastes have unique characteristics that are impediments to the identification of a disposal path and must be individually managed through a variety of treatment paths under waivers, exemptions, or variances to address specific waste constituents. These wastes include:

- 240 m^3 of miscellaneous small-volume waste packages containing sodium waste, beryllium dust, RH- MLLW, and TRU wastes containing polychlorinated biphenyl (PCB) liquids. A disposition schedule for this waste will be completed by June 30, 2011 as required by the TPA.
- 1,936 Cesium and Strontium (4 m^3) high-level waste capsules currently stored in the Waste Encapsulation Storage Facility (WESF) pool on the Hanford Plateau. These capsules are highly radioactive. They contain more than 106.5 million curies (including daughter products) as of November 1, 2010, and generate dose rates in excess of 10,000 Rem (R). The current Hanford baseline includes relocating these capsules to dry storage by FY2018 to enable remediation activities to commence at WESF and the adjacent B Plant facility. The engineering tasks to accomplish this relocation are already underway and include a Project Execution Plan, siting evaluation, resolution of container configuration, and initiation of long-lead regulatory activities. This activity will accelerate the placement of intact capsules in a cask for dry storage with a parallel activity to evaluate the feasibility of disposal options that do not rely on a national

repository. The regulatory approach for capsule management and disposition will be developed in FY2011.

- 125 m^3 of encapsulated, vitrified RH-TRU waste referred to as German Logs and associated wastes are currently in storage on the Hanford Plateau. This includes selected waste containers that are very high activity (up to 500,000 curies of cesium - 137 in a container) and contain low levels of SNM. The waste is not amenable to treatment and requires the development of alternate disposal paths. A feasibility study of disposal options for this waste will be completed in FY2011.
- 29 m^3 of RH-TRU sludge from the Hanford K-Basin is currently being addressed in two phases. Phase 1 of this Sludge Treatment Project (STP) will place sludge into engineered containers to allow the sludge to be transported for interim storage within the T Plant canyon. Phase 1 also includes a technology evaluation and alternative analysis to recommend treatment and packaging technologies for Phase 2. The evaluation will be completed by the end of FY2011. Phase 2 of the STP is to develop, design, and install the necessary treatment and packaging capabilities based on the earlier technology evaluation, for ultimate disposal at the WIPP.

All of these special-case wastes are high-dose rate wastes that require remote handling or hot-cell capabilities not currently available. Design, construction, and start-up of a facility would require seven to ten years making the cost to process this relatively small volume of waste very high. Direct disposal of high-dose waste on-site (e.g., PUREX Tunnels, canyon facilities) may be a viable option for these remaining wastes resulting in a significant reduction in worker exposure, cost, and schedule. However, authorization will be challenging, even if the risks are demonstrated to be acceptable. Near-term evaluations are underway to develop cost effective options for disposition.

WASTE SUITABLE FOR OFFSITE, COMMERCIAL TREATMENT

DOE has successfully accessed offsite commercial treatment capabilities as a means to disposition low-level waste (LLW) and MLLW at reduced costs compared to on-site treatment. A distinct advantage to Hanford is a commercial treatment facility located adjacent to the Site. This commercial treatment is restricted by the SNM limits set for the total quantity of SNM allowed at the vendor facility in accordance with the facility's radioactive materials license(s). Greater than 50% of the Hanford "no path forward" wastes meet the requirements for acceptance and treatment by an offsite vendor with few or no modifications to the vendor's treatment envelope. These wastes, listed in Table 1, represent a major target of opportunity to disposition Hanford TRU wastes through the expanded use of commercial treatment processing.

Table 1. Candidate Waste for Commercial Treatment

Waste Stream	Criteria	Volume (m3)
Large CH-TRU Containers Lower Gram SNM	Container >0.208 m3 ≤ 15 grams SNM ≤ 0.25 Curies Cesium-137 Surface dose rate ≤200 mR/hr Do not contain shielding (i.e., lead, concrete)	2,950

RH-TRU Low Gram SNM Low dose	≤ 15 grams SNM ≤ 2.5 Curies Cesium-137 Surface dose rate > 200 mR/hr Contains shielding (i.e., lead, concrete)	420
Large CH-TRU Containers Medium Gram SNM	Container > 0.208 m3 ≤ 50 grams SNM ≤ 0.25 Curies Cesium-137 Surface dose rate ≤ 200 mR/hr Do not contain shielding (i.e., lead, concrete)	4,280
	Total	**7,650**

The goals of commercial treatment are 1) to have CH-TRU waste packages that meet WIPP acceptance criteria, 2) reduce Site inventory of TRU waste, and 3) to avoid costs associated with building the on-site M-91 Facility. The potential M-91 Facility would provide capabilities to repackage large containers and RH-TRU waste. This approach will result in the processing of more than 7,650 m^3 of wastes that were previously planned to be processed using only on-site capabilities. These on-site capabilities are largely conceptual in nature at this time and are anticipated to be very expensive to obtain; nearly $1.2 billion in life-cycle costs.

The DOE/CHPRC strategy to disposition these wastes is being conducted in three phases. The first phase is a Pilot Program that was initiated in FY10 and will be completed by Sept. 30, 2011. The second and third phases are dependent upon funding availability which is not currently in the CHPRC Project Management Baseline (PMB) until FY2014 when it is partially included and then fully in FY2015. The processing rate would be approximately 300 m^3 per year.

The Pilot Program includes size reduction and repackaging of up to 200 m^3 of TRU wastes. The goal is to demonstrate that production level throughput at a commercial facility is achievable versus the current process on a case-by-case basis. Wastes included in the Pilot Program are low- gram TRU (<15g SNM per container) that meets DOT requirements for shipping. Low-gram TRU is defined as <15 g of SNM per the NRC definition and includes all Plutonium, Uranium-235, and Uranium-233 isotopes. It is important to prove this process is achievable while not interfering with the commercial facility's commitment to their other waste generators and our own MLLW treatment program. Commercial facilities have NRC Radioactive Material License (RML) limits that they must not exceed making turnaround times essential to maintaining these limits. The efficacy of sorting and segregating the waste as LLW or TRU is also being evaluated under the Pilot Program to determine how and where in the process it is most effective for the waste to be segregated and assayed. Once segregated and assayed, CHPRC evaluates TRU and LLW portions. TRU portions are packaged and returned to the Hanford Site where they are certified by the Central Characterization Project (CCP) for WIPP disposal. LLW portions are treated and disposed through the CHPRC LLW/MLLW Disposition Project.

The second phase will be to segregate, size reduce, and repackage the remaining low-gram TRU. The LLW/MLLW portion will remain at the commercial facility for treatment. The TRU portion will be returned to the Hanford Site for certification and shipment to WIPP. During this phase, CHPRC will work with the commercial facility to increase their RML limits to levels that will allow processing additional volumes of waste with >15g of SNM.

The third phase will be to process the remaining volume of TRU that the commercial facility can accept. This portion of waste is >15g of SNM per container and will be dependent upon the new RML limits. This phase will also include working with the DOT and DOE on issues to transport these large packages safely and compliantly offsite for processing. Many of these large packages do not meet DOT requirements and will require additional safety analyses or equivalencies prior to shipment.

To date a total 243.4 m^3 of CH/RH-TRU has been treated under the Pilot Program at an offsite commercial facility, which is just slightly more than the 200 m^3 anticipated under this Phase 1. In addition the vendor is making or has made modifications to accommodate additional shipments of large container, higher dose rate materials under follow-on phases. These modifications include:

- Installation of a rail spur at the vendor facility by mid-year in 2011 to more efficiently transport oversized containers that do not meet DOT requirements for transport. Currently these containers must be transported using road closures from the Hanford Site to the vendor facility.
- Installation of an assay capability to provide accurate segregation of TRU from LLW/MLLW at the vendor facility. This allows the vendor, with CHPRC approval, to treat LLW/MLLW prior to returning the waste to the Site for disposal. This capability is currently on line at the facility.
- Exploring RML amendments to allow the processing of higher SNM anticipated during follow-on phases.

Funding has been received to initiate Phase 2 on a limited basis. This funding authorizes the treatment of 400 m^3 of suspect low-gram TRU material at the offsite commercial vendor facility.

DOE-RL and CHPRC continue to evaluate commercial capabilities for waste disposition that may increase the volume of waste suitable for commercial treatment, incorporating lessons learned to continually improve the process and provide the most cost-effective route to disposition legacy wastes from the Hanford Site.

WASTE CURRENTLY NOT AMENABLE TO COMMERCIAL TREATMENT

Approximately 3,700 m^3 of waste is currently classified as waste not currently amenable to offsite treatment, but for which current on-site capabilities are in development. This waste includes large containers of suspect CH- and RH-TRU currently stored in the 218-W-4B LLBG. The SNM content of each waste container is anticipated to be greater than 50 grams SNM content and surface dose rates are expected to be greater than 200 mR/hr. Many of these wastes containers are degraded and losing their contents. In many instances specific measures such as building shoring boxes for degraded containers or coating or overpacking containers must be completed to ensure acceptable waste containment prior to transferring material for repackaging, processing, and assaying. Three treatment outlets are currently being investigated to address these wastes. In each case all the requisite processing, packaging, and assaying equipment is

located at the trench face to minimize multiple movements of retrieved waste. The options currently being evaluated include:

- Next Generation Retrieval (NGR) capabilities to handle a specific subset of waste containers using temporary or mobile facilities. NGR incorporates the "one touch" philosophy that stipulates that at the point of generation waste will be packaged, classified, and characterized in full compliance with its disposition pathway (i.e., treatment or disposal). This philosophy has proven effective in minimizing: 1) time from waste generation to final disposal, 2) iterative waste handling costs, 3) personnel exposures, and 4) overall risks to personnel, cost, and schedule for all wastes from the Hanford Plateau.
- Use of an off-the-shelf remote waste retrieval system, known as the Alpha Caisson Waste Retrieval System (ACWRS), which will be specifically configured to access, retrieve, sort, size reduce, characterize, package, and transfer RH-waste packages from the LLBG. The ACWRS system provides confinement over the LLBG caissons and utilizes remote-operated equipment to access each caisson from the side. Retrieved waste is packaged as removed to control contamination, shielded to allow loading/handling, and sent to a processing unit/staging area. The goal is to complete and install the ACWRS and start hot operations by 2015 to meet the TPA date of complete retrieval of the waste by 2018.
- Development of additional mobile capabilities yet to be defined.

CONCLUSION

By carefully evaluating waste streams, developing modestly improved transport capabilities, and using available capabilities through existing commercial treatment and processing facilities, the Hanford Site is now safely accelerating processing of large waste volumes, supporting national TRU mission goals, assuring local viable businesses' assets are maintained, avoiding large capital project expenditures, removing legacy waste volumes, and meeting TPA milestones. The current planned volumes are estimated to be viable for complete processing; i.e. segregation of TRU from LLW, treatment of LLW and packaging of TRU fractions for certification, 10 years ahead of schedule at a total project cost of approximately $580 million, resulting in a cost savings of $600 million.