**Department of Energy**
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

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DEPARTMENT OF ECOLOGY
NWP - RICHLAND

15-AMRP-0070

JAN 28 2015

Ms. J. A. Hedges, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton Blvd.
Richland, Washington 99354

Dear Ms. Hedges:

PETITION FOR SITE-SPECIFIC VARIANCE FROM LAND DISPOSAL TREATMENT STANDARDS

This letter is in reference to RL letter to J. A. Hedges, Ecology, from D. S. Shoop, RL and J. A. Ciucci, CHPRC, "Submittal of Updated Part A Form Closure Plan for Waste Encapsulation and Storage Facility (WESF) Closing Dangerous Waste Management Unit," 15-AMRP-0028, dated December 2, 2014.

In accordance with 40 CFR 268.44(h)(2), "Land Disposal Restrictions," "Variance from a Treatment Standard," the U.S. Department of Energy Richland Operations Office (RL) and CH2M HILL Plateau Remediation Company (CHPRC) are submitting this Petition for a site-specific variance from the Land Disposal Restriction (LDR) concentration-based treatment standards. The LDR treatment standards are contained in 40 CFR 268.40, "Land Disposal Restrictions," "Applicability of Treatment Standards," and incorporated by reference in WAC-173-303-140, "Dangerous Waste Regulations," "Land Disposal Restrictions." This Petition applies to six waste items in two of the WESF hot cells. These waste items resulted from the cleanup of the WESF after encapsulation operations were completed in 1985.

The WESF Closure Plan was submitted as a Class 3 permit modification request on December 2, 2014, (Reference). This closure plan identifies that the hot cells will be clean closed by removal (page H-32) at a future date in coordination with the entire WESF Facility. To support a needed ventilation system replacement and future removal of the hot cells, Hot Cells A through F will be grouted.

The attached Petition is being submitted to ensure the action to grout wastes in place does not create future waste that does not satisfy LDR treatment standards since after grouting cannot be practically treated. This Petition describes why it is technically and environmentally inappropriate to treat the referenced waste items to a concentration based LDR treatment standard. In accordance with 40 CFR 268.44(m), an alternative treatment is proposed that is sufficient to minimize threats to human health and the environment posed by land disposal of the waste.

If you have any questions, please contact me or your staff may contact Ray Corey, Assistant Manager for the River and Plateau, on (509) 373-9971.

Sincerely,

Stacy Charboneau

Stacy Charboneau
Manager

AMRP:JAR

Attachment

cc w/attach:
L. T. Blackford, CHPRC
A. E. Cawrse, CHPRC
L. J. Cusack, CHPRC
S. L. Dahl-Crumpler, Ecology
D. L. Flyckt, CHPRC
M. N. Jaraysi, CHPRC
J. R. Seaver, CHPRC
R. R. Skinnarland, Ecology
Ecology NWP Library
Environmental Portal
Administrative Record
HF Operating Record (J. K. Perry, MSA, A3-01)

# Attachment 1

## Petition for Site-Specific Variance from Land Disposal Treatment Standards

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# Contents



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# Terms

| | |
|---|---|
| CHPRC | CH2M HILL Plateau Remediation Company |
| DOE | U.S. Department of Energy |
| DOE-RL | DOE Richland Operations Office |
| DOT | U.S. Department of Transportation |
| Ecology | Washington State Department of Ecology |
| EPA | U.S. Environmental Protection Agency |
| HEPA | high-efficiency particulate air |
| LDR | land disposal restriction |
| RCRA | *Resource Conservation and Recovery Act of 1976* |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TSD | treatment, storage, and disposal |
| WESF | Waste Encapsulation and Storage Facility |

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# 1 Petition for Site-Specific Variance from Land Disposal Treatment

WAC 173-303-140(2)(a), "Dangerous Waste Regulations," "Land Disposal Restrictions," incorporates the requirements of 40 CFR 268, "Land Disposal Restrictions," by reference. 40 CFR 268.44(i), "Variance from a Treatment Standard," requires this Petition to include the information in 40 CFR 260.20(b)(1) to (4), "Hazardous Waste Management System: "General."

## 1.1 Identification of Petitioner

| | |
|---|---|
| Petitioner Name and Address: | U.S. Department of Energy<br>Richland Operations Office<br>P.O. Box 550<br>Richland, WA 99352 |
| | CH2M HILL Plateau Remediation Company<br>P.O. Box 1600<br>Richland, WA 99352 |
| Facility U.S. Environmental Protection Agency (EPA)/ State Identification Number: | WA7890008967 |
| Facility Name and Address: | U.S. Department of Energy – Hanford Facility<br>Near Richland<br>Richland, Washington 99352 |

## 1.2 Statement of the Petitioner's Interest in the Proposed Action

The U.S. Department of Energy (DOE)-Richland Operations Office (RL) owns and operates the Waste Encapsulation and Storage Facility (WESF) on the Hanford Site in Eastern Washington. Pursuant to a contract with DOE-RL, CH2M HILL Plateau Remediation Company (CHPRC) is a co-operator of WESF.

DOE-RL and CHPRC are requesting a site-specific variance, under 40 CFR 268.44(m), incorporated by reference in WAC 173-303-140 from the land disposal restriction (LDR) treatment standards, which require a concentration based standard verification, to allow LDR treatment via in-cell macroencapsulation for the following waste items (WAC-173-303-140 and 40 CFR 268.40, "Applicability of Treatment Standards"):

- Four boats with approximately 0.6 kg (1.3 lb) of floor sweepings located in the Hot Cell B furnace
- Two threaded and capped pipes with approximately 1.2 kg (2.6 lb) of floor sweepings located in Hot Cell C

The waste items would conservatively designate with dangerous waste codes D005, D006, D007, D008, and D011.

## 1.3 Description of the Proposed Action

DOE is in the process of implementing a project to stabilize legacy radioactive contamination and to replace an exhaust ventilation system at WESF. Hot Cells B and C contain waste items that, when disposed, must comply with LDR treatment requirements. This project will use grout to significantly reduce the risk of an environmental release posed by the hazardous constituents as well as the radioactive material from WESF.

The LDR treatment standard in 40 CFR 268.40 for toxic metals is typically met through stabilization to meet leachable concentration limits. This treatment standard requires laboratory testing to confirm that limits have been met. DOE-RL requests a site-specific variance to allow treatment using application of grout to provide a physical barrier to prevent the release of hazardous contaminants to the environment. The treatment will be combined with grouting that fills all the Hot Cells A through F at WESF, to stabilize and prevent the release of the contamination that remains in the interior surfaces of the hot cells. The grout will be a mixture of Portland cement, fly ash, aggregates, and other additives necessary to meet criteria for flowability, compressive strength, and heat of hydration.

## 1.4 Statement of Need and Justification for the Proposed Action

DOE-RL and CHPRC believe that the presumptive treatment of waste items to meet the concentration-based LDR treatment standards is inappropriate in this case, and a site-specific variance from the treatment standard is justified.

The affected waste items are highly radioactive and currently inaccessible. For reasons detailed in Chapter 4 of this Petition, normal handling of the waste items to treat them prior to disposal, in order to meet the existing concentration-based LDR treatment standards, and the manipulation to conduct the sampling and analysis necessary to verify compliance with such standards, is technically inappropriate. Treatment of the waste items to meet the concentration based LDR treatment standards, would require reactivation of Hanford facilities and processes that are not currently in operation, resulting in significant personnel exposure to radiation, generation of hazardous waste, and increased risk of releases to the environment. By contrast, the proposed alternative treatment will stabilize the toxic characteristic metal contaminants and be protective of human health and the environment.

The action requested in this Petition reflects compliance with the standards of 40 CFR 268.44 (h) and is consistent with applicable federal and state guidance, and provides the most appropriate approach. The waste characterization and alternative approaches for treatment are evaluated, and we hereafter describe the rationale for using macroencapsulation as an alternative treatment standard based on a specified method of treatment for the specific waste items.

# 2 Background Information

WESF was constructed on the west end of B Plant between 1971 and 1973 to encapsulate and store radioactive cesium and strontium that had been separated from Hanford Site plutonium production waste. The radioactive cesium-137 and strontium-90 capsules have been stored in pool cells at WESF since operations began in 1974.

Operations at WESF to encapsulate the cesium and strontium were completed by January of 1985, at which point work began to decontaminate and deactivate the facility. Decontamination and deactivation was completed by March 1985 and included chemical and deionized water flushes of process lines and tanks; removal and disposal of some equipment; removal of jumpers from tanks; and shutdown of instrumentation. One of the final steps in the hot cell cleanout was sweeping of the floor in Hot Cells B and C, where strontium encapsulation occurred. The floor sweepings consisted of pieces of broken tools, manipulator fingers, metal shavings, and miscellaneous small debris contaminated with radioactive strontium fluoride salt and radioactive cesium chloride salt.

Some of the floor sweepings were placed into four boats and moved to the Hot Cell B furnace. The remainder was put into two capped pipes and mounted to the wall in Hot Cell C. Floor sweepings are the waste items that are the subject of this Petition. The waste items, some of which are in containers (sealed pipes) have been in Hot Cells B and C since 1985 when decontamination and deactivation was completed.

In August 1987, the *Resource Conservation and Recovery Act of 1976* (RCRA) regulations became effective for active management of mixed radioactive and hazardous waste on the Hanford Site. The cesium and strontium capsules were initially managed as useful radioisotope products used in various applications around the United States, but when DOE decided to end those uses, the capsules were reclassified as mixed radioactive waste on July 14, 1997.

As a result of facility operations, legacy radiological contamination remains throughout the WESF ventilation system and Hot Cells A through F. The exhaust ventilation system at WESF needs to be upgraded to support future activities at WESF. DOE-RL is implementing the Stabilization and Ventilation Project to stabilize a portion of this legacy contamination and replace the K3 exhaust ventilation system. This project will significantly reduce the risk of a release of radioisotopes from WESF into the environment.

The Stabilization and Ventilation Project will stabilize radionuclide contamination in the hot cells and minimize the potential for a release of radioactive material to the environment. Hot Cells A through F are part of the WESF Treatment, Storage, and Disposal (TSD) Unit. Therefore, a permit modification request to revise the WESF Hanford Facility Dangerous Waste Permit Part A Application and a Closure Plan for the Hot Cells A through F dangerous waste management unit was submitted to Ecology in 15-AMRP-0028, "Submittal of Update Part A Form and Closure Plan for Waste Encapsulation and Storage Facility (WESF) Closing Dangerous Waste Management Unit." A public comment period began on December 11, 2014.

The revised Closure Plan for Hot Cells A through F assumes that the identified waste items would conservatively designate for barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011). The Hot Cells A through F Closure Plan specifies that grouting is an interim action until final closure actions occur at the WESF facility. The overall WESF Facility Closure Plan proposes that WESF will be clean-closed by removal of the grouted hot cells, for disposal elsewhere at a future date. This treatment standard variance petition is being submitted to ensure the action to grout wastes in place does not create a future waste stream that does not satisfy LDR treatment standards, but following grouting cannot be practically further treated.

## 2.1 Waste Description and Generator Knowledge

During encapsulation operations at WESF, Hot Cells B through E were used to convert strontium nitrate and cesium carbonate into strontium fluoride salt and cesium chloride salt. Hot Cells B and C were used to convert strontium nitrate into strontium fluoride and place it into capsules. Hot Cells D and E were used to convert cesium carbonate into cesium chloride and place it into a capsule. Hot Cell F also was used to leak test and weld the capsules.

The floor was swept to gather residual loose material. This activity reduced potential spread of contamination from the hot cells and of contamination entering the ventilation system. Based on interviews with facility personnel who performed and documented cleanup of the hot cells, floor sweepings contained pieces of broken tools, manipulator fingers, metal shavings, and small debris. Generator knowledge and dose measurements have determined that the floor sweepings are highly radioactive and contain an estimated 27,000 Ci of strontium-90/yttrium-90 and cesium-137 (after radioactive decay up to 2014).

The primary chemical constituent is in the floor sweepings: insoluble strontium fluoride. Some cesium salts may also be present due to cross-contamination from cesium encapsulation in Hot Cells D and E. Strontium-90 and yttrium-90 are beta radiation emitters; cesium-137 is a gamma radiation emitter. The radiological dose in the cells is estimated at 3,000 to 3,500 Roentgens (R) per hour. For comparison, the radiation dose rate that could be expected to cause death to 50 percent of an exposed human population within 30 days (LD 50/30), is in the range of 450 to 475 R received over a short period. By comparison, after a worker entered the hot cells, exposure to a lethal dose would occur in less than 10 minutes. Therefore, any work in the hot cells, including handling of the waste items, must be performed remotely.

## 2.2 Relevant Waste Codes and LDR Treatment Standards

Analytical data for the metal constituents in the contaminated floor sweepings contained in Hot Cells B and C does not exist. The highly radioactive nature of the material prevents collection and analysis of a representative sample. The waste would be conservatively designated as dangerous waste for the following waste codes: barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011), based on the known presence of metal shavings and strontium and fluoride salts, and the application of waste codes assigned to the encapsulated waste described in the Part A Permit application of WESF.

Since laboratory characterization data does not exist for the encapsulated waste, the designation described in the Part A Permit application was based on process knowledge. A summary of the process knowledge applied to the Part A Permit for each of the hazardous constituents is as follows:

- **Barium** – This is a product from the radioactive decay of cesium-137. As the cesium-137 decays, the concentration of barium will increase in the waste. It is expected that the barium levels will eventually exceed the regulatory thresholds and will be mobile. Although barium is not a decay product of strontium-90, it is assumed that sufficient levels of barium are present in the strontium capsules to exceed regulatory thresholds.

- **Cadmium, chromium, and lead** – These metals were present in the tank waste that served as a feed material to B Plant where the separation of cesium and strontium occurred. These metals were also likely present in the feed material to B Plant. The B Plant separations process utilized ion-exchange resins to separate out the cesium and strontium. These resins may have also separated out small amounts of cadmium, chromium, and lead along with the cesium and strontium. These metals may have been present in the process chemicals utilized in the B Plant separations process. It is assumed that the trace contamination of these toxic metals in the feed material and process chemicals is sufficient to elevate their concentration in the encapsulated material above characteristic regulatory thresholds.

- **Silver** – During the encapsulation of the strontium, process sampling identified the presence of silver. It is assumed that silver contamination is present in both the cesium and strontium waste material and may be sufficient to exceed regulatory thresholds.

Tank waste was processed in B Plant to separate the cesium and strontium from the tank waste. This separation process was performed to reduce the amount of heat generated in the tanks, and to provide cesium and strontium for commercial applications. The product from the B Plant separation process was sent to the WESF hot cells to be converted to cesium chloride and strontium fluoride salts and encapsulated.

The waste items addressed in this variance remained at the end of the WESF encapsulation mission resulting from the cleanout of the WESF hot cells. These waste items are highly radioactive. The waste items were not generated during the reprocessing of fuel rods. Therefore, the LDR treatment standards for waste codes D006, D008, and D011 generated during the reprocessing of fuel rods do not apply. In addition, the waste items do not fit the radioactive subcategories identified for D006, D008, or D011. The waste items would classify as non-wastewater.

The non-wastewater LDR concentration based treatment standards for the hazardous waste codes associated with the waste items addressed in this variance are provided in Table 1.

**Table 1. Applicable Non-Wastewater Land Disposal Restriction Treatment Standards**

| EPA Hazardous Waste Code | Constituent of Concern | 40 CFR 268.40 Non-Wastewater Treatment Standard |
|---|---|---|
| D005 | Barium | 21 mg/L TCLP and meet 268.28 standards* |
| D006 | Cadmium | 0.11 mg/L TCLP and meet 268.28 standards* |
| D007 | Chromium | 0.60 mg/L TCLP and meet 268.28 standards* |
| D008 | Lead | 0.75 mg/L TCLP and meet 268.28 standards* |
| D011 | Silver | 0.14 mg/L TCLP and meet 268.28 standards* |

Source: 40 CFR 268.40, "Land Disposal Restrictions," "Applicability of Treatment Standards."
EPA = U.S. Environmental Protection Agency
TCLP = Toxicity Characteristic Leaching Procedure
*The waste items do not contain any underlying hazardous constituents.

# 3 Engineering Evaluation

An engineering evaluation was performed for identification of a technically feasible approach to treat the waste items in order to meet the specified LDR treatment standards. If the proposed alternative treatment is not allowed and treatment is required to meet the applicable concentration based treatment standards, a detailed engineering evaluation would be required to select the best approach for treatment. Concentration based treatment would require the following tasks:

- Reactivation of WESF capabilities—Due to the highly radioactive nature of the waste items, WESF capacities are required for remote handling of the material to protect the workers and the environment. When WESF was operational, it had the appropriate capabilities for remote handling of material with excessive radionuclide levels. However, these capabilities were deactivated by 1985 at the end of the WESF encapsulation mission.
- Collection and analysis of a representative sample—A sample of the floor sweepings would be collected for TCLP analysis at an approved laboratory to determine the proper level of treatment.
- Treatment of the waste items using remote methods—Treated waste items would require sampling and analysis to ensure that LDR treatment standards are achieved.

Because of the radiological nature, waste items can only be handled remotely. Remote handling requires the use of manipulators in either Hot Cell B or C. Hot Cell C provides access to the waste items in both cells, using the pass through access to the boats of waste, making it unnecessary to restore Hot Cell B capabilities. The following steps would be required to establish the necessary Hot Cell C capabilities:

- **Upgrade electrical power**—Electrical power and lighting (beyond what is needed to grout the cells) is available but nonfunctional and would require extensive refurbishment to be operational in order to supply lighting, remote cameras, and tools.
- **Address inadequacies in the K3 exhaust system**—The K3 exhaust system provides ventilation for the hot cells and controls any release to the environment. This exhaust system contains significant levels of legacy contamination and relies on high-efficiency particulate air (HEPA) filters that are beyond their design life and have an unknown structural integrity. Reactivation of Hot Cell C would require the removal of the Hot Cell C cover blocks and the truck port cover block to install and refurbish equipment and remove samples and waste. Each time a cover block is removed or replaced, the K3 HEPA filters experience a rapid change in pressure drop. A rapid change in pressure drop has the potential to cause a failure of the HEPA filters. If a HEPA filter failed, a significant environmental release would be possible.
- **Install manipulators**—Manipulators are necessary for performing maintenance tasks and handling the waste. The manipulators have been stored in a manner that would allow their reinstallation. However, after storage for approximately 20 years, significant maintenance is expected to be required.
- **Install a new camera system**—This camera system would be necessary to perform tasks in Hot Cell C to repair or replace the Hot Cell C viewing window.
- **Install shielding behind the viewing window**—A shadow shield would need to be put in place to allow removal of the viewing window. Placement of this shielding would require manipulators, the canyon crane, a remote camera, and tools to fasten the shielding to the interior Hot Cell C wall. It would also require removal of the hot cell cover block.
- **Repair or replace the viewing window**—The oil has partially leaked from the Hot Cell C viewing window. As a result, the oil has become exposed to air causing a chemical reaction that etches the leaded glass, making viewing through the window impossible. The viewing window would need to be removed and inspected to determine if repair is possible or if the window must be replaced. Once the shadow shield is in place, the window would have to be removed from the hot cell and placed onto a specially designed table. The window is heavy and would require extreme caution in order to prevent worker injury. Worker protection would be required to accommodate work in radiologically controlled areas; potential worker exposure to high levels of radiation could occur.
- **Install viewing window**—If the viewing window can be repaired, it would be reinstalled following refurbishment. If the window cannot be repaired, a replacement window would be required, and the delivery time could be significant. If the viewing window cannot be repaired and a replacement is not available, the only remaining option would be use of the installed cameras, which may not be reliable in the hot cell environment.

Reactivation of the necessary Hot Cell C capabilities is possible; however, it comes with a significant potential to release radiological contamination, has a substantial effect upon worker safety, and relies on the ability to reactivate equipment that has not operated for approximately 20 years. For these reasons, it is technically and environmentally inappropriate to restore WESF capabilities. The proposed alternative treatment method would accomplish the same reduction in risk to human health and the environment.

## 3.1 Collection and Analysis of a Waste Sample

Once Hot Cell C capabilities are reactivated, the next step would be to collect a representative sample, transport the sample to a laboratory, and perform a TCLP or total metals analysis. These tasks would be necessary to characterize the waste items and to determine the proper level of treatment.

When the WESF hot cells were operational, a sample could be removed by passing it between hot cells to a shielded pass-through drawer. This sample removal option would not be available unless manipulators, lighting and the capability to view the inside the hot cell were reactivated in additional hot cells. A new sample removal method, likely through the cover block would be more practical than reactivation of capabilities in additional hot cells. After removal of the sample from the hot cell, it would be transported in a shielded cask to an approved laboratory for analysis.

A review was performed to determine the capability of onsite and offsite laboratories to analyze a sample of the waste items. 40 CFR 261.24 requires the use of EPA SW846 TCLP (Method 1311) to determine the characteristics of toxicity. This procedure requires a minimum sample size of 0.5 kg.

Section 1.2 of the TCLP allows for a total constituent analysis (EPA Method 3050B) in lieu of the TCLP extraction. The total constituent analysis result is divided by 20 to convert the total results into the maximum leachable concentration. The analysis requires a smaller sample size 4 to 5 grams.

In order to meet the EPA SW846 testing requirements, additional quality control samples (duplicate, spike) would be required, as well as sufficient sample volume for rerun analysis. The minimum sample volumes needed would be 1.5 to 2 kg for TCLP, or 16 to 20 grams for total metals.

Both the onsite and offsite laboratories must operate within approved radioactive license requirements. These license requirements limit the amount of radioactive material that can be accepted in a sample and the radiation absorbed dose that can be accepted from a sample. These limits would significantly reduce the sample size that can be accepted in either an onsite or an offsite laboratory. These limits will not allow a laboratory to accept a sample large enough to meet the minimum sample size of EPA Method 1311 or Method 3050B. The sample size would be limited to several micrograms.

If a sufficiently small sample were to be collected so it could be accepted by a laboratory, the laboratory would then be required to dilute the sample prior to analysis. This would be necessary to minimize radiological exposure to the laboratory staff.

The combination of very small sample size necessary to meet laboratory acceptance criteria, and additional dilution of the sample necessary to protect laboratory staff would result in laboratory detection limits that are significantly above regulatory thresholds for the toxic characteristic metals. The laboratory data would not be adequate to determine if treatment of the waste is necessary or if the treated waste was within regulatory limits.

An attempt to perform an analysis of the waste would also result in the generation of additional wastes. This waste will include protective clothing, laboratory equipment, unused sample aliquots, and analyzed solutions. These additional wastes would designate as mixed low-level waste and would need to be properly managed and disposed.

The following steps are necessary to collect a sample:

- **Obtain a shielded transport cask**—A Type B transport cask may be necessary to transport the sample safely and compliantly from WESF to a laboratory. The cask would allow shipment of the sample to comply with applicable U.S. Department of Transportation (DOT) requirements or demonstrate equivalent safety compliance under DOE/RL-2001-36, *Hanford SiteWide Transportation Safety Document*. Acceptable casks may be available onsite, but would require safety analysis prior to use, considering the specific radionuclides present in the waste and their concentrations.
- **Design, fabricate, test, and install a sampling system**—The capability to collect microgram sample quantities does not exist at WESF. It would be necessary to design, fabricate, test, and install a new sampling system. This system would need to be compatible with the hot cell manipulators.
- **Determine the proper sampling**—The waste is not uniform or homogenous. A sampling and analysis plan would need to be written to determine the sampling strategy and ensure a somewhat representative sample could be obtained. However, due to the radiological characteristics of the waste, the sample size would be limited to microgram size, which would not provide a representative sample, nor allow for proper characterization.
- **Collect a sample**—In order to obtain a sample, the four boats in the oven and the pipe would need to be moved and staged in the hot cell to obtain samples using manipulators. Based on generator knowledge gained from working with carbon steel pipes, the manipulators would not be capable of removing the end caps from the pipe. Therefore, it would be necessary to use the manipulators and an appropriate tool to cut the end caps from the pipe. Cutting operations in a hot cell may require fire suppression capabilities, which would need to be designed. The contents of the pipe would need to be removed and placed into a new vessel for sample collection. A method to store waste safely within the hot cell after it is removed from the pipe would need to be implemented.
- **Remove the sample from Hot Cell C**—Once the samples are collected, they would need to be removed for transportation to the designated laboratory. A method to remove the samples from Hot Cell C and place them in the transport cask would need to be designed and implemented.
- **Remove the shielded cask**—The WESF canyon crane would remove the truck port cover block and place the loaded shielded cask into an appropriate transport vehicle in the WESF truck port.
- **Transfer to a laboratory**—Transfer of the sample to a laboratory would have to be performed in accordance with all applicable DOT or equivalent safety requirements under DOE/RL-2001-36. Due to the radiological activity/dose the DOT A2 value for radioactive materials would be exceeded, requiring transport in a DOT Type B certified container that meets the specific waste characteristics. Transportation safety requirements may dictate development of a new Special Packaging Authorization for transfer of the sample.

The collection and analysis of a sample is possible; however, it is technically and environmentally inappropriate. Significant potential exists for environmental release, additional waste generation, and unnecessary worker exposure.

## 3.2 Treatment of the Waste

Due to the radiological characteristics of the waste and radiological license limits, no commercial or onsite TSD facilities are currently available to accept this waste for treatment. Therefore, a new treatment capability needs to be developed. The safest and least impacting option to provide the required treatment to LDR standards would be to treat the waste items in Hot Cell C.

Without accurate characterization, data to support the design of the waste treatment capabilities are questionable. Treated waste and associated equipment would likely not be removed from Hot Cell C; rather, they would be left in place and ultimately grouted to allow hot cell removal.

The following steps are necessary to treat the waste in Hot Cell C:

- **Design, fabricate, test, and install treatment capabilities**—The major components needed for treatment capabilities would include a stainless steel tank, mixer, and piping to deliver grout. Without accurate waste characterization data, design of this treatment capability would be a significant engineering challenge.
- **Operate the treatment system**—The treatment capability must be operated remotely using manipulators. Grout would be added to the tank by hose through the cover block, and the waste would be added using manipulators. A tank mixer would mix the waste and grout. Once the waste is added to the grout, recovery from any process upset or equipment failure would be difficult.
- **Sample the grout waste mixture**—It would be necessary to sample the waste grout mixture to determine adequate treatment. Collection of the sample and removal from the hot cell must be performed remotely using manipulators and a remote operated crane.
- **Laboratory analysis**—The treated grout waste mixture would need to be analyzed at Pacific Northwest National Laboratory, and the same analytical challenges would exist as for the untreated waste, as described in Section 3.2.
- **Repeat waste treatment if adequate treatment cannot be demonstrated**—If a determination is made that the waste was not adequately treated, it would be necessary to remove the treated waste, size reduce the mixture, and retreat the waste. It is expected that a new treatment system would need to be designed, fabricated, and tested for retreatment of the waste.
- **Macroencapsulate the treated waste in Hot Cell C**—If it is shown that the waste has been treated to LDR treatment standards, it will remain in Hot Cell C, where it will be macroencapsulated. Hot Cell C, along with the other hot cells, will be filled with grout to stabilize the radiological contamination and allow for ventilation upgrades to WESF.

Designing a treatment system for installation into a hot cell is technically inappropriate due the inability to obtain necessary characterization data, limited space available in the hot cells, and inability to confirm that LDR concentration based treatment standards have been achieved.

# 4 Treatability Variance Approach and Alternate Treatment

## 4.1 Appropriateness

40 CFR 268.44(h)(2)(i) indicates that a variance from LDR treatment standards can be approved if "(i) treatment to the specified level or by the specified method is technically inappropriate."

Treatment of the floor sweepings for characteristic metals to meet the applicable concentration based treatment standards is technically inappropriate for the following reasons:

- **Potential for environmental release**—Each time a cover block is removed or replaced, the K3 HEPA filters experience a rapid change in pressure drop, which has the potential to cause filter failure, and could involve a significant environmental release if it occurred.

- **Worker exposure**—Worker exposures would be maintained below allowable limits; however, radiological exposure to workers would be required to treat the waste.
- **Mixed waste generation**—Additional mixed waste would be generated as a result of reactivating Hot Cell C, performing sampling and analyses, and treating the waste within Hot Cell C.
- **Significant engineering challenges**—The highly radioactive component of the waste items requires reactivation of the WESF systems necessary to handle the material safely. Significant engineering challenges would need to be overcome to reactivate these systems, which have not operated in more than 20 years.
- **Analytical capabilities**—Due to the sample size requirements, no onsite or offsite laboratories are capable of providing useable TCLP or total metals data on the waste items. Laboratory acceptance criteria and worker protection requirements would result in analytical data where the minimum detection limit exceeds regulatory thresholds for the concentration-based standards.
- **Treatment capabilities**—No onsite or offsite treatment facilities are capable of accepting waste items for treatment to meet concentration-based standards.

The factors of this Petition are well aligned with circumstances that EPA recognizes as being appropriate to support a variance under 40 CFR 268.44(h)(2)(i). A variance from the required LDR treatment standards is requested to allow LDR treatment via in-cell macroencapsulation.

## 4.2 Proposed Waste Treatment Process

The Petitioner is proposing an alternative treatment of macroencapsulation. This treatment method will use a grout mixture to surround the waste items to immobilize the hazardous constituents.

Interior dimensions of Hot Cells B and C are 2.4 m (8 ft) long, 2.4 in (8 ft) wide, and 3.9 m (12.8 ft) high. The floor and bottom portions of the walls are lined with 14-gauge 304L stainless steel. The walls of the hot cells consist of 0.9 m (35 in.) of high-density concrete. All penetrations to the hot cells will be sealed to prevent the grout from leaking from the hot cells while it is curing. A steel barrier will be placed over the viewing windows. For the two pipe sections that are mounted in Hot Cell C, the grout can easily surround the waste items and encapsulate the pipe segments. The four boats will remain in the furnace between Hot Cells B and C. The furnace has small penetrations, which will remain open during grouting and will allow some grout to flow inside. However, macroencapsulation will be accomplished by grout surrounding and encapsulating the furnace. Although the grout may not completely fill the furnace to directly encapsulate the boats, it will completely encapsulate the furnace containing the boats such that the statutory requirement of 42 USC 6924(m) will be met through substantial reduction of the migration potential of hazardous constituents from the waste.

The grout mixture will consist of Portland cement, fly ash, aggregates, and additives necessary to achieve the project performance criteria for compressive strength, flowability, and heat of hydration. These criteria and testing protocol will be defined in the grout procurement specification and in a grout test plan. Prior to addition of grout to the hot cells, the grout formulation will be tested in accordance with the test plan to demonstrate that it meets the project performance criteria.

The grout will be piped into Hot Cells B and C through an existing penetration in the ceiling of the hot cells. Each hot cell will be filled incrementally in lifts. Each lift will be less than 0.9 m (3 ft). After each lift, the grout will be allowed to cure before the next lift is added to the hot cell. Each hot cell will be filled to the ceiling with grout as indicated by grout being visible at the vent(s). An estimated 23.7 $m^3$ (31 $yd^3$) of grout will be required to fill each of the hot cells. The grout added to each hot cell will be measured and verified to ensure that the cells are completely filled.

The Closure Plan, submitted to Ecology in 15-AMRP-0028 for Hot Cells A through F, provides additional detail on the grouting of the hot cells and proposed waste treatment of macroencapsulation.

## 4.3 Evaluation of Proposed Waste Treatment Process

Macroencapsulation is intended to immobilize the hazardous metals (and radionuclides) by application of surface coating materials or use of a jacket of inert organic materials. The proposed waste treatment process of filling the hot cells with grout would encase the entire waste items rather than treat the interior waste such as in microencapsulation, substantially reducing surface exposure to potential leaching of contaminants.

The macroencapsulated waste would be left intact at WESF during an interim closure period. By treating the waste via macroencapsulation in WESF cells, leachability of contaminants is reduced, radiological exposure to workers is minimized, and transportation to another facility prior to overall WESF closure is eliminated.

Other waste subcategories with characteristic metals have specific or alternative technology based treatment standards using macroencapsulation. One of the alternative treatment standards for debris per 40 CFR 268.45, "Treatment Standards for Hazardous Debris," is macroencapsulation, which is very effective for treatment of mixed waste with characteristic metals such as cadmium, chromium, and lead. For example, the treatment standard for radioactive lead solids is macroencapsulation per 40 CFR 268.40. Radioactively contaminated batteries containing cadmium also have used macroencapsulation, per 40 CFR 268.45 as the specific treatment standard, since they are like debris and cannot be easily recycled.

Macroencapsulation is the best option for radiologically contaminated debris-like waste with RCRA metals that cannot be easily sampled or recycled. This waste stream cannot be easily treated or sampled due to its nonhomogeneous and radiological characteristics.

## 4.4 Protectiveness

40 CFR 268.44(m) requires demonstration that compliance with a proposed treatment standard variance "is sufficient to minimize threats to human health and the environment posed by land disposal of the waste."

Using the alternative treatment standard of macroencapsulation will satisfy the statutory and regulatory requirements of 42 USC 6924(m) and 40 CFR 268.44(m), respectively, by substantially reducing the migration of hazardous constituents from the waste. The treatment is sufficient to minimize threats to human health and the environment posed by land disposal of the waste as demonstrated by the bulleted list. Using macroencapsulation in the cell as an alternative treatment standard for this specific waste stream is the best option capable of achieving reduced radiological exposure (as low as reasonably achievable) and reducing risks associated with potential environmental exposures. The following are main advantages to the proposed treatment of macroencapsulation:

- Immobilization of the metal contaminants sufficient to minimize the threat to human health and the environment
- Elimination of potential environmental exposure that would be associated with managing the waste during sampling, treatment, and long-term storage

- Elimination of personnel exposure associated with facility modifications, sampling, testing, and microencapsulation treatment
- Elimination of secondary mixed waste generation
- Elimination of potential risk associated with transportation of samples

Treatment and verification of treatment to meet concentration based limits would not be protective of workers or the environment. By eliminating extensive facility modifications, waste, and material handling operations, the proposed treatment method reduces the risk of an environmental release, minimizes generation of secondary wastes, reduces radiation exposure to workers, and provides a safer method of transportation for final disposition of these wastes.

## 4.5 Certification Statement

The following certification is made in accordance with WAC 173-303-910, "Petitions," and 40 CFR 268.44(c):

> I certify under penalty of law that I have personally examined and am familiar with the information submitted in this Petition and all attached documents, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including possibility of fine and imprisonment.

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|---|---|
| Stacy L. Charboneau, Manager<br>U.S. Department of Energy<br>Richland Operations Office | 1/28/15<br>Date |

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|---|---|
| John A. Ciucci,<br>President and Chief Executive Officer<br>CH2M HILL Plateau Remediation Company | 1/27/15<br>Date |

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