U-003-305.5

DISAPPROVAL OF TREATABILITY STUDY WORK PLAN FOR OU #1

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[redacted]

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

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SEP 06 1991

Mr. Jack R. Craig
United States Department of Energy
Feed Materials Production Center
P.O. Box 398705
Cincinnati, Ohio 45239-8705

REPLY TO ATTENTION OF:

RE: Disapproval of Treatability Study Work Plan for OU #1

Dear Mr. Craig:

The United States Environmental Protection Agency (U.S. EPA) has completed its review of the Treatability Study Work Plan for Operable Unit #1. u-003-303.5

U.S. EPA hereby disapproves the Work Plan. The deficiencies are enclosed.

Please contact me at (312/FTS) 886-0992 if you have any questions.

Sincerely,

James A. Saric
Remedial Project Manager

Enclosure

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action
response
to u-1953
(3277)

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General Comments:

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The scope of the treatment study appears to be primarily with hazardous materials. However, the major contaminants of Operable Unit 1 are uranium, thorium, and their associated decay products. The study appears to add consideration for stabilization of radiological components, but needs to give more detail and emphasis to this facet. Otherwise, the evaluation of the technology for compliance with ARARs, performed in the feasibility studies may have to be performed over again. The long term stabilization of radioactive contaminants will be essential to validation of a particular treatment technology. Treatability and feasibility studies that ignore or minimize stabilization of the radionuclides, particularly radon, cannot be assured to meet compliance with the ARARs and the remedial action objectives. 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.

Specific Comments:

1. Table 1-1 needs to include estimates of the uranium and thorium daughters for each pit. The data which is presented does not give a complete picture of the radiological characteristics and suggests this is "source material". The process information given earlier in Chapter 1, page 2, suggests this is by-product material.

2. Section 1.0, page 7, second paragraph
All waste pits are characterized by only the quantity of waste expressed as weight of uranium and thorium, which is misleading and disconnected from process information given previously on use of the yellowcake, pitchblende, etc. which references the presence of uranium and thorium decay products. The presence of uranium and thorium daughters in the waste is important to treatabilility and disposal and should be addressed in this study.

3. Section 1.0, page 13, first paragraph
The concentrations of Ra-226 in each pit should be included in the waste pit contents as per comment 2.

4. Table 1-2, page 9, and page 14, third paragraph
Other potential contaminants of concern in the surface and groundwater are Radium-228 and radon. Of particular concern is radium and radon since the new proposed drinking water standard includes radon, and revises radium MCLs.

5. Figure 1-2, page 16
One remedial action objective for air must be the prevention of a dose to the public due to airborne emissions from exceeding 10 mrem per year.

6. Section 3.0, page 1
The 5-Day Static Leach Test, PCT, and TCLP for radionuclides need to be explained in relation to the performance objectives of the study. The effect on data quality of the modification of the American National Standard Measurement of the Leachability of Solidified Low-Level Radioactive Waste by a Short-Term Procedure, American National Standards Institute, 1986 (ANSI/ANS-16.1-1986) leaching procedure needs to be addressed.

7. Section 4.1.4., page 6, second paragraph
The tests run for full TCLP and 5-Day Static Leach Test in Advanced Experiments - Stage II need to be more completely developed to show how they relate to remedial action objectives for radionuclides.

GENERAL COMMENTS

All applicable sections of the text should be revised to address the following general comments.

1. 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. Mot metals, particularly lead, exhibit amphotericity, which means they have high solubility at botgh 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 non-acidic 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 should address site-specific aspects of the alternatives proposed in the feasibility study. Consideration should be given to 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.

      Unconfined compressive strength (UCS) should be measured but since the measurement has a different relevance to the different alternatives, the use of UCS as a screening criteria should be reconsidered.

   c) The leachability analysis is proposed to be performed on treated waste mixtures only and is not proposed on the untreated samples. The efficiency and quantifiable effectiveness of a mixture to fix heavy metal constituents cannot be exactly determined without measuring TCLP (or other leaching procedure) before and after treatment. It should be noted that after treatment leaching results must be corrected for the dilution of additives.

2. The objectives of the treatability study (section 1.0, page 26, lines 10 through 12) do not clearly relate to the remedial action objectives or remedial alternative screening. A clear justification is not provided as to how the screening criteria (especially TCLP results) relate to the feasibility study screening. What is the justification for selecting the characteristic listing standards as the pass/fail standards for the stabilization formulas?

It is recommended that qualitative criteria be considered as performance criteria especially during the preliminary screening tests. The stabilization formulations should be screened by choosing those which demonstrate the highest reduction in constituent leachability on a percentage basis (when corrected for additive dilution). Secondary screening criteria should include selection of formulations which result in the lowest volume increases and/or require the least amount of chemical additives. The UCS should be used as a secondary screening criteria because it has a different relevance to each of the proposed remedial alternatives.

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?

3. The test plan does not clearly identify which constituents of concern will be used to measure the success of the the leachability tests. 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.

4. While the work plan provides a good summary of the site history and nature and extent of contamination, a table summarizing the range of constituent concentrations and known physical properties should be added.

5. 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. Where it is not possible to provide specific decision criteria, the test should explain the process by which a decision is to be made.

6. The work plan does justify or explain the selection of potential stabilizing additives. How do each of the additives relate to the known chemical makeup of the wastes? For example, the wastes from operable unit (OU) 1 contain organic constituents which interfere with bonding in cement-based technologies and also contain halides such as fluoride which can retard the setting of stabilized mixtures.

7. The work plan should reference the origin of the samples to be used in the treatability studies in the forward sections of work plan. Currently, explanation of the sample origins first appears in section 6.0 although the "composite samples" are referenced frequently throughout sections 1.0 to 5.0.

8. The work plan does not recognize that fly ash materials contain heavy metals and possibly trace amounts of organic materials. The work plan should include analysis to quantify the metals in the fly ash additives and the data analysis should address their presence.

SPECIFIC COMMENTS

1. Section 1.2.3, page 14, lines 17-19: In this sentence, a reference is made to the DOE-Derived Concentrations Guide (DCG) limit of 500 and 600 picoCuries per liter (pCi/L) for U-234 and U-238, respectively. The DOE DCG may not be the correct maximum concentration limit (MCL). These levels should corrected to the federal and state guidelines for radionuclide MCLs.

2. Section 1.2.3, page 27, lines 27 and 28: One selection criteria for the vitrification formula screening is durability. If durability is to be a criteria, the work plan should include an objective measurement to quantify durability.

3. Section 3.2, pages 6 and 7, Table 3-3: As described in the general comments section above, pH measurement of the formulated waste mixture should be added to the stabilization test objectives.

Waste mixture viscosity should be considered for measurement as a process parameter.

4. Section 3.1, page 1, lines 27-29: The potential evolution of gases and vapors during stabilization should be identified as a phenomena to be observed and recorded during testing. Such occurences can affect remedy selection, influence the testing protocol in future studies, and require specific address in the remedy design.

5. Section 4.1.6, page 6, line 22 and section 4.2.5, page 11, line 2: A justification should be provided for the use and selection of a 3/8-inch screen in the test procedures. How will this be representative of remedial field methods?

6. Section 4.1.7, page 7, line 16: 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 the ambient conditions in the laboratory or field, by physical occurences such as wind, air conditioning, temperature of the containment vessel, and be such factors such as 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.

7. Section 4.2, page 76, line 26: The work plan should provide justification for the selection of 1250 degrees centrigrade as the vitrification temperature. The work plan should also consider the testing of several different temperatures or provide an explanation as to why a temperature matrix is not being considered.

8. Section 4.2.1, page 10, Table 4-2: According to this table, the mass increases potentially required to affect vitrification is 50 to 70 times the weight of the waste. If reduction in volume is considered a criteria for selection of a remedial alternative, the feasibility and applicability of vitrification to remediate OU1 wastes should be discussed in an appropriate section of the work plan. Reevaluation of vitrification should be considered.

9. Section 6.0 general: The sampling and analysis methods for all of the proposed testing should be specifically provided within section 6.0. This section should address all sampling and analytical methods for raw waste characterization, treated sample analysis, and additive characterization..

   A summary of the sampling and analysis plan (SAP) for collection of the test samples should be provided.

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

11. Section 13 general: The responsibilities of individuals in the management and staffing of the treatability testing project should be briefly described.