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U.S. EPA COMMENTS ON TREATABILITY STUDY WORK PLAN FOR OU4

10-01-91

DOE-FSO/EPA
36
REPORT

[redacted]

U.S. EPA
Comments on Treatability Study Work Plan for OU4

2340

ATTACHMENT A - GENERAL COMMENTS

Commenting Organization:U.S. EPA Commentor:
Pg. # Section # Paragraph # Sent./Line #
Original Comment #1

Comment: The methodology for conducting stabilization treatability studies does not clearly address several issues which are common to stabilization/solidification (S/S) technologies. The following observations on the work plan experimental design outline the issues not adequately addressed.

a) The work plan does not propose pH measurements of stabilization mixtures. The solubility of heavy metals is strongly influenced by the pH of the leaching solution. For each metal the optimum pH for minimum solubility is unique. Most metals, particularly lead, exhibit amphotericity, which means they have high solubility at both high and low pH. Because each metal has a different solubility curve, the combination of metals to be stabilized is critical in selecting the optimum pH of a stabilization mixture in order to minimize the leachability of the metals of concern.

Furthermore, during the leaching procedure (as proposed to be simulated in the work plan using toxicity characteristic leaching procedures [TCLP]), chemical changes continue to occur in the stabilized matrix. For example, an acidic leach will achieve some neutralization of the basicity common in cementatious materials. If a metal is soluble at a high pH, the acidic leach may offset its solubility. However, if in reality a stabilized material would be exposed on site to fairly neutral leaching (such as being exposed to nonacidic rainwater), no neutralization will occur as the leaching occurs, and the metal in question will in fact leach out of the matrix at a much higher rate than observed in a bench scale demonstration with an acidic leach.

b) Advanced screening of the stabilization formulations does not address site-specific aspects of the alternatives proposed in the feasibility study. For example, as described in comment la above, site specific conditions a stabilized waste would experience under the proposed FS alternatives should be simulated. Unconfined compressive strength (UCS) measurements do not provide much useful information for stabilized wastes that will not be disposed of as monoliths. Consideration should be given to advanced testing with a prepared leach that simulates the carbon dioxide concentration (carbonic acid content) and pH of leachate filtering through on-site soils, a cap, or through local ambient air. Site-specific testing should include modification of the TCLP test protocol to address realistic waste-to-leaching solution ratios and exposed surface areas for the various remedial alternatives. Additional leaching tests, such as American Nuclear Society (ANS) 16.1, should be considered.

C) Preliminary screening of stabilization mixtures appears to be based solely on physical parameter measurements (such as UCS) and penetration resistance) and reagent

usage. It is important to note that both physical and chemical phenomena occur in conventional S/S processes. For a specific waste stream, the effectiveness of the chemical fixation cannot be determined by measuring the physical properties. The most important aspect of the treatability testing relative to protection of human health and the environmental is the ability of the selected S/S formulation to chemically fixate the constituents of concern. The physical properties are not unrelated to this process but are of particular interest primarily in the implementation of the remedial alternative design. The primary screening criteria for the preliminary phase should be the ability of a stabilization formulation to chemically fix the heavy metal constituents.

d) **TCLP is proposed to be performed on the treated waste mixtures only and is not proposed for the untreated samples. The efficiency and quantifiable effectiveness a mixture to fix heavy metal constituents cannot be exactly determined without measuring TCLP before and after treatment. It should be noted that after treatment TCLP measurements must be corrected for the dilution of additives.**

e) **The organic analysis of the samples collected from the first silo contents sampling event did not detect significant organic contamination; however the holding times were excessively exceeded. The second silo contents sampling event may find that organic contaminates are a significant factor and the potential of organic constituents to inhibit S/S process effectiveness should be addressed in the work plan.**

Response:

a) It is well understood that the solubility of metals is a function of pH. However, the critical pH is the final pH of the extraction fluid at the end of the extraction methods prescribed contact time. These values will be measured and the formulas adjusted to minimize the leachability of the metal constituents of concern.

The TCLP procedure was selected because it is a regulatory accepted standard test method as identified in SW 846 third edition . It is not within the scope of a remedy screening/remedy selection treatability study to develop and validate new extraction testing procedures when the EPA has established standard methods upon which the Land Disposal restrictions are based.

b) EPA in formulating the TCLP performed 34 laboratory leaching tests on four different wastes to assess accuracy of the method to be selected as TCLP. These tests involved four leaching medium: sodium acetate buffer, carbonic acid, water, actual municipal waste leachate. As a result of this testing two leaching procedures were found to be acceptable and subjected to further testing along with the original EP Tox method. These two leaching procedures involved the sodium acetate buffer solution and the carbonic acid solution.

During the second round of testing it was found that the carbonic acid leaching media was less aggressive towards inorganics than the sodium acetate buffer system and that it did not produce results that correlated with actual field generated data.

Based on this, the use of the TCLP sodium acetate buffer solution, which was selected over the carbonic acid solution for TCLP, will provide more accurate and conservative numbers than using a carbonic acid leaching medium. **See page 21676 - 7, Fed Reg., June 13, 1986.**

The TCLP extraction procedure was selected because it presents a worst case situation based on reduced particle size and surface area to volume ratios. This procedure results in conservation contaminant concentration for input into the risk calculations and does not take into account the effect of the Engineered Waste Management Facility (EWMF).

c) The preliminary screening Stage I was designed to take advantage of some samples which were collected in 1989-1990. These tests were designed to range find the reagent levels necessary to meet the UCS requirements of ≈ 500 psi. The MTCLP test will be added to this stage to augment the UCS results providing additional information on the fixation as well as the solidification of the waste matrices. The determination of the reagents necessary to meet the fixation and solidification requirements are evaluated the preliminary screening stage II testing program using new (1991) samples from the silos.

d) **What is TCLP?**

One of the criteria for determining a hazardous waste is the criteria of Toxicity Characteristic. The toxicity characteristic is based on the ability to waste to leach into the environment a contaminant in concentrations that pos a risk to health or the environment. The wastes subject to the toxicity characteristic are listed in 40 CFR 261.24 and are given a regulatory level for maximum concentration of contaminant. This level is a health risk based level and is determined by subjecting the waste to a special extraction procedure called the Toxicity Characteristic Leaching Procedure (TCLP).

The TCLP is an analytical extraction procedure designed to address the mobility of contaminants in the subsurface environments. Specifically, it is based on a co-disposal scenario of hazardous and solid wastes being disposed of in a sanitary landfill. This extraction procedure is based on a model that takes into account chronic toxicity reference levels, combined with a compound-specific dilution/attenuation factor (derived from application of a groundwater transport equation, to calculate the regulatory level concentrations for individual toxicants. The regulatory level concentrations for these toxicants provide an acceptable health based risk for the land disposal of certain wastes taking into consideration environmental transport. The extract is then analyzed to determine the concentration of the contaminant.

TCLP in Land Ban requirements and toxicity characteristic identification of hazardous waste.

The TCLP was first used in the Land Disposal Restrictions (Land Ban) rules to determine the level to which a waste had to be treated in order to reduce its leachability to an acceptable level for land disposal. Subsequently, its use has been expanded to be used to identify a hazardous waste. Regulatory levels have been set for constituents above which a waste is considered a hazardous waste (TCLP characteristic). Leachate concentrations are determined using the TCLP extraction are compared to these levels.

Some wastes are both TCLP characteristic and subject to land disposal restrictions both of which are determined by using the TCLP. In such cases, it is found that the TCLP characteristic value to identify a waste as hazardous is the same as the Land Ban disposal restriction level. For example, the TCLP concentration of lead in a waste required to identify it as a TCLP characteristic waste is 5 mg/L and the Land Ban treatment level is also 5 mg/L.

A review of the RCRA regulations and the June 13, 1986, "Toxicity Characteristic Rule, Federal Register preamble, found that in the case of these dually listed wastes, no mention is made regarding dilution by the stabilizing agent as a means of meeting treatment standards.

Those wastes which were newly identified as being TCLP characteristic in September 1990 are exempt from Land Ban restrictions because they are "newly listed wastes."

Is TCLP an appropriate measure of the effectiveness of stabilization without the consideration of dilution?

The current regulatory position of the EPA RCRA permitting division, Washington, D.C., is that stabilization is a recognized (legal) form of treatment that only requires that the levels be met and as such the stabilization media cannot be considered dilution. That is because the way the regulations are set up, EPA has inadvertently recognized the dilution factor as part of treatment by stabilization. Rulemaking is being formulated to address this situation but proposed rules have not been published.

Results will be reported with and without dilution.

e) The work plan was written to reflect the known constituents in the waste. It is expected that the inorganic inhibitors, e.g., MgF_2 and inorganic or organic - phosphate compounds, will cause more problems that the organic contaminants. Due to the anticipated problems resulting from the inorganic inhibitors and the potential organic constituents, a wide range of cement and fly ash concentrations will be investigated in the Preliminary Phase. In Stage I, the proposed range of reagents in Table 4-3 will be investigated on archive samples. The experiments were designed such that trends could be identified and utilized in the subsequent experiments in this treatability study. When possible contour maps of UCS and MTCLP results versus reagent loadings will be created to aid in visualization of the trends. Based on the results of the tests, the ranges for each reagent may be adjusted prior to Stage II. In Stage II, contour maps will also be used. The contour maps will plot separately UCS, bulking factor, and MTCLP results versus reagent loadings.

The general procedure of this work plan is an iterative process where the results from matrices of experiments are used to determine the course of the next set experiments.

Action: The work plan will be revised.

Commenting Organization:U.S. EPA Commentor:
Pg. # Section # Paragraph # Sent./Line #
Original Comment #2

Comment: **The objectives of the treatability study are not stated up front in the work plan, and they conflict with the performance and screening criteria of the test design. As stated in section 1.0, page 10, line 13, the purpose of treatability studies performed during the remedy selection phase should be to gather data. The data will assist in screening remedial alternatives by assessing the ability of the treatment technology to meet the cleanup criteria (action levels) and assess costs. However, the performance criteria for stabilization testing described in the test objectives, section 3.0, page 2, line 13, [UCS greater than 500 psi and TCLP less than characteristic listing criteria] are not necessarily consistent with the study objectives. For example, for alternative 1B (Silos I and 2), successful stabilization to the TCLP criteria is relatively meaningless. Since action levels have not been established specifically for all the wastes in question, the performance objectives for the stabilization testing should be revised to conform to quantitative criteria that are related or consistent with the ground-water action levels and should take into consideration the variety of remedial alternatives being considered. For example, for alternative 1B, a ground-water model can be used to predict allowable constituent leachability to meet the ground-water action levels.**

Qualitative criteria should be considered as performance criteria, especially during the preliminary screening tests. For example, stabilization formulations can be screened by choosing those that demonstrate the highest reduction in constituent leachability on a percentage basis (when corrected for additive dilution). None of the formulations in the proposed stabilization matrix (Table 4-3) may be able to treat lead to the TCLP criteria without extremely high volume increases, which essentially would be treatment by dilution. Secondary screening criteria should include selection of formulations that result in the lowest volume increases and require the least amount of chemical additives. The UCS should be used as a secondary screening criteria because only some of the remedial alternatives require a treated waste with certain physical properties.

Finally, the work plan should clearly provide a framework for screening formulations based on both the primary and secondary criteria. For example, must a formulation meet all of the criteria in order to be included in the advance testing?

Response: The treatability work plan was organized in accordance with the suggested outline in EPA's "Guide for Conducting Treatability Studies Under CERCLA." Goals on which objectives are based will be added to Chapter 1.

We agree that the purpose of the treatability study is to gather data. We also believe the treatability study should, if possible, identify stabilization formulation that will be acceptable from the health risk point of view. TCLP is recognized as an acceptable method for determining if the health risk associated with exposure from the leachate of a stabilized, landfilled waste is acceptable. Since remedial action objectives (RAO) have not been finalized, we believe it is prudent to attempt to meet standards (TCLP), which

are based on acceptable groundwater concentrations. The UCS of 500 psi was chosen and included because of an NRC technical position on waste form for low-level radioactive waste. UCS of 500 psi will not be considered a criteria but will be considered a target. UCS and TCLP data are not the only performance data being collected. Leachate from the TCLP will also be analyzed for radionuclides. This data will be factored into a groundwater model. The results and the model will be used in the evaluation of the types of disposal (i.e., on site or off site). If on-site disposal is chosen, the engineered waste management facility will be designed to meet RAOs.

Also see response to General Comment 1e.

There are several chemical reactions and physical mechanisms taking place when cement/fly ash/sodium silicate reagents are used to fixated metals. Some of the chemical reactions are metal hydroxide, oxide, carbonate, and silicate formation. Encapsulation is an example of a physical mechanisms. Therefore, the waste is not being treated solely by dilution. (Conner, Jesse R., Chemical Fixation and Solidification of Hazardous Waste, Van Nostrand Reinhold (1990).

During these pre-ROD treatability studies, the most promising cement based formulations will meet at a minimum the following requirements, an unconfined compressive strength of approximately 500 psi, meet or exceed TCLP standards, and have a minimum volume increase after treatment. The third criteria will be a secondary requirement. For vitrification, the formulations should meet the TCLP leaching standards, form a durable glass and have minimum volume increase. In addition, the leaching data will also be inspected from a risk perspective to assist in the selection of the most promising formulations.

The best technology will be determined by comparison of multiple criteria during the detailed analysis. The detailed analysis of alternatives phase of the RI/FS follows the development and screening of alternatives and precedes the actual selection of a remedy in the ROD. During the detailed analysis, all remedial alternatives are evaluated based on nine/RI/FS evaluation criteria. These criteria re as follows:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost
- State acceptance
- Community acceptance.

The relationship between the evaluation criteria and the data that will be generated during treatability studies is shown in Table 1-5. For example the ability of a particular waste formulation or technology (cement stabilization versus vitrification) to provide protection of human health and the environment would be determined by evaluating factors such as;

concentration of contaminants in the leachate, the durability of the waste form, its compressive strength as it relates to disposal and handling, permeability, and intrinsic properties of the waste form (glass versus cement).

Compliance with ARARs would be determined by whether the treated material meets compressive strength requirements for disposal, whether these leachate exceeds established discharge standards and on factors relating to waste form. A full evaluation of the technology for compliance with ARARs will be performed in the feasibility study.

Treatability testing that relates to a technology's long-term effectiveness and permanence include its shear strength and durability for handling and disposal purposes, its solubility as measured by leachability, and the extent to which it transmits water based on permeability. The waste form itself (glass or cement) also influences long-term stability. A glass for instance would tend to be a more stable waste form provided the glass is of good quality.

The ability of a technology or formulation to reduce the toxicity, mobility, or volume will be measured by indicators such as; bulking factor for volume reduction, leachate analysis for toxicity and mobility, and permeability, and waste form for mobility reduction.

Short-term effectiveness is impacted primarily by bulking factor, which is an indicator of the volume of treated waste that must be handled and disposed of and by the specific technology chosen. The short-term impacts associated with implementing cement stabilization would be different from vitrification because they have significantly different requirements to construct, operate, and maintain during remediation.

The implementability of a particular technology is influenced by the volume of waste to be handled as measured by bulking factor and by the waste form itself (glass versus cement). As with implementability, cost is impacted by the technology selected and the volume of waste to be generated. Because cement stabilization and vitrification are radically different processes, each will require different equipment and facilities.

The final two evaluation criteria, state, and community acceptance are influenced by the results of all the data and by the other seven criteria.

Additional information on use of the evaluation criteria and treatability data in the feasibility study process can be found in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA 1988).

This work plan addresses technologies applicable to Alternatives 2A, 2B, 3, 4, 6, and 7. (See Section 3, page 2, lines 1 - 7). In all of these alternatives the waste is stabilized to support a bearing strength, which is measured by the UCS test, as well as leaching criteria. The treatability study is not relevant as far as Alternatives 1A and 1B are concerned since neither of these alternatives propose to treat the waste.

Action: The work plan will be revised as discussed in the response.

Commenting Organization:U.S. EPA Commentor:
Pg. # Section # Paragraph # Sent./Line #
Original Comment #3

Comment: **The test plan does not clearly identify the constituents of concern that will be used to measure the success of the testing at each phase of the treatability testing. For example, if during preliminary screening of stabilization formulations, a particular test mixture shows the best fixation for lead but the worst for thorium, what criteria will be used to screen the formulations for the next phase.**

Response: The contaminants of concern were listed in Tables 1-1 and 1-2.

Preliminary Phase - Stage 1 is a range finding set of experiments. The treated waste will need to achieve a UCS value at least 300 psi to be considered for Stage 2. At the discretion of the investigator, formulations which have UCS values much greater than 500 psi may be eliminated.

Before any formulation can be accepted for the Advanced Phase, it must pass through two tiers of decision making. The treated waste should achieve a UCS value of approximately 500 psi and, meet TCLP standards. The second tier of decision will be applied to those samples which pass the first tier. The professional judgment of the investigator will be used to determine a reasonable compromise between leaching and minimization of the bulking factor and reagent loadings. Formulations which provide this reasonable compromise will be considered for the Advanced Phase.

Action: Contaminants of concern will be clearly presented.

Commenting Organization:U.S. EPA Commentor:
Pg. # Section # Paragraph # Sent./Line #
Original Comment #4

Comment: **A description of the waste characteristics from all three silos should be presented in section 1.0 of the work plan. This description should be a short summary of the chemical and physical properties of the wastes in each silo.**

Response: The characteristics of the silo waste are discussed in the section "Operable Unit 4 Description." Section 6.0 also discusses the waste.

Action: No action required.

Commenting Organization:U.S. EPA Commentor:
Pg. # Section # Paragraph # Sent./Line #
Original Comment #5

Comment: **The work plan has many decision points in the test design defined by ambiguous terms such as "if necessary," "if warranted," "the most promising formulation," and so forth. The work plan should replace all such terms with concrete decision criteria if possible. When providing specific decision criteria is not possible, the test should explain the process by which a decision is to be made.**

Response: Agreed.

Action: Text will be revised to clarify the decision process.

ATTACHMENT A - SPECIFIC COMMENTS

Commenting Organization:U.S. EPA Commentor:
Pg. #6 Section #1.3.1 Paragraph # Sent./Line #12
Original Comment #1

Comment: **The purpose of treatment is not to render the waste materials noncharacteristic but to treat them so that the remedy will attain the action levels. Treatment to below the TCLP limits that define toxic characteristic wastes may or may not result in attainment of action levels, depending on which remedial alternative is considered. This statement should be deleted from the justification section and/or rewritten.**

Response: Agree the purpose of the treatment purpose needs clarification.

Action: Clarify statement of purpose.

Commenting Organization:U.S. EPA Commentor:
Pg. #6 Section #1.3.1 Paragraph # Sent./Line #14-18
Original Comment #2

Comment: **This paragraph appears to conflict with the statement made in section 2.1, page 1, lines 28 and 29. The paragraph cited or other appropriate text should clearly state that while in situ vitrification is not considered feasible, vitrification treatability studies are proposed to address the ex situ alternatives.**

Response: Agreed.

Action: Text was revised to state that ex situ vitrification of the silo material is feasible.

Commenting Organization:U.S. EPA Commentor:
Pg. #11 Section #1.3.4 Paragraph # Sent./Line #23 & 24
Original Comment #3

Comment: **Provide a brief justification for selection of the additives proposed in the stabilization. For example, Type II Portland cement is designed to be used in the presence of moderate sulfate levels. The test plan should describe how the selection of additives relates to the expected characteristics of the wastes and constituents of concern.**

Response: Materials that were processed to produce the silo wastes included pitchblende and ore concentrates. Pitchblendes contain varying amounts of sulfate. Ore concentrations are produced by processing ore with acid. Frequently the acid used to process the ore is sulfuric acid. Pitchblende and ore concentrations could result in moderate quantities of sulfate in the raffinate.

Portland cement is added to solidify the waste, to add silicates to react with the metals, and to maintain the treated waste in an alkaline form to decrease the leachability of the metals of concern. When the cement is used in conjunction with fly ash, it acts to increase the strength of the treated waste. The fly ash also may decrease the effect of inhibitors, e.g., sulfates and oils, on the cement setting and strength formation reactions. Sodium silicate is added to react with the metals and lower their solubilities. The soluble silicates additive may also increase the treated waste bearing strength, decrease the bulking factor, and lower the effect of inhibitors, e.g., sulfate, for a given cement/fly ash additive loading. Attapulgite and clinoptilolite are added to absorb and adsorb metals, in particular cesium, in order to decrease the leachability of the treated waste. Further justification, based on a literature study, for the use of cement/fly ash for this treatability study is given in Appendix F. The work plan was customized to the limited availability of sample from each silo. It was considered prudent to follow the conservative path that sulfate may be a problem. If during the sample characterization, it is determined that sulfate is not present, then in the remedy design phase portland Type I cement may be tested.

Action: No action required.

Commenting Organization:U.S. EPA Commentor:
Pg. # Section # Paragraph # Sent./Line #
Original Comment #4

Comment: **Page 12, Figure 1-2: The figure does not make clear whether the solvent extraction procedure is a single-step process or multiple step process to render the remaining solid residue a nonhazardous waste. A single step process with any chemical may fail to meet TCLP and radioactive substances criteria for the treated residues. This point should be clarified. Similarly, the supernatant (liquid) from the precipitation step is shown as discharging into the wastewater collection system. The supernatant should meet the industrial wastewater pretreatment standards before it is discharged to the publicly owned treatment works (POTW). The treatability study should include a treatment step for the supernatant resulting from precipitation. TCLP and radioactive substances criteria for the stabilized waste and for the solid waste treated by solvent extraction should be listed in a table of potential contaminants of concern. The acronyms MTCLP and PCT should be defined, and the criteria for MTCLP and PCT should be included.**

Response: Figure 1-4 (now Figure 1-3) is a general overview of the process. Further information on each process step is given in Sections 3 and 4.

The work plan was customized to the limited availability of sample from each silo. This limitation, restrains the depth of experimentation with the samples. The treatability study will determine the proof of principle of the leaching process. In the remedy design phase, the details of the process will be investigated. If the matrix of experiments indicates that multiple extractions are needed, this will be noted in the report. Also, if sample

availability is not a limitation and at the discretion of the investigator, a few experiments with multiple extractions may be investigated.

The supernatant from the leaching process and any liquid from the precipitation process will not be sent to a POTW, they will instead go to site wide water treatment system.

Sentence 7: A list of substances of concern is given in Table 3-1. The TCLP criteria has been given in the Federal Register. The final radioactive substance criteria will be determined by an analysis by risk assessment. See also responses to general comments 1(e), 2, and 3.

Sentence 8: Acronyms for MTCLP and PCT will be added to acronyms list. A definition of the terms will be added to the text after Figure 1-3 is introduced. Procedures for PCT and MTCLP are included in Appendix C.

Action: Revisions have been made as discussed in the response.

Commenting Organization:U.S. EPA Commentor:
Pg. #13 Section #1.3.5 Paragraph # Sent./Line #1-11
Original Comment #5

Comment: Identify the various acids proposed for metals extraction testing and provide a brief justification for the selection of each.

Response: Hydrochloric and nitric acid were selected as a result of their use in the uranium mining industry and since most metal chloride and nitrate salts are soluble. Nitric acid has the additional benefit of being able to oxidize UO2 to a more soluble hexavalent uranium complex. Acetic acid was selected due to its mild complexing ability which may accentuate the metal solubilities.

Action: Above sentence will be added to the text.

Commenting Organization:U.S. EPA Commentor:
Pg. # 13 Section #1.3.5 Paragraph # Sent./Line #1-11
Original Comment #6

Comment: Clarify whether the preliminary or remedy screening study will include all the steps shown in Figure 1-4 or if they will include only the metals extraction step with various chemicals. The text should clearly indicate the various steps to be used separately in the preliminary screening and in the advanced screening treatability studies. Whether or not additional studies such as "leaching kinetics . . ." will be conducted in the preliminary screening should also be specified.

The text states that the most effective stabilization reagents used in the preliminary screening for stabilization of untreated silo material will be used to stabilize the precipitated material. Because the precipitated material will vary in composition due to the presence of organic compounds compared to untreated silo materials, a preliminary screening test should be conducted to select the effective stabilization reagents and best formulation for the advanced treatability studies. The procedures to be used for vitrification of the liquid from the solvent extraction step are not provided. Another viable option for volume reduction and treatment of liquid from solvent extraction is evaporation followed by stabilization of concentrated material from the evaporator. This process option should also be considered during the preliminary screening study.

Response: Paragraph 1:

A general flow diagram describing the phases and stages of the overall project has been added in Section 1.3. Tables have also been added describing the main experiments for each of the phases and stages.

Paragraph 2:

Sentences 1 and 2: The sentence "The most ...(Figure 1-4)" needs to be revised to "The most effective stabilization reagents determined from the screening described in Section 1.3.4 will be used as a guide in determining the formulations to investigate. Up to 10 formulations will be examined with the precipitated material."

From the available data, there should not be significant quantities of organic compounds in the waste. The work plan was written to remove the metals. If large quantities of organic compounds are present, the viability of the leaching alternative will have to reevaluate.

Sentence 3: The leachate will be vitrified by first removing the liquid by evaporation followed by heating dried waste combined with glass former/modifiers at 1250°C. The glass former/modifiers tested in this study are alumino-silicates (soil and fly ash) and sodium hydroxide.

Sentence 4: We agree that this could be a viable option; however, material quantity limitations will not permit this test.

Action: Revisions will be made as discussed in the response.

Commenting Organization:U.S. EPA Commentor:
Pg. #1&2 Section #2.1 Paragraph # Sent./Line #
Original Comment #7

Comment: **Alternatives 3 through 5 are not described. If these alternatives have been previously eliminated, provide a brief explanation of the rationale for their elimination.**

Response: Originally, the alternatives for OU4 were 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. Alternatives 0, 1, and 2 considered both the K-65 silos (Silo 1 and 2) and the metal oxide silos (Silos 3 and 4); Alternatives 3, 4, and 5 considered only the metal oxide silos; and Alternatives 6, 7, 8, a;nd 9 considered only the K-65 silos. It was decided in the DOE report "Initial Screening of Alternatives for Operable Unit 4, Task 12 Report, October 1990," to divide the alternatives to completely separate the silos. Alternatives 0, 1, and 2 were broken into parts, A (Silos 1 and 2) and B (Silo 3). The resulting alternatives for Silos 1 and 2 are 0A, 1A, 2A, 6, 7, 8, and 9 and for Silo 3: 0B, 1B, 2B, 3, 4, and 5. Since Silo 4 was never used, it was not included in the Silo 3 alternatives. All alternatives for Silos 1, 2, and 3 are discussed in Sections 2.1 and 2.2.

Action: None required.

Commenting Organization:U.S. EPA Commentor:
Pg. #2 Section #2.1 Paragraph # Sent./Line #16
Original Comment #8

Comment: **The references Mound Laboratories (1951) and Battelle (1981) are not listed in the Work Plan References section.**

Response: These references have been added.

Action: Text has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. # 1 Section #3.0 Paragraph # Sent./Line #10-30
Original Comment #9

Comment: **The specific objectives of the laboratory treatability testing program should be expanded to clearly state if they pertain to both the preliminary and advanced screening programs. If they do, the objectives should be given separately for preliminary screening and advanced screening.**

The text on the fifth bullet is not applicable for laboratory treatability testing program during preliminary screening. The preliminary screening test does not provide cost and design data (EPA, 1989).

The following objectives should also be included:

- **Establish the validity of the selected stabilization technology**
- **Screen a large number of parameters and identify those that will be critical for later bench-scale studies.**

Response: Sentence 1-2: The objectives are the same for both Preliminary and Advanced Phases. The QA/QC is the only difference.

Sentences 3-4: It is not the primary purpose of the Preliminary Phase "to provide preliminary cost and design data for the RI/FS." Yet analysis of the results from the wide range of conditions encountered during the Preliminary Phase will provide information that can be used to help predict the preliminary cost and design criteria.

Sentence 5: Agreed, will add the two lines:

- Establish the proof of process and applicability of the selected stabilization technology
- Screen a large number of parameters and identify those that will be critical for later bench-scale studies

Action: Text will be revised.

Commenting Organization: U.S. EPA Commentor:
Pg. #1 Section #3.1 Paragraph # Sent./Line #16-17
Original Comment #10

Comment: Rewrite this test objective to more accurately reflect the type of leaching results desired in the treatability testing as described in general comment 2 above.

Response: The test objective was rewritten as follows: to develop a database of stabilization reagents and corresponding hazardous and radioactive materials leachability for stabilized waste forms.

Action: Text has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. # 1 Section #3.1 Paragraph # Sent./Line #18-20
Original Comment #11

Comment: **Provide justification for selection of 500 psi as an appropriate physical property performance criteria. What type of field conditions would necessitate the treated material to withstand 500 psi?**

Response: A compressive strength of 500 psi is recommended by the NRC as a practical strength value that is representative of the quality of cementitious material that should be used in the waste form to provide assurance that it will maintain integrity and thus possess the long-term structural capability required by Part 61.

Action: Justification for selection of 500 psi was added in Appendix F.

Commenting Organization:U.S. EPA Commentor:
Pg. #1 Section #3.1 Paragraph # Sent./Line #27-29
Original Comment #12

Comment: **Subsection 3.1, page 1, lines 27-29: As described in the general comments section above, pH measurement of the formulated waste mixture should be added to the process parameters.**

Response: The pH of the leachate solution will be measured.

Action: Text has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #1 Section #3.1 Paragraph # Sent./Line #27-29
Original Comment #13

Comment: **The potential evolution of gases and vapors during stabilization should be identified as a phenomena to be observed and recorded during testing. Such occurrences can affect remedy selection, influence the testing protocol in future studies, and require specific address in the remedy design.**

Response: The evaluation of gases will be noted.

Action: Text has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #2 Section #3.1 Paragraph # Sent./Line #31
Original Comment #14

Comment: **Subsection 3.1, page 2, line 31 and Section 3.0 general: Explanation should be provided as to how the measurement of the temperature rise after stabilization treatment will be accomplished in a controlled manner to be of value in this phase of treatability testing. Temperature rise could theoretically be calculated and will be strongly affected in practice and in testing by the rate of chemical addition, by the adequacy of mixing, by sample size, by the ambient conditions in the laboratory or field, by physical occurrences such as wind, air conditioning, temperature of the containment vessel, and by factors such as thermometer placement in the mixture. What is the justification for selection of the 10 minute reaction time? Is this based on the proposed sample size and a predicted peak of heat release? The work plan does not adequately address these potential influences on the measurement, and therefore, such measurements will be of non quantitative value.**

Response: The measured temperature rise is a qualitative test. It is conducted as a screening test to alert of potential problems and hazards during scale-up. Further investigations of the actual temperature rise may be made during the remedy design phase when larger equipment, which has a design similar to the full scale equipment, will be used. The data from the temperature rise measurement will be DQO analytical Level I.

Action: Text revised in Section 3.2.1.

Commenting Organization:U.S. EPA Commentor:
Pg. # Section # Paragraph # Sent./Line #
Original Comment #15

Comment: **Table 3-2, page 4: The procedures for pocket penetrometer compressive strength, shear strength, 5-day static leach, permeability, waste-form temperature, and full TCLP tests, including sample volume and sample preparation, should be included in this work plan. In addition, the rationale (or a reference) for using the 5-day static leach test should be provided.**

Response: Test procedures have been incorporated into Appendix C of the Work Plan.

The 5-Day Static Leach Test uses a monolith and demineralized water. These conditions are more representative of what would be expected for waste placed in a disposal facility.

The procedure for the 5-Day Static Leach Test is given in Appendix C.

Action: Procedure was added to Appendix C.

Commenting Organization:U.S. EPA Commentor:
Pg. #6 Section #3.2.2 Paragraph # Sent./Line #
Original Comment #16

Comment: **The general design of the advanced testing, phase is confused by the statements made on lines 14 through 16. These statements describing the advanced screening are not clear but seem to state that the formulations which are successful on strata samples will be rerun to confirm the first trial results. The statement implies that the criteria for success will be low reagent usage and volume increase. The measurement of formulation success of strata is inadequate, because it considers physical properties only. Furthermore, the next sentence is ambiguous in its purpose and intent to provide further study direction. What is considered "adequate waste form" and what types of "additional formulations" will be attempted?**

Response: The sentence in lines 14 through 16 was incorrect. "Additional" formulations will be conducted if there is adequate sample available at the end of the study. See also original specific comment #6, and general comments 1(e), 2, and 3.

Action: Section 3.2.2 has been rewritten.

Commenting Organization:U.S. EPA Commentor:
Pg. #7 Section #3.3 Paragraph # Sent./Line #22, 23, 28, and 29
Original Comment #17

Comment: **The performance criteria for the extraction treatability testing should be reassessed with respect to general comment 2 above.**

Response: Agreed.

Action: Objective has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #7 Section #3.3 Paragraph # Sent./Line #24 & 25
Original Comment #18

Comment: **The work plan should clarify whether the proposed performance goals are total concentrations or leachable concentrations and should provide a justification for these levels.**

Response: The work plan will be revised to indicate that these are total concentrations. These limits were obtained from DOE Order 5400.5 for all four radionuclides. 40 CFR 192 also specifies these limits for Ra-226 and Ra-228.

Action: This information has been provided in tabular form elsewhere in Section 3.0.

Commenting Organization:U.S. EPA Commentor:
Pg. #7 Section #3.3 Paragraph # Sent./Line #31
Original Comment #19

Comment: **Provide justification for selection of 500 psi UCS as a performance criteria.**

Response: See response to Comment No. 11.

Action: See action for Comment No. 11.

Commenting Organization:U.S. EPA Commentor:
Pg. #8 Section #3.3 Paragraph # Sent./Line #7-9
Original Comment #20

Comment: **Reference specific comments 12, 13, and 14 above.**

Response: Text has been revised.

Action: Text has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #8 Section #3.3 Paragraph # Sent./Line #10
Original Comment #21

Comment: **Consideration should be given to evaluating a temperature matrix during vitrification studies.**

Response: Conducting a temperature matrix experiment for the vitrification is beyond the scope of this work plan. Temperature matrix experiments may be considered during the remedy design phase.

Action: No action.

Commenting Organization:U.S. EPA Commentor:
Pg. # Section #3.4 Paragraph # Sent./Line #
Original Comment #22

Comment: **Subsection 3.4 general: The data quality objectives (DQO) for the metal extraction/precipitation aspect of this phase of treatability testing appear weak with respect to evaluation of all the parameters that can potentially affect extraction**

effectiveness. This section does not address important process parameters such as pH, leaching time, temperature, and waste-to-leach solution ratios. The DQOs for this testing should be more comprehensive.

Response: Parameters such as leaching time and waste-to-leach matrices are desired data and will be added to the list in Section 3.3. Temperature and pH will be added to Table 3-7.

Action: Text has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #1 Section #4.0 Paragraph # Sent./Line #4
Original Comment #23

Comment: Provide a justification for the selection of the 3/8-inch screen. The DQOs should be revised to include a record of the maximum particle size treated.

Response: The 3/8-inch mesh screen size was selected due to the use of 3/8 inch screens in the TCLP test.

The data-required sections will be changed to include a record of the maximum particle size treated, if the material was crushed/ground before use, and the weight/percentage of material sieved out from the raw waste before treatment. The text has been revised in Sections 4.1.5 and 4.2.7.

- The maximum particle size treated, weight and percentage of material sieved out from the raw waste before treatment.
- General description of the waste form before and after reagents are mixed, this includes a description of any grinding of the sample to meet particle size requirements for UCS.

Action: Text has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #2 Section #4.12.2 Paragraph # Sent./Line #
Original Comment #24

Comment: This section should be rewritten to describe the procedures to be followed in performing the ethylenediaminetetraacetic acid (EDTA) extractions.

Response: The procedure for EDTA extractions will be similar to that for the acid extractions.

Action: Text has been revised and included in Appendix C.

Commenting Organization:U.S. EPA Commentor:
Pg. #2 Section #4.1.2.3 Paragraph # Sent./Line #17
Original Comment #25

Comment: **The test plan should clearly identify the precipitation reagents that will be used.**

Response: The precipitation reagents to investigated are sodium or potassium solutions of hydroxide, sulfide, sulfate, carbonate, and phosphate. Also calcium hydroxide, magnesium hydroxide, alum, ferric sulfate, and aqueous sodium silicate will be investigated. Refer to 4.2.5.1.1.

Action: Text has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #3 Section #4.2 Paragraph # Sent./Line #6-9
Original Comment #26

Comment: **Additional physical characterization, such as viscosity measurements, should be considered.**

TCLP analysis on the raw waste composites should be added to the chemical characterization. The text should provide a justification for the selection of the chemical parameters in Table 4-2.

Specific analytical procedures should also be referenced in Table 4-2.

Sample analysis of the stabilization additives, especially Portland cement and fly ash, should be performed as part of the treatability studies. Both additives contain some quantity of heavy metal constituents. Alternatively, a reagent mix blank samples can be prepared by using pure quartz sand in place of the waste materials. The sand should also be tested to confirm that it is free of any contamination.

Response: Paragraph 1:
The data in the Certificate of Analysis is the 1989 sampling effort.

Viscosity measurements are applicable to the remedy design phase. A list of all chemical analyses and geophysical tests during sample characterization is given in Section 6.0. The methods used to conduct these tests are also provided.

Paragraph 2:
Sentence 1:
The list of physical properties and chemicals in Table 4-2 was selected since they may affect the cement reactions or affect the glass making reactions of vitrifications. This table has been incorporated into tables in Section 6.0.

Paragraph 4:
A metals TCLP analysis of a blank consisting of cement/fly ash/sodium silicate reagents with sand will be conducted.

Action: None required.

Commenting Organization:U.S. EPA Commentor:
Pg. # Section #4.3 Paragraph # Sent./Line #
Original Comment #27

Comment: Figure 4-1: The stabilization treatability flowsheet indicates that Stage I preliminary screening will be based strictly on UCS testing. This test approach should be revised in accordance with general comment 1C above.

Response: Modified TCLP analyses are being added to the Stabilization Preliminary Phase - Stage I program.

Action: Text has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #10 Section #4.3.2 Paragraph # Sent./Line #27-31
Original Comment #28

Comment: The text should justify the selection of the bentonite-silo material mixture ratios.

Response: Ideally, various concentrations of bentonite would be tested. It is very unlikely that the layer of bentonite will be mixed in with the 20 plus feet of silo wastes before processing. Most of the bentonite would be expected to be removed with the top half of the silo waste. The 20/80 and 10/90 weight percentages were chosen arbitrarily to identify any potential problems or effects that might be caused by the presence of the bentonite.

Action: None required.

Commenting Organization:U.S. EPA Commentor:
Pg. #13 Section #4.4.1.1 Paragraph # Sent./Line #6
Original Comment #29

Comment: Provide an explanation for performance of certain run numbers before others.

Response: Run number 8 should have been in the initial screening list. The following three sentences are added to the text.

In these initial screening tests, the effect of temperature is measured with the concentrated acids by testing them at ambient and 80°C. The effect of acid concentration is being measured by testing concentrated acid and dilute acid at elevated temperature. For each acid this entails three test points.

Action: Text has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #13 Section #4.4.1.1 Paragraph # Sent./Line #7 & 8
Original Comment #30

Comment: What criteria will be used to determine when and if hydrogen peroxide and ferric chloride are to be added?

Response: Hydrogen peroxide, chlorine bleach (NaOCl), and ferric chloride will be added if it is apparent that uranium is not extracting from the solid. Hydrogen peroxide and bleach are added to oxidize lower oxidation state compounds of uranium, e.g., U02, to the more soluble uranium (VI) species. Ferric chloride is a catalyst for this oxidation reaction.

Action: No action required.

Commenting Organization:U.S. EPA Commentor:
Pg. #13 Section #4.4.1.1 Paragraph # Sent./Line #8 & 9
Original Comment #31

Comment: How will a determination be made if additional experiments (other run numbers) are "warranted"?

Response: A matrix of experiments is being conducted to determine trends of solubilities. If it is apparent from the analytical results that a particular acid is not successfully leaching the metals, the acid will be eliminated from further testing. If the analytical results indicate that particular leachant(s) extracts more uranium and lead than another leachant, than it is considered promising. The promising leachant may be investigated further to better define the effect of acid concentrations and temperature on the solubilities.

Action: Text was revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #13 Section #4.4.1.3 Paragraph # Sent./Line #16-25
Original Comment #32

Comment: **The text in this section does not clearly indicate the purpose of stage 3 preliminary screening. Analytical procedures are detailed rather than presenting the objectives and steps to be used for stage 3 preliminary screening. The risk-based limits for uranium should be included in the work plan.**

Response: Section 4.4.1.3 is being renamed to Advanced Phase from Preliminary Phase - Stage 3.

The following was added to the text:

The objective of this Advanced Phase is to demonstrate on larger sample that the leached material is a nonhazardous material as defined by RCRA and that uranium, lead, thorium, and radium were successfully leached from the solid.

Action: Text has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. # Section # Paragraph # Sent./Line #
Original Comment #33

Comment: **Table 4-4, page 15: Provide the rationale for the selection of hydrochloric acid (HCl) and the weak acetic acid (HOAC) for the extraction procedure. The residues in the silos include untreated uranium ore and other impurities from treating uranium-rich ore with nitric acid. With the use of HCl and HOAC, additional impurities such as chlorides and acetates will be increased in the leachate. The presence of these compounds will make the subsequent treatment steps more complex.**

The actual volume in milliliters (ml) of a particular normality of an acid and the weight in grams (gm) of the sample should be used in the table, rather than presenting the strength of an acid and dose (weight acid/weight sample) for experimental runs.

EDTA is a good chelating agent which will form complexes with certain heavy metals. Precipitation of metal complexes is difficult and may require additional treatment steps to remove the metal complexes from the leachate. A separate flow sheet should be included for EDTA extraction. The formation of metal complexes with EDTA should be taken into consideration.

Response: Paragraph 1:
Hydrochloric and nitric acid were selected as a result of their use in the uranium mining industry and since most metal chloride and nitrate salts are soluble. Nitric acid has the additional benefit of being able to oxidize UO2 to a more soluble hexavalent uranium

complex. Acetic acid was selected due to its mild complexing ability which may accentuate the metal solubilities.

We agree that the use of HCl or HOAC may cause the subsequent treatment steps to be more complex. During the detailed analysis of the RI/FS, these complexities will be weighted against the benefits of the use of the two acids.

Until the treatability study is conducted it is not known which, if any, acid will effectively extract the RCRA metals and the radioactive components.

Paragraph 2:
Normality will be given in the table. The use of ratios in dose instead of using volume to weight allows for a more flexible and efficient laboratory operation.

Paragraph 3:
EDTA may cause problems with metal precipitations. Several tests have been added to the work plan. These procedures have been used to precipitate metals from EDTA-metal solutions.

Action: Text was revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #17 Section #4.4.2 Paragraph # Sent./Line #1-9
Original Comment #34

Comment: **The text in this section is confusing. Except for sodium hydroxide (NaOH), the purpose of adding precipitation reagents and the types of precipitation reagents are not provided. This section should clearly explain step-by-step procedures for the vitrification process, the type of reagent, the amount of reagent in volume (mL) or in weight (gm), the final product, the side-stream waste products, and their treatment.**

Response: Text will be rewritten.

Action: Text will be revised.

Commenting Organization:U.S. EPA Commentor:
Pg. # Section # Paragraph # Sent./Line #
Original Comment #35

Comment: **Figure 4-4, page 18: The steps shown in this figure should be explained in Subsection 4.4.2. The text should also include whether the vitrification reagents will be added in dry or wet form. The text in the box "Mix Reagent with Leachate" should be changed to "Mix Reagents with Concentrated Leachate." The side-stream condensate**

from the evaporation step should be shown on the flow sheet with treatment and disposal options after analysis of condensate.

Response: See Specific Comment 34. The figure will be modified. The condensate is not being analyzed.

Action: Figure has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #17 Section #4.4.3.2 Paragraph # Sent./Line #21
Original Comment #36

Comment: The text should define the term "promising."

Response: The most promising reagent formulations will be determined by use of professional judgement. The experimenter will note the appearance of turbidity and precipitation in the solution. Correlations between changes in pH and on-set of turbidity and precipitation and correlations of pH and with volume or weight of titrant added will also be noted. The experimenter will also note the rate of setting and which reagents lower the uranium and the lead the most.

The general procedure of this work plan is an iterative process where the results from matrixes of experiments are used to determine the course of the next set experiments.

Action: Text revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #17 Section #4.4.4 Paragraph # Sent./Line #27 & 28
Original Comment #37

Comment: The application of stabilization formulations from the stabilization testing is not justified. The precipitated metal solids will likely have very different physical and chemical properties than that of the sample matrix from silo; therefore, a separate study should be conducted to develop stabilization formulations for the precipitated materials.

Response: Replace sentence on lines 27 and 28 with: The most effective stabilization reagents determined from the screening described in Section 4.3 will be used as a guide in determining the formulations to investigate. Up to 10 formulations will be examined with the precipitated material.

Action: Text has been revised as above.

Commenting Organization:U.S. EPA Commentor:
Pg. #22 Section #4.4.5.1 Paragraph # Sent./Line #5 & 14
Original Comment #38

Comment: **The text should define how it will be determined if the polymer settling and filter aid tests are necessary.**

Response: Agreed.

Action: Text has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #22 Section #4.4.6 Paragraph # Sent./Line #
Original Comment #39

Comment: **Subsection 4.4.6, page 22, lines 20-26: A factorial experimental design should be used to obtain the optimal conditions for leaching time and temperature. The Cochran and Cox (1957) plan should be used to determine the number of experimental runs.**

Response: This set of experiments will use the most promising formulation from Section 4.4.1.3. Initial range finding experiments will be conducted to determine the maximum time the samples will be extracted in the later statistical experiments. The samples will be extracted at 80°C for seven and 24 hours. If the concentration of uranium and lead in the leachate are similar for the two experiments, the seven hour extraction times will be used as the maximum extraction time in the statistical study. Otherwise, the maximum time will be 24 hours. The range finding experimental matrix is in Table 4-8A.

The proposed statistical matrix is in Tables 4-8B. Experiment numbers 1 through 5, in Table 4-8B, are constructed in a 2 x 2 factorial experimental design matrix with a center point. The minimum temperature and time of extraction are 25°C and 1 hour. The maximum temperature and time of extraction may be increased as a results of the range finding experiments.

Ten to twenty gram composite samples with 20 percent bentonite will be used in these experiments. The uranium and lead concentration in each leachate will be analyzed. A mathematical model will be derived from these experiments. An experiment at the optimum conditions predicted from the mathematical model will be completed.

Action:

Commenting Organization:U.S. EPA Commentor:
Pg. # Section # Paragraph # Sent./Line #
Original Comment #40

Comment: **Section 6.0, general: Sampling and analysis methods for all proposed testing should be specifically provided in Section 6.0. This section should address all sampling and analytical methods for raw waste characterization, treated sample analysis, and additive characterization.**

Response: See response to Comment No. 15.

Action: See action to Comment No. 15.

Commenting Organization:U.S. EPA Commentor:
Pg. # Section # Paragraph # Sent./Line #
Original Comment #41

Comment: **Section 8.0, general: The exact quantities of raw waste, liquid, and dry additives should be recorded. Interpretation of leachability test results should evaluate the sample leachability before and after treatment. Interpretation of the test results should also evaluate the treated sample results corrected for dilution, in order to separate the dilution effects of stabilization treatment from chemical fixation.**

Response: Section 8.0 has been revised to include the requested information.

Action: See response.

Commenting Organization:U.S. EPA Commentor:
Pg. # Section # Paragraph # Sent./Line #
Original Comment #42

Comment: **Section 13, general: Briefly describe the management and staffing responsibilities of individuals involved in the treatability testing project.**

Response: Replace existing Section 13.0 (now Section 14.0) text with the following: An organizational chart for the management of Operable Unit 4 treatability study is provided in Figure 14-1. The principal parties include: DOE Fernald, WEMCO, ASI/IT, TDL, and Parsons.

Personnel involved in the management of the entire RI/FS include: Jack Craig, DOE RI/FS Project Director; John Wood, ASI/IT's Project Director for the RI/FS consultant; and ASI/IT's John Razor, who serves as Deputy Project Director and is responsible for the technical content within all of the RI/FS consultant's documents.

Additional personnel involved in the management of RI/FS treatability programs for all operable units include Briand Wu, ASI/IT's Technical Integration Manager, who is responsible for the RI, NEPA, and Treatability. Also, Sam Wolinsky serves as Treatability Coordinator for all operable unit treatability studies performed by the RI/FS consultant.

Those personnel specifically involved in Operable Unit 4 include: Randi Allen, the DOE Operable Unit manager; Dennis Nixon, WEMCO's (the integration contractor) Operable Unit manager; and Steve Hammitt, Operable Unit manager for Parsons, the remedy design contractor. Susan Rhyne of ASI/IT serves as the RI/FS consultant acting as Operable Unit manager and as the focal point for supervision of the laboratory performing the treatability study.

The IT Technology Development Laboratory personnel will perform the actual treatability testing. Those personnel include Jack Hall, Laboratory Director, and Ed Alperin, Laboratory Manager, who is responsible for all of the treatability testing programs within the treatability laboratory. Darrell Drouhard, Project Manager/Engineer, coordinates all treatability laboratory work between the laboratories and the site. Ernie Stine, Operations Supervisor, is responsible for the technical aspects of the treatability programs at the laboratory; Ken Sadler and Ed Morren perform most of the experiments; Patti Carswell is responsible for all QA activities and reports directly to the Laboratory Director.

Action: Incorporate the above text into Section 13.0.

GENERAL COMMENTS

Commenting Organization:U.S. EPA Commentor:
Pg. # Section # Paragraph # Sent./Line #
Original Comment #1

Comment: **The scope of the treatment study is only with hazardous materials. However, the major contaminants are uranium, thorium, and decay products. The study omits consideration for stabilization of radiological components, particularly radon. The study should add investigation of radionuclides/radon or else justify emitting it. The study could also be suitably modified to include leachability and stability investigations of radionuclides including radon. Long term stabilization of radioactive contaminants, <u>particularly radon</u> will be essential to validation of a particular treatment technology. Therefore, the study in its current form cannot be used to make a definitive selection of treatment technology which would be best for comprehensive treatment of the residues preparatory to disposal.**

Response: The constituents of concern were listed in Tables 1-1 and 1-2. Radon and polonium-210 will be added to the list presented in those tables. Gaseous radon emissions from the treated material final form will be measured. While the leachability of dissolved radon from the treated materials are of academic interest, the short half-lives of the isotopes of radon limit its transport in groundwater systems to a few feet from its source. Beyond this point, radon will be in equilibrium with its radium precursors in the surrounding soil and water. Thus, DOE feels that efforts should be directed at determining the leachability of radon's parent nuclide (radium) instead.

Action: Radon and Po-210 will be added to the constituents of concern.

Test procedures for measuring radon emissions from the treated material will be included in Appendix C.

SPECIFIC COMMENTS

Commenting Organization:U.S. EPA Commentor:
Pg. # Section #1.0 Paragraph # Sent./Line #
Original Comment #1

Comment: **Section 1.0, Table 1-1, page 4**

a. The FMPC Action Level for multiple radionuclides shown in Table 1.1 must follow a sum rule, i.e. the sum of the ratios of concentrations to maximum contamination levels must be less than unity.

b. In the footnote denoted as "c" The proposed limits are 20 μg/L for total uranium, instead of the 20 μg/L for total uranium, listed in the footnote.

Response: a. The table heading is misleading. The purpose of a treatability study is to obtain quantitative data on the performance of key components of the proposed alternatives. This data will be used later in the FS process to evaluate each alternative design in toto. Table 1-1 will provide information which focuses that effort rather than supply a list of simple pass-fail criteria. This information will include TBCs, ARARs, PRGs, background concentrations, and contract detection limits. In this context, the basis of using a "sum of fractions rule" is not clear. This is especially true when one considers that EPA did not direct its use when it established regulatory limits for toxic constituents in March of 1990 (Preamble to amendments to 40 CFR 261 and 271, FR 55(61):11845-6 and Table IV-3. See also III-C-3 "Apportionment of Health Limits" on page 11815 of the same preamble.

b. Table 1-1 is incorrect.

Action: The information in Table 1-1 will be moved to the performance objectives section of the treatability study. Supporting text will be revised to clarify the tables purpose and include the additional parameters listed in the response.

Commenting Organization:U.S. EPA Commentor:
Pg. #6 Section #1.3 Paragraph #1.3.1 Sent./Line #
Original Comment #2

Comment: The treatment to render the material nonleachable and not hazardous must also take in to account the emission of radon. The treatment method must not allow significant emission of radon in order to be considered a viable method for the final treatment of the residues.

Response: Agree with comment.

Action: Methodology to evaluate gaseous radon emissions from the final waste form will be added to the treatability study work plan.

Commenting Organization:U.S. EPA Commentor:
Pg. # Section # Paragraph # Sent./Line #
Original Comment #3

Comment: The Performance objectives in this section need to address the stabilization of all radioactive constituents, especially radon.

Response: Agree with comment.

Action: Radionuclides will be specifically mentioned in the performance objective section.

Commenting Organization:U.S. EPA Commentor:
Pg. #7 Section #3.3 Paragraph # Sent./Line #
Original Comment #4

Comment: **Current interpretation of 40 CFR 192 by the Office of Radiation Programs is that for situations where both Ra-226 and Ra-228 are present, the combined concentration should be less than 5 pci/g. This will also impact situations where both thoriums are present.**

Response: Agree with comment.

Action: Text will be deleted. The information will be included in Table 3-2.

Commenting Organization:U.S. EPA Commentor:
Pg. #8 Section #3.4 Paragraph # Sent./Line #
Original Comment #5

Comment:
a. Paragraph 4 should consider alpha heating from precipitate concentration.
b. Table 3-3 - Modified TCLP and PCT entries reference relative leachabilities of radionuclides. Specific isotopes should be referenced. Radon-220 and Radon 222 should be specifically addressed.

Response:
a. DOE has considered alpha heating, but does not believe heating from radioactive decay of constituents in silo waste or it concentrate will be significant.

b. While the leachability of dissolved radon from the waste forms are of academic interest, the short half-lives of the isotopes of radon limit its transport in groundwater systems to a few feet from its source. Beyond this point, radon will be in equilibrium with its radium precursors in the surrounding soil and water. Thus, DOE feels that efforts should be directed at determining the leachability of radon's parent nuclide (radium) instead.

Action: No action required at this time.

Commenting Organization:U.S. EPA Commentor:
Pg. #6 Section #4.0 Paragraph # Sent./Line #
Original Comment #6

Comment: **Table 4-3: In the stabilization Matrices, the Potential Range of water needed in grams for run number 1 needs to be clarified. Should the range be 6.5 - 9, .9 - 6.5, or is 9 - 6.5 correct? The matrix should be consistent throughout in the manner that the values are presented.**

Response: The range should be 9-65.

Action: The table (now Table 4-1) has been revised to show the correct numbers.

Commenting Organization:U.S. EPA Commentor:
Pg. #19 Section #4.0 Paragraph # Sent./Line #
Original Comment #7

Comment: Table 4-6: In the footnote "a", the work "mixture" needs to be replaced with the word "mixture".

Response: Agreed.

Action: The table was revised to correct the typographical error.

Commenting Organization:U.S. EPA Commentor:
Pg. #2 Section #4.1.2.1 Paragraph # Sent./Line #
Original Comment #8

Comment: A more accurate analysis for uranium would be through alpha spectroscopy. The method described may not be accurate enough to characterize the leachability of uranium.

Response: In preliminary stages 1 and 2, quantitative results are not required. The spot tests are used as a quick screening method. The radiological analysis of the residual or extracted soils specified in 4.4.1.3 provide the best evidence as to which of the various extractants is most effective.

Action: None required.

Commenting Organization:U.S. EPA Commentor:
Pg. #2 Section #4.1.2.2 Paragraph # Sent./Line #
Original Comment #9

Comment:

a. Need to specify how the Feigl Test is modified and to specify the effect of this modification on accuracy.

b. The reference to Appendix E is incorrect.

Response: The modification to the Feigl Test is written in the work plan procedure. The effect on the absolute accuracy is not important because relative gross changes are being monitored with this method.

Action: No action required.

Commenting Organization:U.S. EPA Commentor:
Pg. #3 Section #4.3.1 Paragraph # Sent./Line #
Original Comment #10

Comment: Sulfur cement has been recommended by the staff at the Nevada Operations Office as a good cement for radon retention. It does not appear to be considered here.

Response: Per our discussions with Nevada Site Office they have not used sulfur cement. We have found no information on the radon retention properties of sulfur cement.

Action: None required.

Commenting Organization:U.S. EPA Commentor:
Pg. #10 Section #4.3.2 Paragraph #2nd Sent./Line #
Original Comment #11

Comment: Need to justify the 20/80 and 10/90 weight percentages since only one foot of bentonite is to be added to approximately 20 feet of residue.

Response: Ideally, various concentrations of bentonite would be tested. It is very unlikely that the layer of bentonite will be mixed in with the 20 plus feet of silo wastes before processing. Most of the bentonite would be expected to be removed with the top half of the silo waste. The 20/80 and 10/90 weight percentages were chosen arbitrarily to identify any potential problems or effects that might be caused by the presence of the bentonite.

Action: None required.

Commenting Organization:U.S. EPA Commentor:
Pg. #24 Section #4.4.8 Paragraph # Sent./Line #
Original Comment #12

Comment: In the fourth bullet under data to be recorded during the leachant screening, the work "lend" needs to be replaced with "lead". In the third bullet under data to be recorded during the precipitation screening the word "is" needs to be replaced with the word "in".

Response: Agreed.

Action: The text was revised to correct the typographical errors.

Commenting Organization:U.S. EPA Commentor:
Pg. #4 Section #8.4 Paragraph # Sent./Line #
Original Comment #13

Comment: **In the example of calculations of precision, the variable values do not correspond. In the equation the variable used is RFP, while in the key for the formula the variable used in RPD. This needs to be clarified.**

Response: Agreed.

Action: The formula was revised to read RPD.

Commenting Organization:U.S. EPA Commentor:
Pg. #2 Section #12.0 Paragraph # Sent./Line #
Original Comment #14

Comment: **In the sentence the word "communicated" is inappropriate in form and needs to be replaced with "communicate".**

Response: Agreed.

Action: The text was revised to correct the typographical error.

Commenting Organization:U.S. EPA Commentor:
Pg. #A-1-2 Section #1.0 Paragraph # Sent./Line #
Original Comment #15

Comment: **Part VIIa. needs to be clarified as to the number of samples to be used. It needs to be more specifically stated whether there will be 3 samples, 1 each at a pH of 9, 10, and 11, or if one sample is progressively changed in pH from 9 to 10 to 11 in the process.**

Response: The actual number and method will be based on observations made during the experiment.

Action: No action required.

Commenting Organization:U.S. EPA Commentor:
Pg. #A-6-1 Section #6.2 Paragraph # Sent./Line #
Original Comment #16

Comment: **a. Urine bioassay for thorium is not appropriate due to insolubility of thorium compounds. Uranium needs to be included due to chemical toxicity.**

b. 3rd paragraph, "gross alpha activity" is inappropriately used for specifying an activity concentration.

Response: a. This will be revised to delete thorium from the urine sample. If a significant uptake of radioactivity is suspected, fecal samples will be analyzed for th-230. Uranium will be included in the post-work 24-hour urine analysis.

b. The third paragraph will be revised to delete the sentence that correlates gross alpha activity to an activity concentration.

Action: Text has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. #A-10-1 Section #10.0 Paragraph # Sent./Line #
Original Comment #17

Comment: **In the last two paragraphs the term "client" needs to be clarified as to whom is being referenced.**

Response: The word client has been replaced with DOE.

Action: The text has been revised.

Commenting Organization:U.S. EPA Commentor:
Pg. # 4 Section #5.8.1 & 5.8.2 Paragraph # Sent./Line #
Original Comment #18

Comment: **Appendix B: The values for "B" and "C" are unclear as stated. The value for "B" is the volume of water added to the sludge. The value "C" is the volume of water added to the treated sludge.**

Response: "B" is the amount of water added to the raw untreated waste. "C" is the amount of water added to the container that contains reagents and waste.

Action: No action required.