APPROVAL PAGE

TREATMENT PLAN AND PROTOCOLS FOR TREATMENT OF LEAD-CONTAMINATED SOILS AND OTHER LEAD CONTAMINATED WASTE MATRICES

DOCUMENT NUMBER DFS-ERDF-028, REV. 0

August 25, 2005

Dennis Faulk U.S. Environmental Protection Agency	8-25-05 Date
Chris Smith U.S. Department of Energy	8/25/05 Date

Environmental Excellence
HANFORD

DFS-ERDF-028

Environmental Restoration Disposal Facility

Waste Disposal Operations

TREATMENT PLAN AND PROTOCOLS FOR TREATMENT OF LEAD-CONTAMINATED SOILS AND OTHER LEAD-CONTAMINATED WASTE MATRICES

Work Performed for Bechtel Hanford Inc. Under Subcontract 0600X-SC-G0006

Duratek

Record of Revisions

Revision/PCN No.	Date Entered	Entered By (Handwritten Signature)

List of Effective Pages

Page Number	Revision/PCN	Revision/PCN Date
All Pages	Revision 0	08/12/2005

TABLE OF CONTENTS

TERMS

BHI	Bechtel Hanford, Inc.
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
LDR	Land Disposal Restriction
RPAS	Remaining Pipelines and Sewers
TCLP	toxicity characteristic leaching procedure
UTS	Universal Treatment Standards

1.0 Introduction

Bechtel Hanford, Inc. (BHI) is the Environmental Restoration Contractor for the U.S. Department of Energy, Richland Operations Office at the Hanford Site. As the Environmental Restoration Contractor, BHI is responsible for performing site investigations, characterization, remediation, and restoration of all locations identified as Remedial Action Sites at Hanford. As a result of remedial activities performed at various burial grounds, several small waste streams will require stabilization treatment of *Resource Conservation and Recovery Act of 1976* metals with concentrations above land disposal restriction (LDR) limits found in 40 *Code of Federal Regulations* (CFR) 268.48[1] Universal Treatment Standards (UTS).

There are a number of these small waste streams at the 100 Areas, including the Remaining Pipelines and Sewers (RPAS) site. The waste streams require stabilization treatment of lead prior to disposal in the Environmental Restoration Disposal Facility (ERDF) at the Hanford Site. The contribution from lead in the waste exceeds the LDR limit in 40 CFR 268.48.

2.0 Background

Stabilization treatment has been completed at the ERDF on the basis of treatability experiments that demonstrate reduction in leachability of the *Resource Conservation and Recovery Act of 1976* metals present in the waste to levels below the UTS. The treatability experiments have been documented in U.S. Environmental Protection Agency (EPA)-approved treatment plans that described the treatability experiments to be done and the full-scale treatment process. Comparison of the treatability experiment results to base-line analysis of the untreated waste via the toxicity characteristic leaching procedure (TCLP) in Method 1311[2] yields a reduction ratio in leachability between the treated and untreated waste matrices. This comparison is an indication of successful treatment capacity inherent in the mixture of reagents and waste.

This stabilization treatment process has been completed at the ERDF on a case-by-case basis—one waste stream at a time. Each individual treatment plan, documenting treatability experiment mix ratio(s) and full-scale treatment processes, has been pre-approved by EPA with careful consideration being given to the calculated reduction ratio.

Lead-contamination in various waste matrices has been successfully stabilized at the ERDF via the described treatment process. A soil and portland cement mixture analyzed in 1999 yielded a reduction ratio of 280:1 upon completion of the mixing process—and a reduction ratio of 1000:1 - 20 minutes after complete mixing.

A Uranium-Oxide and portland cement mix analyzed in 2003 yielded a reduction ratio of 53:1 upon completion of mixing. Note that the Method Detection Limits established for the analytical method prescribed for the Uranium-Oxide and portland cement mixture limited the true analytical results and corresponding reduction ratio to 53:1. It is, however, postulated that the actual reduction ratio was likely much greater than 53:1. The reduction ratios described above indicate that lead can be treated with confidence using portland cement as a stabilization reagent.

For comparison purposes, it is assumed that waste streams in the 100 Areas will be similar in the type of media (e.g., soils) and lead will be similar in composition within the waste matrices.

3.0 Purpose

The purpose of this treatment plan is to establish a pre-approval by EPA for stabilization of lead when analysis indicates that the reduction ratio generated from the treatability experiments described in this treatment plan is sufficient to assure treatment of similar waste streams. In addition, this treatment plan will establish stabilization mixtures for lead and describe the actual process to stabilize the waste.

4.0 Scope

The scope of this treatment plan involves the treatment of lead-contaminated waste from the 100 Areas. The plan covers analysis of the treatment method, the treatability experiments, full-scale treatment process, and the protocol for establishment of the reduction ratio that could allow approval of similar 100 Areas waste streams to be stabilized under this treatment plan.

5.0 Protocol

The treatability experiments completed for the RPAS waste stream were used to establish a reduction ratio that can be compared to other 100 Areas waste streams baseline analyses (TCLP) in order to determine if the treatability experiment mixtures from the RPAS waste stream could successfully stabilize lead in the other 100 Areas waste streams to concentrations below UTS. The reduction ratio yielded in the analysis of the mixture of the RPAS waste stream and the selected reagent demonstrated a sufficient reduction in leachability for stabilization of the lead component before being applied to other 100 Areas waste streams.

As a part of this process, a baseline sample (untreated waste) was analyzed along with a minimum of two treatability experiments (waste + weighted ratio of reagent). More than one mix can be selected for comparison purposes to determine the least costly, successful mix. The first experiment required the mixture to be placed in the extraction vessel (see Table 2, SW-846, Method 1311) immediately after it passed the paint filter test (a complete mix) identified in Table 2 (SW-846, Method 9095) of this treatment plan. The second experiment required a 20-minute set time after passing the same paint filter test before placing the mixture in the extraction vessel. Any treatability experiment that reduces the leachability of lead by 90% of the baseline is considered a successful mixture for full scale treatment operations. Any treatability experiment that does not achieve a 90% reduction in comparison to the baseline sample will not be considered for stabilization of the waste. The basis of this decision is found in 40 CFR 268.49 (c) (1) (B), "Alternative LDR treatment standards for contaminated soil"[3] where metals in soil must be treated to 90% reduction of leachability.

For the purposes of determining applicability of this treatment plan to other 100 Areas waste streams, reduction ratios developed from the experimental process described above will be applied to other similar 100 Areas waste streams contaminated with lead. It will be assumed that the waste matrices are similar in nature, and the composition of lead is also similar. One half (50%) of the reduction ratio from any successful treatability experiment described above may be applied to other 100 Areas waste streams to achieve the required 90% reduction of leachability. For purposes of this discussion, the reduction ratio is the ratio between the analyzed baseline sample (TCLP) described above and the results of the treatability experiment (TCLP). The reduction ratio demonstrates the ultimate treatment capability of a given mixture. For conservatism, only 50% of that capability will be applied to other waste streams.

For example, assume that a new 100 Areas waste site has a lead concentration that leaches at 80 mg/L (TCLP). Further assume that 50% of the reduction ratio of one of the experiments described above is 100:1. This ratio would be applied to reduce the leachability of the lead from 80 mg/L to 0.8 mg/L, which is greater than a 90% reduction of the leachability of lead (7.2 mg/L) from the new 100 Areas waste stream. Therefore, the reagent mixture used to generate that particular reduction ratio would be approved for treatment of new 100 Areas waste streams.

6.0 Treatment Plan for Lead-Contaminated Waste

6.1 Waste Description

The wastes covered by this treatment plan can be for any given 100 Areas waste streams that require stabilization of lead. The waste is primarily made up of soil and has lead in similar composition. As a starting point, soil contaminated with lead in concentrations up to 53 mg/L (TCLP) from the RPAS will be analyzed.

6.2 Hazardous and Radiological Characteristics

The waste may be designated as mixed waste. The radiological constituents will be assumed to be any concentration acceptable in the ERDF landfill as prescribed in BHI-00139, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*[4]. The waste is in a solid form, primarily soil, but may be comprised of other media (e.g., garnet from sand blasting operations, other media that is not considered debris) and is considered inert material. With the exception of lead, the heavy metals present, and other constituents present such as organics, are identified in quantities less than the maximum treatment standards for these contaminants in 40 CFR 268.40, Subpart D, "Treatment Standards for Hazardous Waste."[5] Due to the concentrations of lead in the soil, this waste must be treated to meet the standards in 40 CFR 268.49 prior to land disposal. The highest detected levels of hazardous constituents in the waste and treatment standards are shown in Table 1.

Table 1. Hazardous Constituents.

Constituent	Analysis	Heavy Metals (Highest value detected)	Treatment Standard (TCLP) (mg/L)
Lead	TCLP (mg/L)	53.0	5.3 mg/L TCLP

NOTE: Actual baseline samples analyzed yielded a concentration of 0.563mg/l.

6.3 Treatment Standards

The treatment standard for this waste is a stabilization process for the heavy metals present utilizing a technology identified in 40 CFR 268.42, "Treatment Standards Expressed as Specified Technologies."[6] Stabilization is a treatment technology that reduces the hazard potential of the waste by converting the contaminants into their least soluble mobile or toxic form.

6.4 Treatment Method

A portland cement-based stabilization method will be used. The portland cement shall conform to ASTM C150. Type I or Type II cement as defined in ASTM C150 is acceptable.

Water is controlled to achieve the desired consistency. Water is added to the waste matrix using a fire hose. Testing and suitability of the treatment technology is discussed in Section 7.0 of this treatment plan.

The mixtures initially analyzed are identified in Table 2 of this treatment plan. The lowest-cost mixture that passed the acceptance test process will be used to treat that waste stream. Once a mixture is selected, the mixture ratios will be controlled in the field to ensure the characteristics of the production material matches the characteristics of the treatability experiment. Therefore, no subsequent testing of the production material is required. All sample mixtures produced during mixture development were subjected to the acceptance tests shown in Table 2.

Table 2. Acceptance Test Program.

Test	Procedure	Reference	Acceptance Limit
Free Liquid	Method 9095[7]	SW-846[8]	No free liquids
TCLP	Method 1311	SW-846	Metal concentrations less than UTS limits in 40 CFR 268.48

7.0 Treatability Experiments

The purpose of the treatability experiment is to establish baseline treatment parameters for stabilizing the waste. The TCLP levels for heavy metals present in the treatability experiment samples represent the baseline for determining if additional treatability experiments are needed, and they are used to validate the mixture options prescribed in Table 3, Section 7.2 of this treatment plan.

7.1 Representative Samples

The full-scale treatment will consist of mixing one roll-off can of waste in a single stabilization run. Samples for the treatability experiments (in containers up to 5 gallons full) were taken from a selected pile with the highest detected concentration of heavy metals present as indicated in Table 1. Portions of these samples were used as representative samples for baseline analysis and treatability experiments. Samples were retrieved using appropriate sampling equipment and transported to the Waste Sampling and Characterization Facility. Samples were managed in accordance with approved Duratek Federal Services, Inc., procedures and Waste Sampling and Characterization Facility procedures.

7.2 Treatability Experiment Test Plan

Weighted samples were taken from each generator-supplied container with the highest detected concentration of heavy metals present as indicated in Table 1. This operation was performed under a Waste Sampling and Characterization Facility Test Plan.

Table 3 shows the ratios for each sample in weight percent. There are two constituents—portland cement and waste. Sections 7.2.1 through 7.2.8 describe the test process.

Table 3. Treatability Experiments.

Mixture	Waste (Wt %)	Cement (Wt %)	Water (Wt %)
1	79	21	Note
2	70	30	Note

NOTE: Water will be added to achieve a desirable consistency in the finished mixture.

7.2.1 Weight out the ratio-ed amounts for each sample in accordance with Table 3 to give a final weight of 120 grams. Mix the materials, remove five grams of the mixture and follow Method 1311 for determination of pH.

7.2.2 Add water to the mixture to achieve desired consistency.

7.2.3 A Paint Filter Test will be performed on the mixture immediately after finishing the mixing process and every five minutes thereafter, if needed to determine when the mixture contains no free liquids. As soon as the materials pass the paint filter test, place them in the TCLP extraction vessel, sizing as necessary to meet the requirements of Method 1311.

7.2.4 For both mixes (Mixtures 1 and 2, Table 3) duplicate the mix ratio and mixing process. Allow the mixture (100 grams) to cure for 20 minutes after passing the paint filter test and then place the cured mixture into the TCLP extraction vessel.

7.2.5 Add the proper extraction fluid (fluid 1 or 2) as determined from step 7.2.1 to determine a pH.

7.2.6 Place the extraction vessels in the TCLP rotator for the time required by Method 1311, note the time, temperature and rotation speed and record in the TCLP logbook as required by Method 1311.

7.2.7 When the extraction period has finished, remove the vessels from the rotator, note the time and temperature and record in the TCLP logbook. Filter approximately 250 mL of the fluid into a poly bottle properly labeled, "acidify <2 pH," and store in an approved refrigerator.

7.2.8 Analyze filtered TCLP extract. Any unused sample material will be bagged and placed back into an appropriate waste container.

7.3 Evaluation of Test Results

The treatability experiment results were analyzed against the baseline untreated TCLP results for the original TCLP results regulating the soil pile, the baseline sample results prepared from waste contained in the 5-gallon container, and the regulatory limits. Any mixture/duration that produces an analytical result below regulatory limits (e.g., a reduction of 90%) and that demonstrates that substantial treatment has been accomplished by comparing treatability experiment test results with regulatory limits will be provided to the regulatory agencies for concurrence that the mixture provides successful treatment. The mixture that is determined by the regulatory agencies to not be successful cannot be used for the treatment of the waste. Verification sampling will not be required for successful treatment mixes that regulatory agencies have concurred with.

The initial successful mixtures (from Table 3) are identified in Table 4 along with the baseline, untreated TCLP results from the soil sample, and the resulting reduction ratio.

Table 4. Treatability Experiments (Including Results and Reduction Ratios).

Mixture	Waste (Wt %)	Portland cement (Wt %)	Water (Wt %)	Result (TCLP—mg/L)	Reduction Ratio
Baseline	-	-	-	0.563	-
1	79	21	to desired consistency	< .021 mg/L*	27:1
2	70	30	to desired consistency	< .021 mg/L*	27:1
Completed mix 1 plus 20 minute set time)	79	21	to desired consistency	< .021 mg/L*	27:1
Completed mix 2 plus 20 minute set time)	70	30	to desired consistency	< .021 mg/L*	27:1

*Method Detection Limit.

NOTE: Future results of the treatability experiments will be provided in a separate report.

8.0 Stabilization of Lead-Contaminated Waste

The stabilization of the lead-contaminated waste will be completed using a mixing box at the ERDF site (Section 8.4).

8.1 Determine Mixture Volumes and Weights

The bounding net waste weight of a container will be established for the lead-contaminated waste and will be used to establish the proper mix ratio. Water will be added to a desired consistency. Portland cement will be added according to the successful treatability experiment test(s) (see Section 7.2 of this treatment plan).

8.2 Equipment and Supplies for Stabilization in the Mix Box

- Mix box
- Cement mix (1 or 2 ton Ag bags)
- Water supply
- Track hoe
- Dozer
- Hand tools, rope, and appropriate signage

8.3 Mobilization for Stabilization in the Mix Box

- Procedures, including work plans, Radiation Work Permits, and job-specific Activity Hazards Analyses, will be developed and/or current for mixing operations.
- Perform training of personnel to procedures/equipment and complete dry run(s) with inert material as needed.

8.4 Stabilization Process Using the Mix Box

- Prepare the mix box with access and egress points for haul trucks transporting roll-off cans or drums of lead-contaminated waste.
- Ensure that personnel have inspected the area for soil fissures and run off.
- Ensure that the mix box is inspected for cracks and other damage from prior mixing operations.

  NOTE: Do not proceed with mixing operations if damage is present.
- Dump waste from the roll-off can or drum(s) into the mix box. Ensure that water is available as dust suppressant.
- Add portland cement in the percent specified based on the selected successful treatability experiment.
- Mix waste in accordance with Section 8.5 of this treatment plan.
- Clean the mix box after mixing using Daily Operations Cover.
- If waste is in the mix box and cannot be mixed until the next day, cover with fixative prior to stopping mix box operations.

8.5 Mixing the Waste

Add water using a fire hose. The actual amount of water may vary depending on the moisture content of the waste. Water will be added at pressures that do not allow spread of material outside of the mix box. The calculated amount of portland cement will then be added to the mix. The mixing process will be monitored by operations supervision to ensure proper mixing. Signs of incomplete or improper mixing are dry spots and/or excessive wet mixtures. Dry spots require further mixing and/or additional water. Excessively wet mixtures will be allowed additional time to cure inside the mix box prior to disposal, or may require additional cement.

8.6 Disposal of Stabilized Waste

After the mixture passes the paint filter test, as determined during the treatability experiments, dispose of the mixture in the ERDF cell. The minimum set-up time within the mix box will be based on the time established in the treatability experiment and visual observations (see Section 7.0 of this treatment plan). Only after the proper set-up time (cure time) for the mixture has elapsed, the waste will be placed in the ERDF landfill.

8.7 Sampling

The stabilization reagents, waste, and process used in the treatability experiments are meant to represent the process for full-scale treatment. The results of the successful treatability experiments will constitute the LDR compliance for disposal per 40 CFR 268.7 (c) (2), "Testing, Tracking, and Recordkeeping Requirements for Generators, Treaters, and Disposal Facilities."[9]

8.8 Spill Response

In the event of a spill outside the mix box, follow the ERDF Health and Safety Plan (DFS-ERDF-002.1, current revision[10]) to implement initial spill control. The cleanup will be accomplished by using available ERDF equipment (i.e., shovels, drums, etc.). Radiological controls will be used to protect personnel from any radiological hazards associated with the spill cleanup.

Loss of waste (a spill) within the ERDF cell is not considered a spill to the environment, but will be cleaned up in the same manner. In both cases, the waste will be placed into containers and the weight of the containers re-verified on the ERDF truck scale. Then it will be transported back to the ERDF cell for proper disposal.

8.9 Breakdown of Mixing Operation

The used mix box may be retrieved and, using the excavator and bulldozers, dragged to a location for future use. If used, the excavator will be de-contaminated (if not a regulated machine) using dry decontamination methods and released. Decontamination will be performed in accordance with DFS-ERDF-002.10 (D), *Decontamination Procedure*[11].

9.0 References

The following references were used in the preparation of this treatment plan.

1. 40 CFR 268.48, "Universal Treatment Standards."
2. SW-846, 1998, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, Rev. 5., U.S. Environmental Protection Agency, Method 1311.
3. 40 CFR 268.49 (c) (1) (B), "Alternative LDR treatment standards for contaminated soil."
4. BHI-00139, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*, current revision.
5. 40 CFR 268.40, Subpart D, "Treatment Standards for Hazardous Waste."
6. 40 CFR 268.42, "Treatment Standards Expressed as Specified Technologies."
7. SW-846, 1998, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, Rev. 5., U.S. Environmental Protection Agency, Method 9095.
8. SW-846, 1998, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, Rev. 5., U.S. Environmental Protection Agency.
9. 40 CFR 268.7 (c) (2), "Testing, Tracking, and Recordkeeping Requirements for Generators, Treaters, and Disposal Facilities."
10. DFS-ERDF-002.1, *ERDF Health and Safety Plan*, Section 14.0, "Spill Response Plan."
11. DFS-ERDF-002.10 (D), *Decontamination Procedure*.