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AUDITABLE SAFETY RECORD FOR DEWATERING EXCAVATION, EVALUATION PROGRAM

12/22/94

C:CRU1:94-0071
FERMCO DOE-FN
2
LETTER

Fernald Environmental

FERMCO
Restoration Management Corporation P.O. Box 398704 Cincinnati, Ohio 45239-8704 (513) 738-6200

December 22, 1994

U. S. Department of Energy
Fernald Environmental Management Project
Letter No. C:CRU1:94-0071

Mr. David A. Lojek
Department of Energy
Fernald Area Office
P. O. Box 538705
Cincinnati, Ohio 45253-8705

Dear Mr. Lojek:

CONTRACT DE-AC24-92OH21972, AUDITABLE SAFETY RECORD FOR THE DEWATERING, EXCAVATION, EVALUATION PROGRAM

Attached for your review and comment is the Auditable Safety Record (ASR) 93-0024 Addendum 2 for the Dewatering, Excavation, Evaluation Program (DEEP) Phases 2, 3, and 4, an Operable Unit 1 activity. As we discussed earlier this year, DEEP is a nonfacility nuclear activity. DOE Order 5480.23 allows safety analysis reports for such activities to be required only on a case-by-case basis. The attached document is FERMCO's safety assessment of DEEP.

There are no activities associated with this project which could produce enough energy to disperse material in the stockpiles in concentrations which would have an impact on off-site receptors. The only credible scenario which could disperse significant quantities of material is an extreme wind event. The ASR contains an evaluation of this scenario along with that for expected wind conditions. Appropriate air monitoring will be in place to measure airborne releases for protection of the workers, public, and the environment. A project-specific health and safety plan has been prepared and is available for your review.

FERMCO intends to begin DEEP Phase 2 on January 9, 1995. It is our plan to resolve any comments you may have on this ASR and then proceed with the project as described.

Fernald Environmental
FERMCO
Restoration Management Corporation

Mr. David A. Lojek
Letter No. C:CRU1:94-0071
Page 2

If there are any questions/and or concerns, please feel free to contact me at 738-9118 or Willy Benson, of my staff, at 738-6208.

Please indicate your concurrence with this plan by signing below.

Sincerely,

Robert Fellman

R. T. Fellman
CRU1 Project Director

Concurrence: Randy C. Janke for D.A. Lojek 1-5-95
D. A. Lojek, Date
DOE CRU1 Project Director

JCS 1/12/95

RTF:EB:gss
Attachments (3)

c: With Attachments

L. E. Parsons, DOE Contract Specialist
M. S. Davis, FERMCO
J. T. Hey, FERMCO
File Record Storage Copy 102.1

Without Attachments

W. M. Benson, FERMCO
E. M. Blakely, FERMCO
E. R. Schmidt, FERMCO

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Auditable Safety Record	File No.: 93-0024 Addendum 2
Dewatering Excavation Evaluation Program (DEEP) Phases 2, 3, and 4	Hazard Category: 3
	Issue Date: 12/21/94

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ernald Environmental

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n Management Corporation P.O. Box 398704 Cincinnati, Ohio 45239-8704 (513) 738-6200

December 22, 1994

U. S. Department of Energy
Fernald Environmental Management Project
Letter No. C:CRU1:94-0071

Mr. David A. Lojek
Department of Energy
Fernald Area Office
P. O. Box 538705
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Fernald Environmental
FERMCO
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Please indicate your concurrence with this plan by signing below.

Sincerely,

Robert Fellman

R. T. Fellman
CRU1 Project Director

Concurrence: Randy C. Janke for D.A. Lojek 1-5-9
D. A. Lojek, Date
DOE CRU1 Project Director

JCS 1/12/95

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January 6, 1995

U. S. Department of Energy
Fernald Environmental Management Project
Letter No. C:CRU1:95-0001

Mr. David A. Lojek
Department of Energy
Fernald Area Office
P. O. Box 538705
Cincinnati, Ohio 45253-8705

Dear Mr. Lojek:

CONTRACT DE-AC24-92OH21972, OPERATIONAL READINESS FOR DEWATERING, EXCAVATION, EVALUATION PROJECT, PHASES 2, 3, AND 4

The purpose of this letter is to document the decisions of Operable Unit 1 (OU1) to proceed with the Dewatering, Excavation, Evaluation Program (DEEP) Phases 2, 3, and 4 under a Readiness Assessment (RA) in accordance with FERMCO Operational Readiness Manual SM-0005.

DEEP is a Post Record of Decision Operable Unit 1 Treatability Study designed to evaluate waste dewatering and excavation techniques that will be implemented during remediation of the OU1 waste pits. Results of this evaluation will directly support OU1 Remedial Design.

The DEEP project consists of four phases: Geotechnical Testing, Wet Excavation, Dewatering, and Dry Excavation. In October 1994, Geotechnical Testing of soil borings and correlation of Standard Penetration Tests and Cone Pentrometer Tests (Phase 1) was completed. DEEP has now reached a point where field mobilization for the "Wet Excavation" phase (Phase 2) is in the planning stages. Phase 2 includes excavating a total of seven test areas and removing 15 cubic yards of waste from each of Waste Pits 1, 2, and 3 for future treatability investigations; the remaining waste will be returned to the pit of origin. Following the wet excavation phase, DEEP Phases 3 and 4 which consist, respectively, of dewatering and dry excavation will be performed.

Prior to initiating DEEP, FERMCO, in conjunction with DOE-FN, determined that DEEP was a "non-facility" as utilized in DOE Order 5480.23, Attachment I, Section 4.a.(3) which states:

> "Safety analyses are required for all DOE nuclear operations; however, the preparation and submission by contractors of a SAR for non-facility nuclear operations, such as environmental remediation programs or the transportation of nuclear materials, will be required only on a case-by-case basis. DOE may require SAR preparation and submittal for non-facility nuclear operations at its discretion, as this Order indicates in paragraph 8 'requirements.'"

The OU1 Staff submits that the DEEP project is expressly defined as a "non-facility" and is not constrained to perform the requirements of DOE Order 5480.31 "Startup and Restart of Nuclear Facilities." The OU1 Staff will pursue the following relevant safety activities for Phases 2, 3, and 4:

- Project Specific Plans, Project Specific Health and Safety Plans, Auditable Safety Records, DEEP Hazard Assessments, Readiness Assessments, Radiation Work Permits, and Radiation Worker training courses have been developed so that work can proceed safely under such conditions as will be encountered during DEEP field work.

- OU1 Staff will require the availability and use of surfactant, tarpaulin, or other engineering control mechanisms, contained in the DEEP Work Plan, to keep the stockpiles intact.

- There are no credible accident initators due to DEEP activities that could disperse this material in concentrations that would impact on-site or off-site populations. Material dispersion by an unlikely high wind event has been evaluated and found to be acceptable. The DEEP Work Plan identifies runoff and dispersion control measures to mitigate foreseeable problems.

- Stockpiles will remain open for a limited time and will be returned to the pit of origin when the excavation is closed. Only one excavation will be open at a time.

Fernald Environmental
FERMCO
Restoration Management Corporation

Unless directed otherwise by DOE-FN, OU1 Staff will proceed with Phases 2, 3, and 4 beginning January 19, 1995.

Sincerely,

Robert Fellman

Robert T. Fellman
CRU1 Project Director

Concurrence: Walter J. Quarles 1-11-95
~~David A. Lojek~~, Date
~~DOE CRU1 Project Director~~
Acting Assoc Director Safety/Assessment

RTF:WMB:JTH:gss
Attachment

c: L. E. Parsons, DOE Contract Specialist
W. M. Benson, FERMCO
E. M. Blakely, FERMCO
M. S. Davis, FERMCO
J. T. Hey, FERMCO
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Auditable Safety Record Dewatering Excavation Evaluation Program (DEEP) Phases 2, 3, and 4	File No.: 93-0024 Addendum 2 Hazard Category: 3 [1] Issue Date: 12/21/94

Prepared by: Elaine M Blakely Date: 12/21/94

E. M. Blakely, System Safety

Requested by: W. M. Benson Date: 12/22/94

W. M. Benson, CRU1 Project Manager

Concurrence: Michael S Davis Date: 12/22/94

M. S. Davis, Manager, CRU1 Health and Safety

Fred Krach Date: 12/21/94

F. G. Krach, Manager, System Safety

Ron Green Date: 12/22/94

R. J. Green, Nuclear Criticality Safety

[1] Meeting Notes "CRU1 Dewatering Excavation Evaluation Program (DEEP) held April 26, 1994; issued 5/06/94 documents Department of Energy (DOE) concurrence that although the inventory of material (i.e. the open pit, pit waste and soil cap stockpiles) exceeds Category 3 thresholds, the DEEP project may be considered a nonfacility nuclear operation. Per DOE 5480.23 safety analysis reports for nonfacility nuclear operations will be required on a case-by-case basis. For DEEP, a DOE approved safety analysis report has not been required by DOE/FN. A FERMCO approved safety analysis in the form of this Auditable Safety Record (ASR), is to be prepared.

Auditable Safety Record Dewatering Excavation Evaluation Program (DEEP) Phases 2, 3, and 4	File No.: 93-0024 Addendum 2 Hazard Category: 3 [2] Issue Date: 12/21/94

Concurrence:

_____ Date: 12/21/94

J. A. Craighead, CRU1 Health and Safety Field Operations Lead

_____ Date: 12/21/94

J. T. Hey, CRU 1 Field Operations Lead

Approvals:

_____ Date: 12/22/94

E. R. Schmidt, Manager, Safety Analysis

_____ Date: 12/22/94

R. T. Fellman, Manager, CRU1

[2] Meeting Notes "CRU1 Dewatering Excavation Evaluation Program (DEEP) held April 26, 1994; issued 5/06/94 documents Department of Energy (DOE) concurrence that although the inventory of material (i.e. the open pit, pit waste and soil cap stockpiles) exceeds Category 3 thresholds, the DEEP project may be considered a nonfacility nuclear operation. Per DOE 5480.23 safety analysis reports for nonfacility nuclear operations will be required on a case-by-case basis. For DEEP, a DOE approved safety analysis report has not been required by DOE/FN. A FERMCO approved safety analysis in the form of this Auditable Safety Record (ASR), is to be prepared.

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Auditable Safety Record Dewatering Excavation Evaluation Program (DEEP) Geotechnical Testing	File No.: 93-0024 Addendum 2 Hazard Category: 3 [3] Issue Date: 12/07/94

E.0 Executive Summary

Potential hazards associated with DEEP Phases 2, 3, and 4 have been identified and evaluated using a three step graded approach.

There are no activities associated with this project which would produce enough energy to disperse material in the stockpiles in concentrations which would have an impact on off-site receptors. The only credible accident scenario which could disperse significant quantities of material is an extreme wind event.

Among the conservatism used in the hazard and accident analyses are that the material in the pits and stockpiles is homogeneous, dry, dispersible, and of a respirable particle size. With these assumptions the radionuclide of concern in all three pits is thorium-230 and it is this isotope alone which keeps DEEP Phases 2, 3, and 4 as a hazard category 3 activity.

The chemical constituents of concern are:

- Pit 1 - uranium
- Pit 2 - arsenic
- Pit 3 - arsenic and vanadium

All contractors shall be held responsible for adhering to assumptions and commitments set forth in this safety assessment. Any changes to the scope of work are to be reviewed by FERMCO Safety Analysis to determine whether the proposed change is significant to the safety envelope established in this document (ASR 93-0024 latest addendum).

1.0 Site Characteristics

Operable Unit 1 is one of five FEMP operable units (Attachment 1 and 2). It consists of Waste Pits 1 through 6, the Clearwell, the Burn Pit,

[3] Meeting Notes "CRU1 Dewatering Excavation Evaluation Program (DEEP) held April 26, 1994; issued 5/06/94 documents Department of Energy (DOE) concurrence that although the inventory of material (i.e. the open pit, pit waste and soil cap stockpiles) exceeds Category 3 thresholds, the DEEP project may be considered a nonfacility nuclear operation. Per DOE 5480.23 safety analysis reports for nonfacility nuclear operations will be required on a case-by-case basis. For DEEP, a DOE approved safety analysis report has not been required by DOE/FN. A FERMCO approved safety analysis in the form of this Auditable Safety Record (ASR), is to be prepared.

miscellaneous structures/facilities, and environmental media within the Operable Unit 1 boundary. Radioactive waste, consisting of radionuclides generated from uranium ore processing and various chemicals, are stored in Operable Unit 1.

2.0 Project Description

The Dewatering Excavation Evaluation Program (DEEP) was developed to:

- Provide data and observational information that will be used to optimize and refine plans for removing waste from the waste pits by using the safest, fastest, and most economical excavation techniques.

Data collected from this project will be evaluated for use in developing the RD/RA work plan for Operable Unit 1. Table 1, 2, and 3 identify the tests to be performed during the DEEP. Sections 2.2, 2.3. 2.4. and 2.5 of this ASR provide detailed information on each test.

The purpose of DEEP is to identify applicable excavation technique(s) to remove waste pit material and to determine how to optimize and refine these technique(s). Prior to excavation, further information from the following areas of investigation must be evaluated to support the excavation technique selected:

- Pre-dewatering condition of the waste pits of concern. For DEEP, the waste pits of concern include Waste Pits 1, 2, and 3.
- Homogeneity/Heterogeneity of the waste pits.
- Characteristics of the waste within the pits.
- Dewatering methods potentially applicable to the DEEP project.
- Changes in physical properties of the wastes observed during dewatering.
- Stability of the dewatered wastes following dewatering. Stability is related to the waste's ability to support excavation equipment, and the waste's ability to be safely and efficiently removed by conventional excavation methods.

Based upon the results of the field and laboratory investigations which the DEEP project addresses, more detailed information relative to the areas of investigation will allow DOE to determine the most suitable excavation technique(s) for removal of waste from the pits.

The listed dewatering and excavation techniques will be tested in the following order:

- Wet excavations, waste reslurrying and pump tests. Qualitative and

quantitative observations of the behavior of the waste under these conditions will be made.

- Dewatering, to include well comparison and pumping tests, will be performed in areas adjacent to the wet excavations to evaluate waste material consistency and homogeneity/heterogeneity.

- Dry excavations, to include dry trench excavation and ramp excavation, will be performed to determine the efficiency of the dewatering techniques, amenability of the waste to excavation and handling, and the ability of the waste to support heavy equipment.

2.1 Wet Excavation

Seven wet (not dewatered) trenches will be excavated: two each in Waste Pits 1 and 2, and three in Waste Pit 3. Wet trenches will be excavated where no dewatering wells are planned. This approach is being used to evaluate normal conditions for the waste or sludge. The proposed wet excavations will evaluate the effectiveness of conventional mechanical equipment, and will provide the basis to evaluate the effectiveness of dewatering a wet waste to a dry waste. Waste Pit 2 trenches will be excavated first, followed by either waste Pit 3 trenches, or Waste Pit 1 trenches. Individual trenches within each waste pit will be sequenced at the discretion of the Dewatering Excavation Evaluation Program (DEEP) project manager or designee. Each trench must be completely backfilled before excavation of another trench can begin.

The wet waste will be excavated with side walls as steep as possible. This will provide visual data on how steep the waste can be excavated. For example, if the waste side walls collapse, information on the natural angle of repose will be obtained. The trenches shall be excavated to a maximum depth of 15 feet with an affected top area of 30 by 30 feet. If the trenches are found to be too wet for excavation using conventional equipment, then slurrying the waste or conventional equipment with waste dewatering may be concluded to be the more efficient excavation technique. Samples will be taken from the waste stockpile and placed in steel boxes for treatability studies at a later date. Coatings and surfactants will be applied to the waste stockpiles to test each surfactant's ability to contain the waste and to prevent windborne emissions.

2.1.1 Stockpile Area

At each trench location, two lined pads will be used: one to store soil cap material while the other will be used to stockpile waste. The cap in Waste Pit 3 is relatively thick, ranging from 6 to 8 feet thick at proposed trench locations. The caps at Waste Pits 1 and 2 may be less than 2 feet thick; therefore, caution will be exercised in removing the cap material and not contaminating it with waste material. All stockpile pads will be graded such that drainage flows back into the trench.

Containment berms for the stock piles will be made with straw bales lined

up to form a barrier. The bales will be covered with 6-mil plastic sheeting.

2.1.2 Excavation

After lining the pad areas and constructing containment berms, the capping can be stripped. Stockpiles shall be covered when excavations are no longer in progress or dust control agents will be applied.

Maximum trench depths will be 15 feet. The backhoe will excavate to near-vertical slopes until failure of the trench walls occurs. An assumed slope of 2V to 1H is expected to maintain stability through the cap, and a 1-to-3 vertical to horizontal ratio (1V to 3H) is expected to maintain stability through the waste sludge. Determining actual angles of repose for the cap and waste sludge is one of the objectives of the excavation.

The wastes in Waste Pits 1 and 2 may support a slope of 1V to 3H. Waste Pit 3 waste is assumed to be very wet; the 1V to 3H slope is an estimate but may not be stable. If near-vertical slopes can be obtained, then the excavation will progress in that manner. If the walls collapse at near-vertical slopes, then the trench shall be regraded to a stable slope. An estimate of 312 cubic yards (cy) of waste may be retrieved from each trench. Due to the characteristics of the waste, i.e., wet waste, then the excavations will be shallower and less waste will be removed.

In excavating the trenches, an emphasis will be placed on visual observations of the waste behavior; thus, equipment operators will be given direction as to how fast and where to excavate. Field observations will include:

- Angle of repose of the waste
- Amount (depth) of water in the trench
- Waste strata (colors, texture, etc.)
- Approximate trench depth, as determined by the boom length
- Wall stability following contact with equipment
- Waste strength

Excavations will proceed at the discretion of the Field Operations Manager, with no wet excavation remaining open for greater than three days. Equipment used for certain phases of the excavation, i.e. cap removal or waste excavating, will be determined by the field operations lead.

2.1.3 Waste Material Archives

A 15 cubic yard (cy) sample shall be taken from each of the three waste

pits. Each sample shall be taken from the second trench excavated in each waste pit and placed in a 96-cubic-foot white metal box. Samples from different waste pits will be placed in different white metal boxes, there will be no mixing of material from different pits. After surveying to ensure no contamination exists above the FEMP Radiological Control Manual Criteria, the boxes shall be transferred to the Plant 1 storage pad, or to another suitable hard-surfaced storage pad at the FEMP, in keeping with the Amended Consent Decree with the State of Ohio.

2.1.4 Reclamation/Closure

Following trench excavation and gathering samples for material handling studies, the waste will be backfilled into the trench and compacted with the track-hoe bucket, if necessary. The cover material will be returned and again compacted to the greatest extent possible with the track-hoe bucket. Any remaining cover will then be added and further compacted by repeatedly driving the track-loader over the returned cover material. These compaction actions will return the soil permeability to a state that is equal to or less than that which previously existed. The sludge will need to be compacted with the backhoe bucket as it is placed in the trench. When the waste stockpile is backfilled down to the plastic liner, the liner will be disposed of in the trench. Next the cap material will be placed on the waste and compacted with the excavation equipment by driving on the disturbed areas. The disturbed areas will then be seeded and straw will be dispersed over the seeded areas. Caution must be used in backfilling the trench such that rubber-tired equipment does not create any slope failures.

2.1.5 Equipment Decontamination

When salvageable equipment is no longer needed for the DEEP project, it will be scraped with a shovel to remove excess sludge waste. Any gross contamination will be removed on site prior to full decontamination at the FEMP Decontamination Facility, where it will be authorized for free release off site. The FEMP will utilize a high-pressure steam and detergent mixture illustrated in FEMP SOP 55-C-101, "Operation of Steam Detergent Cleaner in the Decontamination and Decommissioning Building." Subsequent to decontamination, the salvageable equipment will be radiologically surveyed and authorized for free release off site.

2.1.6 Video Recording

All excavations will be video recorded for a permanent record of visual waste characteristics.

2.1.7 Residuals Management

2.1.7.1 Unused Field Samples

Excess field sample material will be returned to each excavation area in Waste Pits 1, 2, and 3 and used as backfill. Additional backfill will be

obtained from other areas within Operable Unit 1 that have been characterized under Removal Action 17: Improved Storage of Soil and Debris.

2.1.7.2 Excavation Waste

Approximately 45 cubic yards (15 cubic yards per pit for Waste Pits 1, 2, and 3) of the excavated waste will be used as feed material for the Waste Pit 6 Drying Study. The pit material to be dried will be placed in white metal boxes and placed on the best available hard-surfaced storage area in a manner that is protective of human health and the environment.

The remaining portion of the excavated waste will be returned to each excavated area in Waste Pits 1, 2, and 3.

2.1.7.3 Wastewater

Wastewater will be managed as described in Section 2.4.2.

2.1.7.4 Contact Waste and PPE

Contact waste is categorized as PPE, such as gloves, wipes, plastic, etc. generated during a sampling event that may be contaminated from contact with the sampled material. Contact waste generated during the DEEP will be collected in a plastic bag and sealed with tape. The bag will be labeled with the name and phone number of the project supervisor and the name of the person placing the bag in the dumpster. The bag will be placed in the CRU3 RI/FS-designated locked dumpster. No Material Evaluation Form will be generated. The trash in the dumpster will go to the trash baler, where it will be compacted and boxed for transport from the site as low-level radioactive waste. Contaminated PPE will be placed in a container and stored with the dried material awaiting the Waste Pit 6 Drying Study.

2.1.8 Equipment and Materials List

Equipment:
- Large backhoe and crane
- Front-end loader or tractor-loader
- Mobile lift platform
- Generator
- Submersible electric sump pump
- Lighting
- Electrical cable
- Video camera
- TV monitor

Supplies:
- 6-mil plastic sheeting for liner
- Light-weight plastic (tarp) for covering waste stockpile
- Timber ties and mats
- Orange plastic hazard fencing and fence posts
- Grass seed

- Straw bales
- Dust control agents and application equipment

2.2 Waste Reslurry and Pumping Test

The waste reslurrying and pumping test will be performed as part of the wet excavation testing. The test objectives are:

- To evaluate the practicality and cost of excavating the waste by slurry pumping.

- To obtain information needed for preliminary design of a waste pumping system. This preliminary design will allow a viability and cost comparison between waste excavation by mechanical methods and slurry excavation with mechanical excavation of residual debris.

Reslurrying was selected as a test because of the fine-grained nature of much of the waste in the waste pits and because of the potential for difficulty in dewatering the wastes. Most of the waste is fine material, perfect for reslurrying. (Heavy and large debris would be picked up by a backhoe or clam shell.) Previous studies of pit waste have shown that significant amounts of amorphous materials exist within the waste pits and that these amorphous materials may behave more like a liquid after water has been introduced. Thus, pit amorphous materials removal may be more efficiently performed by reslurrying. Additionally, it is likely that the presence of significant quantities of amorphous materials may hinder the effectiveness of conventional well dewatering.

The test will consist of lowering a slurry pump into an excavation in the waste pits, slurrying the waste, and pumping it to a holding tank. Moisture content, pulp density (geotechnical), and settling rates of the slurry will be measured to provide critical design information, i.e., to determine the amount of solids that can be pumped from the trenches and the thickeners required to separate out solids. This information will be collected by visual observation of the slurry/clear water interface and measuring the moisture content of samples taken from each vertical foot of the contents of the tank at specified time intervals. The waste and supernatant will be pumped back into the excavation after the test is complete. Three trenches shall be reslurried, one in each waste pit. Slurrying and pump tests will be performed on the second "wet" trench to be excavated in each waste pit.

The water to be used during reslurrying will be derived from existing water in the waste pits, which are located within the perched water table. Water run-in should be adequate to reslurry. Water would be added to the excavation only if insufficient run-in occurs; this water would be slurried immediately and there would be no standing water. When this occurs, only enough water would be added to support the reslurry and would be negligible relative to the amount of water already contained in the waste pits. The negligible amount of water to be added during reslurrying will be offset by the treatability information gained by performing an

experiment to determine the viability of the technique. Decant water from the slurry settling tank is pumped to a temporary holding tank, then ultimately treated through the FEMP water treatment system. Solids resulting from decant operations are to be directed back into the respective waste pit of origin.

The slurry pump assembly will be suspended (at a safe standoff distance) from a backhoe bucket or a crane boom and lowered into the waste pit trench. Water will be added to cover the pump inlet to allow the pump to prime itself. The slurry pump is then started and will operate from 10 to 50 gallons per minute (gpm). Water flow will be decreased gradually to achieve a balance with sustained slurry pumping of the wastes. The slurry pump will be raised or lowered, as needed, to achieve desired waste inflow and slurry concentration. Water may be added through jet rings or a water hose for priming and normal operation. The waste will be pumped through a rubber hose into a large translucent tank (minimum 3,000 gallons). The waste in the tank will also be sampled to measure the pulp density of the slurry immediately after pumping as well as after various settling times. The waste slurry will be sampled at the following intervals: 5, 10, 15, 30, 60, 240, and 1,440 minutes. This information will be used to design the thickening and filtration system. This information will also be collected from laboratory testing, but this field settling test will help to evaluate large-scale field effects, such as segregation of debris, as the waste is pumped.

The slurry pumping will be monitored and videotaped to record the waste/pump interaction. Samples will be taken at regular intervals to measure pulp density. These samples can be correlated to the videotaped pumping record. These samples will be analyzed at the laboratory for settling rates, particle size distribution, specific gravity of solids and moisture content.

The tank will be placed on a plastic liner on a unimat base near the trench. Hoses will be connected to the tank near the top. The hoses will have a sampling tee and valve to allow sample collection during pumping. The tank overflow hose will be directed to the excavation.

A top port and side valve ports will be installed in the tank for stratified sampling. After the tank has been filled with waste, strata samples will be taken at regular intervals depending on the settling rate of the slurry; the recommended intervals are stated above. These intervals may be changed by the Field Operations Manager after initial settling rates have been observed.

The contents of the tank will be pumped back to the excavation after settling is complete (or 24 hours). The tank top will have an opening 36 inches in diameter to insert the pump into the tank to reslurry and pump the material back into the pit. If possible, the waste will be agitated and drained by gravity back into the pit.

Water which separates from the waste in the trench will be pumped with a

sump pump to a holding tank for disposal. The trench can be backfilled as with the other wet excavations.

2.2.1 Residuals Management

Waste will be controlled to prevent release to the environment during this test. Waste will be pumped in a sealed line (preferably double walled) to prevent spills. The hose will be attached to the pump and the tank. The ground under the hose will be lined with plastic and graded to drain back into the trench (or double walled pipe/hose will be used.). The venting from the tank will be equipped with a mist eliminator and will be monitored to assure no unacceptable release to the air.

Waste pumped to the tank will be pumped back into the trench when the test is completed. Excess water will be pumped to a tank and treated along with the water from the dewatering wells. Residual sludge in the bottom of the test tank will be vacuumed out with the site's large vacuum truck. The tank will be rinsed out after the test. Rinse water will be sent to the AWWT and treated before release.

2.2.2 Test Equipment

- Agitator slurry pump (50 gpm) Toyo or equivalent, with jetting water nozzle assembly
- Temporary power supply for pump
- Sling to suspend pump from backhoe or crane
- Slurry hose from pump to tank
- Polypropylene or fiberglass tank (3000 gallons strong enough for specific gravity fluids 1.8) with drain, overflow, vent, 6 side ports, and 3 ft. manway in top (approximately 8 feet diameter 6-7 feet high)
- Wooden platform for tank (unimats)
- Water supply pump with pressure gauge
- Slurry overflow hose
- Plastic liner under tank > 10 mil thick
- Water hose with in-line flow meter
- Slurry hose from pump to tank (30 to 60 ft)
- Wooden platform for tank (unimats)
- Water hose with in-line flow meter
- Crane

2.3 Dewatering

Dewatering the waste in-situ may be economically advantageous over removing the water thermally and may make excavation of the pits easier and safer. To determine if this is in fact the case, the dewatering system must be defined. To determine if installing a dewatering system will improve excavation conditions, an area of the pits must be dewatered and excavated. The first two phases of the dewatering test respond to the first information gap. The third phase responds to the second information gap.

Dewatering tests will be performed in three phases to support design optimization for the final dewatering test systems. Phase 1, the Comparative Well Test, will be conducted in Waste Pit 1. A driven well point will be compared to a drilled cased well. Two pumping methods will also be compared. Phase 2 will attempt to confirm (or revise) well spacing distances that will be used in the final test of dewatering systems (Phase 3). Phase 2 will be conducted in Waste Pits 1 and 3. Phase 3 will involve dewatering an area in Waste Pit 1 and an area in Waste Pit 3 to facilitate excavation of a trench in each pit.

Phases 2 and 3 are designed according to the anticipated results of Phases 1 and 2, respectively. If the results are different from those anticipated, then the tests will be modified accordingly by the Lead Geologist.

Phase 1 - Comparative Well Test - The objectives of Phase 1 are:

- Determine if a driven well point will work in the fine-grained pit wastes
- Determine if there are any installation or development difficulties for the proposed drilled well design (drilled, cased, and sand packed)
- Determine if a surface well point pump will work adequately for a more shallow well and how it compares to a submersible pump
- Determine pumping characteristics for the wells and expected sustainable flows

Data from Phase 1 are expected to confirm (or prompt revisions to) the drilled well design in Phase 2 testing. Data gathered will include flow rate from the well in gallons per minute and total volume of water pumped (in gallons); well water levels in pumping wells and wells used for observation; well or well point discharge line pressure readings; and vacuum readings within the well or well point casing.

Phase 2 - Well Spacing Test - The objectives of Phase 2 well-spacing testing are to determine the effect of vacuum enhancement, E-O enhancement, and a combination of E-O and vacuum enhancement on the flow

rate and to determine if the proposed 20-feet well spacing for Phase 3 will be adequate for dewatering. For the spacing testing, nine wells will be installed in Waste Pit 1, and 16 wells will be installed in Waste Pit 3. Various well combinations will be pumped and observations made to determine the zone of influence of the final well spacing. This phase will collect and document the same type of data as gathered in Phase 1. In addition, total energy use for E-O testing in kilowatt-hours (kwh) and direct readouts of power, voltage, and amperage will be recorded.

Phase 3 - Full Installation Dewatering Test - The primary objective of Phase 3 is to dewater selected areas of Waste Pits 1 and 3, to facilitate trenching with minimal interference from groundwater. This phase will include installing the full complement of wells in Waste Pits 1 and 3, then proceeding with dewatering. The best well design and spacing, as determined in Phases 1 and 2, will be installed in Phase 3. These wells will be pumped for several weeks to dewater those areas of the waste pits such that dry or post-dewatered excavations can be performed in the waste pits.

This phase will collect the following performance data:

- Variations in the volumetric rate of water removal over time
- Changes in shear strength of the waste as dewatering progresses
- The magnitude and area of influence of sustainable vacuum for the downhole pump configuration versus the surface-based pump configuration, if two configurations are adopted
- Water table elevations over time during pumping
- Vacuum measurements over time, if vacuum techniques are adopted.

2.3.1 Surveying

Surveying will be performed to locate the borings, dewatering wells, and piezometers. Additionally, surveying of each waste pit's surface will be used to measure subsidence due to dewatering and excavation.

Subsidence at the surface of each waste pit to be dewatered will be measured in the following manner:

- A grid pattern will be established across each Waste Pit.
- Grid line intersections will be surveyed prior to dewatering and the elevations recorded.
- Following dewatering, the grid line intersections will be surveyed and the resulting elevations compared to the pre-dewatering elevations.

Waste permeability must not be reduced during well construction and installation. Well borehole advancement methods will be designed to minimize any potential for smearing borehole side walls. Installation of the well casing, screen, and sand pack must also be accomplished in a manner that does not reduce the waste permeability at the borehole face. The driven well point will be installed by hammering, pre-augering, or jetting.

Well development for each of the well types will be accomplished by bailing and surging. Resultant wastewater will be collected and sent to the existing Fernald Environmental Management Project (FEMP) wastewater treatment system before being discharged to the Great Miami River in accordance with National Pollutant Discharge Elimination System (NPDES) effluent limits set at manhole 175 (*4001). Development of these wells will be an iterative process, but completion will be terminated once pumped water reaches a "steady state" clarity.

2.3.2 Residuals Management

2.3.2.1. Wastewater

The total volume of wastewater to be generated by the project is difficult to quantify; however, current estimates call for approximately 105,000 gallons of water per day to be pumped during the initial three to four days of the project. After start-up operations are complete, the pumping rate is expected to decline to a relatively stable rate of 5,000 gallons per day. Two additional 20,000 gallon tanks will be installed within the Waste Pit area to supply surge capacity for wastewater produced during initial pumping operations. These tanks will also be used to provide storage capacity once the pumping rate stabilizes.

Wastewater will be pumped from the storage tanks as needed and transferred to the existing Plant 8 treatment system using a 5000 gallon mobile tank truck. Plant 8 has a treatment capacity of 30,000 gallons per day and utilizes lime precipitation, sedimentation, and filtration to remove uranium, heavy metals and fluoride from wastewaters. At Plant 8, the wastewater will be treated to remove uranium and other heavy metals through lime precipitation, sedimentation, and filtration. The quantity of water that can be pumped in any one day is limited by the combined storage and treatment capacity of 75,000 gallons per day. Treatment will be provided for all wastewaters generated by the project. Rather than providing additional storage for the excess water produced during initial dewatering, the dewatering activities will be phased so the maximum quantity of water produced in any one day does not exceed the maximum storage and treatment capacity of 75,000 gallons. Treated effluent from Plant 8 will be discharged to the uranium-contaminated side of the General Sump, where it will be combined with other wastewater and discharged to the Biodenitrification (BDN) Facility.

The BDN facility consists of the BDN Surge Lagoon (BSL), a High Nitrate

Storage Tank (HNT), four BDN Towers, followed by the BDN Effluent Treatment System (NPDES outfall *4605). At the BDN facility, removal of organic constituents will occur through aeration within the BDN Towers and through activated sludge processes at the BDN-Effluent Treatment System (BDN-ETS). After treatment at the BDN-ETS, the wastewater will be discharged through the NPDES-permitted outfall *4605 (BDN-ETS), with ultimate disposition occurring to the Great Miami River via outfall *4001 (MH-175).

2.3.3 Equipment

- Dewatering wells, piping, and appurtenances
- Mobile water holding tanks total capacity 40,000 gallons
- AC generator power supply system

2.4 Dry Excavation

Dry (post-dewatering) excavation activities include excavation of a dry trench in Waste Pit 1 and excavation of a ramp in Waste Pit 3. (The dryness of the waste will depend on the success of the dewatering.) The trench in Waste Pit 1 will be completed and backfilled before the ramp in Waste Pit 3 is started. The dry trench and ramp will be excavated to help characterize conditions necessary for planning the full-scale excavation.

The objective of these excavations is to provide data on:

- The degree of success of the waste dewatering program
- Whether tracked equipment can be driven directly on a ramp in Waste Pit 3
- The angle of repose for the dewatered waste
- Slope steepness comparisons between the wet (pre-dewatered) excavations and dry (post-dewatered) excavations

Coatings and surfactants will be applied to the waste stockpiles to test each surfactant's ability to contain the waste by avoiding windborne emissions.

2.4.1 Waste Pit 1 Dry Trench Excavation

The dry trench excavation in Waste Pit 1 must be excavated so as not to damage the dewatering wells that will continue operation around the perimeter of the excavation.

2.4.1.1 Deactivate Inner Wells

The dry trench excavations are centrally located in the midst of an array of dewatering wells. Prior to starting the trench excavation, the inner wells shall be deactivated. The remaining wells will keep the dewatered area free of inflow from the surrounding pit area. Following deactivation of the inner wells, the pumps with attached wiring, piping, and connections shall be removed and salvaged. Plastic well casings will be left in place and demolished as the excavation proceeds.

2.4.1.2 Stockpile Areas

Stockpile pads shall be sloped to drain back toward the excavation. One or two waste pads may be needed, depending on the slopes that can be obtained in the excavation. Excavated stockpile materials will include both cap and waste. Containment berms will be made with straw bales lined up to form a barrier. The bales will be covered with 6-mil plastic sheeting.

2.4.1.3 Excavation

After lining the pad areas and constructing containment berms, the capping can be removed. The thickness of the cap in Waste Pit 1 ranges from approximately 6 inches to 2 feet. Capping will be stripped down until there is a definite appearance of waste or sludge-like material. Excavation progress will be continually monitored to ensure that contaminated waste or sludge is not mixed with excavated capping. All stockpiled areas shall be covered with plastic sheeting or a dust control agent will be applied when excavations are not in progress.

In Waste Pit 1, the waste is deeper than 15 feet, so the excavation will not penetrate into the waste pit liners. For dry trenching at Waste Pit 1, an attempt should be made to excavate down to 15 feet deep while maintaining nearly vertical side walls. The initial attempt to excavate down to 15 feet in waste will depend upon the strength or stability of excavated waste as demonstrated while excavating. If the waste holds at steep slopes, a 14-foot by 28-foot trench shall be the maximum size of excavation. If the side walls immediately collapse, the remaining trench excavation would be carried to a depth of 10 feet or to a depth determined by the field operations managers. In this case, where the waste begins to slough, the trench walls will be laid to a slope that the waste can maintain. Since the wall slopes will be flatter in a sloughing condition of the waste, an area no greater than 30 feet by 30 feet will be disturbed.

2.4.1.4 Reclamation/Closure

Following trench excavation the waste will be backfilled into the trench. The sludge must be compacted with the backhoe bucket as it is placed in the trench. When the waste stockpile is backfilled down to the plastic liner, the liner will be disposed of in the trench. Next, the cap material will

be placed on the waste and compacted with the excavation equipment. The disturbed areas will then be seeded and straw will be dispersed over the seeded areas.

2.4.1.5 Equipment Decontamination

When salvageable equipment is no longer needed for the DEEP project, gross decontamination will be performed at the project site, and the equipment will then be transferred to the FEMP Decontamination Facility for further decontamination.

2.4.1.6 Waste Pit 1 Dry Trench Equipment

Equipment:

- Large backhoe
- Front-end loader or tractor-loader
- Mobile lift platform
- Generator
- Submersible electric sump pump
- Lighting
- Electrical cable
- Video camera
- TV monitor

Supplies:

- 6-mil plastic sheeting for liner
- Lightweight plastic (tarp) for covering waste stockpile
- Timber ties and mats
- Orange plastic hazard fencing and fence posts
- Grass seed
- Straw bales
- Dust control agents and application equipment

2.4.2 Waste Pit 3 Ramp Excavation

A "full-sized" ramp will be excavated into Waste Pit 3 sludge to determine

if tracked excavation equipment can be operated on sludge. The proposed ramp excavation is located in the southeast portion of Waste Pit 3, near the Clearwell.

The ramp itself is 20 feet wide and will be excavated at -12°. Cap thickness varies; it is thinnest in the southeast part of the excavation and thickens to the northwest. The planned excavation contains 750 cy, consisting of 550 cy of cap and 200 cy of sludge. An attempt will be made to extend the excavation 3 feet down into the sludge where a 30-foot diameter circular pit floor will be excavated. It is presumed that slopes in the overlying clay capping could be carried at 2V to 1H while slopes in the weaker sludge would stand at 1V to 2H. If conditions are favorable to driving tracked equipment on the waste, then the ramp will be excavated an additional 3 to 5 feet into the waste.

The initial excavation will terminate along the outside perimeter of the dewatering wells. Observations will be made to evaluate slope stability. The excavation will continue in a northwest direction through the perimeter dewatering wells for 50 feet. The plan is to visually observe the equipment's ability to excavate wet waste. The excavation must extend 50 feet such that the excavation is outside of the perimeter wells' radius of influence which is assumed to be 20 feet. The additional quantities for excavation extension beyond the dewatering wells is 520 cy cap and 335 cy waste sludge, for a total of 855 cy waste and cap material. The waste in the wet area of the ramp is assumed to be stable at a 1V to 3H slope. See

2.4.2.1 De-activate Inner Wells

The proposed ramp excavation is placed in the midst of 27 dewatering wells. The inner wells will be deactivated before beginning the excavation. Pumps and all attached wiring, piping, and connections shall be removed and salvaged. The remaining peripheral wells will continue operation, reducing water inflow to the excavation. After the initial excavation is complete, exterior perimeter wells will be deactivated. All plastic casings will be left in place and demolished as the excavation proceeds.

2.4.2.2 Stockpile Areas

At the ramp excavation, the stockpile pads shall be graded to drain to the excavation. Some grading may be needed to remove vegetation and to smooth the surface. Containment berms will be made with straw bales lined up to form a barrier.

2.4.2.3 Excavation

Capping will be trammed up the ramp and dumped at the stockpile area. The ramp is extended down as successive cuts into capping are made. The excavation will extend down 3 feet into waste, revealing its underfoot condition. Then, if waste conditions are favorable for tracked equipment, the ramp excavation will extend an additional 3 to 5 feet into the waste. Waste will be excavated using the tracked loader-excavator. The loader

will tram its load up the ramp and out of the excavation and over to a stockpile. A small "Bobcat" loader may be used to place the waste in the main stockpile.

2.4.2.4 Reclamation/Closure

Following the ramp excavation, the waste will be backfilled into the trench. The sludge must be compacted with the tractor loader as it is backfilled. Next, the cap material will be placed on the waste and compacted with the excavation equipment by driving on the disturbed areas. The disturbed areas will then be seeded and straw will be dispersed over the seeded areas.

2.4.2.5 Equipment Decontamination

When salvageable equipment is no longer needed for the DEEP project, gross decontamination will be performed at the project site, and the equipment will then be transferred to the FEMP Decontamination Facility for further decontamination.

2.4.3 Waste Pit 3 Ramp Excavation Equipment

Equipment:

- Tracked loader-excavator
- Rubber-tired front-end loader
- Large backhoe
- Generator
- Submersible electric sump pump
- Electrical cable
- Video camera
- TV monitor

Supplies:

- Lightweight plastic tarp for covering stockpiles
- Orange plastic hazard fencing and fence posts
- Grass seed
- Straw bales
- Dust control agents and application equipment

3.0 Hazard and Accident Analyses

3.1 Introduction

Potential hazards associated with DEEP Phases 2, 3, and 4 have been identified and evaluated using a three step graded approach [1] as outlined in Section 3.3.1. There are no activities associated with DEEP Phases 2, 3, and 4 which would produce enough energy to disperse material in the stockpiles in concentrations which would have an impact on off-site receptors. The only credible accident scenario which could disperse significant amounts of material are extreme wind conditions.

3.2 Requirements and References

- Preliminary Hazard Assessment (PHA), integrated, Dewatering Excavation Evaluation Program (DEEP) Phases 2, 3, and 4, issued 12/01/94
- ISCST2 computer model
- DOE Order 5400.5, "Radiation Protection of the Public and the Environment"
- DOE Order 5480.11, "Radiation Protection for Occupational Workers"
- EPA/600/6-88/005Cc, "Estimating Exposure to Dioxin-Like Compounds, Volume III: Site Specific Assessment Procedures", June 1994, REVIEW DRAFT
- DOE-STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports"
- 40 CFR 302.4, "Designation, Reportable Quantities, and Notification"
- NIOSH Pocked Guide to Chemical Hazards, June 1990
- NIOSH Listing of Revised IDLH (Immediately Dangerous to Life or Health Concentration) Values", 9/15/94
- "Sax's Dangerous Properties of Industrial Materials", Eighth Edition

3.3 Hazard Analysis

An integrated preliminary hazard assessment (PHA) has been prepared and will be issued separate from this auditable safety record (ASR). A summary of this PHA is provided in the following subsections.

3.3.1 Methodology

The integrated hazard assessment team for DEEP consisted of the

Environmental Safety and Health Department members matrixed to CRU1 activities plus representatives from CRU1 Engineering, Construction, and Project Support. Tasks and subtasks associated with DEEP Phases 2, 3, and 4 were determined using the "Operable Unit 1 Dewatering Excavation Evaluation Program (DEEP) Treatability Study Work Plan", August 1994.

Using the graded approach concept, potential hazards were identified and evaluated in three steps:

Step 1: Hazard Identification Worksheets were prepared first as a quick screening tool. The major tasks and associated subtasks were identified and then evaluated with respect to inventory of material, location of the task/subtask, personnel hazards, decontamination, and process residues.

Step 2: The integrated preliminary hazard assessment evaluated the potential hazards in greater detail than Step 1.

Step 3: Dispersion of the stockpiles was modeled to estimate what the concentration of chemical and radiological contaminants to on-site and off-site receptors from material removed from these stockpiles through wind erosion under meteorological conditions common to the southern Ohio area and an extreme wind event.

3.3.1.1 Hazard Identification

Hazard identification was performed in Step 1, refer to "Integrated Preliminary Hazard Assessment, Dewatering Excavation Evaluation Program (DEEP) Phases 2, 3, and 4", 12/01/94. Conclusions are as follows:

- The inventory of material in the stockpiles exceeds the hazard category 3 threshold for radionuclides.

  The CRU1 Remedial Investigation Report, August 31, 1994 provided the radiological constituent data for Waste Pits 1, 2, and 3 used to determine the inventory of pit wastes which could be stockpiled so that the tasks would remain below Hazard Category 3 thresholds. The steps used were:

  - Compare representative concentration of the individual radionuclides with the category 3 threshold limits listed in DOE-STD-1027-92. The thresholds were exceeded.

  - Determine the total radiological inventory and percentage of pit solids that is composed of radionuclides

Table 3.1. Hazard Category 3 Thresholds				
Location	% Radionuclides (based on total solids in the Pit)	Radionuclides Only, Grams	Total Solids, Grams	Volume, Yd^3
Waste Pit 1	5.26	2.85E+06	5.47E+07	50
Waste Pit 2	5.64	1.34E+06	2.38E+07	20
Waste Pit 3	0.88	3.76E+05	4.32E+07	45

Table 3.2. DEEP Phase 2, 3, and 4 Waste Material Stockpile Inventory				
Location	Category 3 Threshold, Yd^3	Wet Excavation, Yd^3	Dry Excavation, Yd^3	Ramp and Pad Excavation, Yd^3
Waste Pit 1	50	312	312	None
Waste Pit 2	20	312	None	None
Waste Pit 3	45	312	None	535
Archive Samples		15	None	None

Table 3.3. Radionuclides of Concern					
Radionuclide	DOE-STD-1027-92 Category 3 Threshold Limit, Ci	Material Stockpiles, Ci (Note: Shaded blocks indicate that the threshold is not exceeded.)			
		Pit 1	Pit 2	Pit 3	Pit 3 Ramp and Pad
Thorium-230	6.2E-01	1.82E+00	6.15E+00	3.25E+00	5.58E+00
Thorium-232	1.0E-01	1.64E-01	1.14E-01	1.13E-01	1.94E-01
Uranium-234	4.2E+00		6.08E+00		
Uranium-238	4.2E+00	5.4E+00	5.98E+00	4.86E+00	8.33E+00

Table 3.4. Radionuclide Content of Unfiltered Pit Leachate from Monitoring Wells in Pits 1, 2, and 3								
Radionuclides of Concern from Table 3.	Pit 1 Unfiltered Leachate			Pit 2 Unfiltered Leachate		Pit 3 Unfiltered Leachate		
	Well 1765	Well 1766	Well 1767	Well 1768	Well 1769	Well 1770	Well 1771	Well 1772
Thorium-230, pCi/l	97.2	403.0	21.7	4070.0	479.0	12200.0	904.0	854.0
Thorium-232, pCi/l	1.27	29.3	< 0.13	108.0	11.0	592.0	68.5	107.0
Uranium-234, pCi/l				1450.0	188.0			
Uranium-238, pCi/l	562.0	3990.0	580.0	1540.0	267.0	1350.0	922.0	2890.0
Total Uranium, µg/l	1780.0	12110.0	1280	4400.0	776.0	1970.0	948.0	6500.0

Table 3.5. Comparison of Radionuclide Content of Unfiltered Pit Leachate with Category 3 Thresholds				
Radionuclide	DOE-STD-1027-92 Category 3 Threshold Limit, Ci	Estimated Radionuclide Content in 40,000 Gallons of Water Removed from the Pits, Ci (Note: Only the radionuclides of concern listed in Table 3 were evaluated.)		
		Pit 1	Pit 2	Pit 3
Thorium-230	6.2E-01	6.10E-05	6.16E-04	1.85E-03
Thorium-232	1.0E-01	4.44E-06	1.64E-05	8.96E-05
Uranium-234	4.2E+00		2.20E-04	
Uranium-238	4.2E+00	6.04E-04	2.33E-04	4.04E-04

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- For each radionuclide, determine the ratio of that radionuclide to the category 3 threshold. Total these ratios, take the inverse (i.e. 1/totaled ratios), and multiply it by the total radionuclide inventory to determine the radiological inventory that will remain below category 3 thresholds.

- Back calculate to determine the mass of pit solids (radiological inventory + other solid materials in the pit).

To remain under a hazard category 3, the waste stockpile sizes are 50 yd^3, 20 yd^3, and 45 yd^3 for Pits 1, 2, and 3, respectively (Table 3.1). The DEEP work plan requires that larger stockpiles be created (Table 3.2).

The size of the excavation directly impacts the validity of the study results. CRU1 considered downsizing the excavations, but decided not to jeopardize their test results. Therefore, based on the inventory of contaminated material in the stockpiles, the DEEP wet excavations in Pits 1, 2, and 3; dry excavation in Pit 2; and ramp and pad excavation in Pit 3 are hazard category 3 activities.

- Personnel hazards would be considered standard for civil engineering/construction and remediation of commercial landfills. Many of the subtasks identified are common activities in the contamination areas at the FEMP.

The project hazard category is being driven by the inventory of material in the stockpiles. A more detailed evaluation of potential hazards is warranted. Therefore, Step 2 was initiated.

3.3.1.2 Hazard Evaluation

Step 2 evaluated the hazards identified in Step 1 in greater detail by:

- Further defining the potential hazards (e.g. exposure to radiological and chemical contaminants (Step 2) versus working in a contamination area (Step 1))

- Identifying causes for the potential hazards

- Identifying protection and mitigative systems

- Determining the consequences

- Estimating the frequency of occurrence based on the cause(s) identified

- Assigning a ranking number to the cause based on the consequences and frequency of occurrence

- Identifying action items and providing additional information

The results of Step 2 are summarized below. Refer to the "Integrated Preliminary Hazard Assessment, Dewatering Excavation Evaluation Program (DEEP) Phases 2, 3, and 4", Final Draft 11/17/94 for further detail.

- There are a variety of unknowns due to the treatability study nature of DEEP such as subsidence of the excavation; airborne contamination due to wind erosion; effectiveness of surfactants used to control wind erosion; and radon emissions once the soil cap is removed. Controls and mitigators are in place and documented in either the work plan or project specific health and safety plan (PSHSP) for the anticipated problems associated with DEEP.

- The tasks and subtasks associated with DEEP Phases 2, 3, and 4 are standard industrial activities for civil engineering, construction, and environmental remediation of commercial landfills. The "non-standard" aspect of DEEP is that the excavation work is being done in waste pits containing chemical and radiological contaminants specific to the Fernald Environmental Management Project (FEMP). Short-term stockpiles of waste material will be created, however, there is no processing of this material and there is no accident specific to DEEP which could produce enough energy to disperse the material in the stockpiles beyond the boundary of the pit being worked in.

- The tasks and subtasks identified for DEEP are repeated throughout the different phases. This provides a lessons learned platform for each successive geotechnical test.

Although no DEEP-specific activity could disperse material from the stockpiles beyond the boundary of the pit being worked on, it is possible for wind erosion to remove and disperse this material. Further evaluation is warranted, therefore, Step 3 was initiated. It was decided to include an extreme event with the DEEP dispersion model as the most credible accident.

3.4 Accident Analysis

Step 3 of the graded approach to hazard identification and evaluation for DEEP Phases 2, 3, and 4 postulated dispersal of material in the waste stockpiles under meteorological conditions common to the southern Ohio area and dispersal under an extreme wind event.

Table 3.6. Modeling Parameters DEEP Phases 2, 3, and 4		
Model Parameter	**Condition(s) Stated in the DEEP Work Plan**	**Action Items/Comments**
1. All wet excavations and stockpiles are open and susceptible to wind erosion for the duration of the averaging period.	• Only one excavation and its associated stockpile of material are to be open at one time. • Only one waste pit will be worked on at a time.	• Four source groups were identified for dispersion: Pit 1, Pit 2, Pit 3, and All. Concentration values due to dispersion of exposed materials from the individual source groups is tabulated separately so it is possible to segregate the effect of each pit to account for phasing of the excavation work. • Concentration values can be scaled up or down depending upon the size of source group. Concentration values for the dry excavation in Pit 1 and ramp and pad excavation in Pit 3 were determined by resizing the source group. • Examining the effect of all excavations and stockpiles being open and available for wind erosion represents a "worse case" scenario. Remediation activities are driven by Consent Agreement and Record of Decision completion dates. To meet these dates, CRU1 may need to phase DEEP activities concurrently.

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Table 3.6. Modeling Parameters DEEP Phases 2, 3, and 4		
Model Parameter	**Condition(s) Stated in the DEEP Work Plan**	**Action Items/Comments**
2. All exposed material is assumed to be dry.	• Pits 1, 2, and 3 have a soil cap. Typical water levels are as follows: Pit 1: 3 - 3.5 feet below ground surface Pit 2: 1 - 1.5 feet below ground surface Pit 3: 2 - 4.5 feet below ground surface • Unified Soil Classification System (USCS) designations for waste pit samples are as follows: Pit 1: low plasticity silt (ML) having slight cohesion and low dry strength Pit 2: sandy silt and silt with sand (ML); sandy elastic silt (MH); and silty sand with gravel (SM) Pit 3: elastic silts (MH); silty sands (SM); sandy elastic silt (MH); and sandy silt (ML) • Moisture content of samples is as follows (% dry weight basis): Pit 1: 20 - 39% Pit 2: 120 - 317% for ML and MH samples 21 - 33% for SM and SC samples Pit 3: 55 - 139% for MH samples	• Assuming the material is dry and dispersible represents a worse case scenario. The drying characteristics of large piles of material from these pits is not well documented and so extrapolating this information to stockpiles of the sizes estimated for DEEP would be questionable. • It was assumed that the moisture in the silty sands, sandy silts, gravel, etc. would drain from the stockpile back into the open excavation. Material on the surface of the stockpile would dry to a hard crust which eventually decomposes to dust.

Table 3.6. Modeling Parameters DEEP Phases 2, 3, and 4		
Model Parameter	**Condition(s) Stated in the DEEP Work Plan**	**Action Items/Comments**
3. All the dispersed material is assumed to be respirable. (Note: Respirable particle size is 10 microns (PM10)).	• Particle size distributions are as follows (% dry weight basis): Note Gravel: 76.2 mm - 4.75 mm Sand: 4.75 mm - 75 microns Fines: less than 75 microns Pit 1 Gravel: 0.4 - 3.9% Sand: 9.0 - 37.6% Fines: 58.5 - 91.0% Less than 2 microns: 0.0% Pit 2 Gravel: 1.0 - 7.6% Sand: 22.3 - 56.1% Fines: 43.9 - 73.5% Less than 2 microns: 11.7 - 22.2% Pit 3 Gravel: 36.1 - 152.7% Sand: 1.0 - 6.0% Fines: 56.6 - 83.7% Less than 2 microns: 3.1 - 15.7% (Source: Geotechnical Laboratory Material Property Testing Results)	• Existing geotechnical data does not specifically indicate the percentage of material is 10 microns and less in size. The closest designations are fines and less than 2 microns. • Greater than 70% of the contents of Pits 1, 2, and 3 are classified as fines. Assuming 100% of the exposed material is respirable represents the worse case. This can be scaled up or down similar to the stockpile size.

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Table 3.6. Modeling Parameters DEEP Phases 2, 3, and 4		
Model Parameter	**Condition(s) Stated in the DEEP Work Plan**	**Action Items/Comments**
4. The pit contents are homogeneous.	• Pit contents vary with location.	• The Operable Unit 1 remedial investigation collected and analyzed samples; reviewed the operating records, procedures, and reports for the waste pit area; and interviewed plant personnel. Their conclusions are presented in the "Remedial Investigation Report for Operable Unit 1", August 1994 (FINAL). The constituents of concern and their representative concentration in each pit used to determine radiological and chemical exposures to on-site and off-site receptors were taken from Tables E.2-3, E.2-4, and E.2-5 of the final RI. • The representative concentration is the maximum of the upper confidence limit/maximum value (UCL/Max) from either the Characterization Investigation Study (CIS) or Remedial Investigation/Feasibility Study (RIFS) data. The UCL/Max value from each data set is the lower of the maximum detected value or the 95% upper confidence limit.
5. Material from inside the excavation, the soil stockpile, and waste stockpile are available for dispersion.		• The model provided concentration values for a dry, respirable dust of unspecified radiological and chemical composition at specified locations. Exposures due to the radiological and chemical constituents of each pit were determined by multiplying the concentration value by the representative concentration of the constituent in the pit wastes. Although the volume of material was separated into open excavation, soil cap, and waste stockpile, no credit was taken for the lower contamination levels (radiological and chemical) in the soil cap stockpile. This was done to simplify the calculation. The soil cap thickness varies from a few inches to several feet. The volume of material in the soil cap stockpile is inconsequential compared to the volume of pit wastes and it may not be possible to separate the soil cap from the waste.

Table 3.6. Modeling Parameters DEEP Phases 2, 3, and 4		
Model Parameter	**Condition(s) Stated in the DEEP Work Plan**	**Action Items/Comments**
6. The on-site receiptor is located at the CRU4 Vitrification Plant approximately 400 meters south south east (SSE) of the DEEP excavations.		• The CRU4 Vitrification Pilot Plant is the nearest regularly occupied facility. It is expected to be under construction during DEEP. • Maintenance activities to the grounds near DEEP (spraying for insects, mowing the grass) or inspections of the other pits and support facilities in the waste pit area could occur during DEEP. It is assumed that any of these activities would be covered by either a health and safety plan (HASP) or radiation work permit (RWP) and that the authors of these documents would be aware of DEEP. • The concentration value from the dispersion model used to determine radiological and chemical exposure to the on-site receiptor was the maximum possible at 400 meters from DEEP regardless of the direction.
7. The off-site receiptor is located at the fenceline approximately 860 meters north north east (NNE) of the DEEP excavations.		• The dispersion model includes receptors at various locations along the fenceline. The receiptor at 860 meters NNE was chosen because this location received the maximum concentrations from Pits 1, 2, and 3 when evaluated separately and collectively over a monthly and annual averaging period. The maximally exposed off-site receiptor location varied for each pit over the shorter (1-hour and 8-hour) averaging periods.

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Table 3.6. Modeling Parameters DEEP Phases 2, 3, and 4		
Model Parameter	**Condition(s) Stated in the DEEP Work Plan**	**Action Items/Comments**
8. Concentration values over the maximum 8-hour averaging period were used to calculate radiological and chemical exposures to on-site and off-site receptors under normal operations.	• Each wet excavation in Pits 1, 2, and 3 and the dry excavation in Pit 1 will be closed after 72 hours. • The ramp and pad excavation in Pit 3 will be closed after 288 hours.	• (Note: The ISCST2 computer code has several averaging periods built into it. The DEEP model was run with a maximum 1-hour, maximum 8-hour, maximum monthly, and annual averaging period. The concentration values were compared to verify that varying the release rates from the stockpiles based on wind speed over these time periods resulted in a proportional decrease in concentration over the longer averaging periods.) Concentrations for the maximum 8-hour averaging period were used to calculate radiological and chemical exposures to on-site and off-site receptors because they more closely represent the 72-hour activity duration than the maximum 1-hour or monthly averaging periods for normal operations.
9. Concentration values over a 1-hour averaging period using a wind speed of 75 miles per hour were used to calculate radiological and chemical exposures to on-site and off-site receptors under the most credible accident condition (a 1-in-100 year high wind event).		• There are no activities associated with DEEP that would provide enough energy to the stockpiles to disperse the material beyond the immediate work area. The most credible accident scenario is a 1-in-100 year high wind event. It was modeled as a 75 MPH wind lasting for 1-hour, and so, it would represent the maximum 1-hour average.

Table 3.6. Modeling Parameters DEEP Phases 2, 3, and 4		
Model Parameter	**Condition(s) Stated in the DEEP Work Plan**	**Action Items/Comments**
10. Release rates due to wind erosion were calculated using formula 4-5 [2] of USEPA regulatory guide EPA/600/8-85/002, "Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites". Six wind speed categories were selected for the model. Release rates were calculated for wind speeds of 6, 7,8, 9 and 10 meters per second. Wind Speed, m/s — Release Rate, g/m^2-s Less than 5 — 0.00000 5 - 6 — 0.00216 6 - 7 — 0.00343 7 - 8 — 0.00512 8 - 9 — 0.00729 9 - 10 — 0.010 @ 75 MPH — 0.377	• The release rate equation assumes no vegetative cover. The closed excavations will be covered with a soil cap. These bare soil patches will be re-seeded after at the conclusion of the project.	• Variations in wind speed are to be common to the southern Ohio area. The amount of material dispersed is proportional to the speed of the wind that is removing it from the stockpile, therefore, this more accurately reflects field conditions.
11. Stockpile configuration is low (1.73 - 2 meters high) and square (5 - 9.14 meters per side).	• Stockpile dimensions are not specifically stated, however, they appear on a location map drawn to scale. Stockpile sizes are approximately 10 meters on each side.	

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2. $E = 0.036(1-V)([u]^3)$

   Where: V = fraction of contaminated surface vegetative cover = 0 for DEEP Phases 2, 3, and 4
   [u] = wind speed, m/s

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3.4.1 Methodology

The ISCST2 computer code was used to model dispersion of material from the waste stockpiles. Modeling parameters are listed in Table 3.6. These parameters are conservative. The stockpiles were modeled as containing a single constituent material. The resulting concentration values are in terms of $\mu g/m^3$ of homogeneous pit material. Representative concentration data from Tables E.2-3, E.2-4, and E.2-5 of Remedial Investigation Report for Operable Unit 1", August 1994, were used to determine the concentration of the individual pit constituents. Concentration values for all the radiological constituents listed in these tables were determined. The list of chemical constituents was screened first to remove chemicals that were present in quantities below the reportable quantities listed in 40 CFR 302.4, or for which there is neither an IDLH (immediately dangerous to life and health) value nor a threshold limit value (TLV). Dioxins were screened using EPA/600/6-88/005Cc, "Estimating Exposure to Dioxin-Like Compounds, Volume III: Site-Specific Assessment Procedures, June 1994 REVIEW DRAFT.

3.4.2 Evaluation Criteria

3.4.2.1 Radiological Constituents

Concentration values of the constituent radionuclides due to dispersion of stockpiled material under meteorological conditions common to southern Ohio were compared to:

- The derived air concentrations (DACs) for controlling radiation exposures to workers at DOE facilities found in DOE Order 5480.11. The DACs are based on a 2,000-hour work year. The wet excavations and dry excavation in Pit 1 will be open no longer than 72 hours. The DAC was adjusted to compensate for this time differential by multiplying the DAC by 2,000/72. The ramp and pad excavation in Pit 3 will remain open no longer than 288-hours. The DAC was adjusted by 2,000/288.

- The derived concentration guides (DCGs) for members of the public listed in DOE Order 5400.5. The DCGs are based on a 24-hour day over a 365-day year (8760 hours). The wet excavations and dry excavation in Pit 1 will be open no longer than 72 hours. The DCG was adjusted to compensate for this time differential by multiplying the DCG by 8760/72. The ramp and pad excavation in Pit 3 will remain open no longer than 288-hours. The DCG was adjusted by 8,760/288.

- These criterion are based on individual radionuclides. For known mixtures of radionuclides, the sum of the ratio of the observed concentration of a particular radionuclide and its corresponding DAC for all radionuclides in the mixture must not exceed 1.0. Therefore, the concentration values for each radionuclide were divided by either the adjusted DAC or adjusted DCG and then added. If the total exceeded 1.0, then the event (normal operations under meteorological conditions common to southern Ohio or 1-in-100 year high wind event) would be unacceptable. The results are presented in Table 4, none of the

activities exceed this criteria.

Concentration values resulting from the extreme wind event were converted to a committed dose for a 1-hour event using dose conversion factors found in EPA-520/1-88-020, "Limiting Values of Radionuclide Intake and Air Concentration Dose conversion Factors for Inhalation, Submersion, and Ingestion", September 1988. The committed dose for a 1-hour event was obtained by converting the committed effective dose into units of mrem/μCi, multiplying by the concentration value for the individual radionuclide and a breathing rate of 1.2 m^3/hr. Radiological siting guidelines provided in DOE Order 6430.1A, "General Design Criteria", state that the maximum calculated dose shall not exceed 25 rem to the whole body to off-site individuals. The ratio of the committed effective dose equivalent for on-site and off-site receptors was divided by 25 rem. If this number exceeded 1.0, then the consequence of this event would be unacceptable. The results are presented in Table 4, none of the activities exceed this criteria.

A check was made to verify that the dispersion of material as modeled for DEEP Phases 2, 3, and 4 falls within the evaluation basis guidelines for hazard category 3 activities as described in DOE-STD-1027-92. This Standard provides the threshold limits for individual radionuclides used in Step 1 to determine the maximum stockpile inventory. These threshold limits are based on a release fraction of 0.001. The DEEP model is based on an emission rate which varies with the wind speed.

Release fraction is defined as the ratio of the amount of material dispersed over the amount of material available for dispersion. The mass of stockpile material removed under the extreme wind event of 75 mph was determined and the estimated release fraction was calculated. The results are provided in Table 3.8. The conclusion is that the release fraction for the DEEP model is approximately half of the evaluation basis release fraction listed in DOE-STD-1027-92. The radionuclides of concern listed in Table 3.3 of this ASR can be recalculated and compared with the Category 3 threshold limits. The results are presented in Table 3.9. Thorium-230 remains as a radionuclide of concern and by itself keeps DEEP a Category 3 activity even with an inventory correction for the reduced released fraction.

3.4.2.2 Radon (^{222}Rn)

The activities for DEEP will involve digging excavations/penetrations into the already closed and covered waste pits that will only be opened for a minimum amount of time and then refilled. Through previous monitoring activities, Waste Pits 1, 2, and 3 have had radon flux measurements performed. Localized hot spots within the pits leading to higher flux rates have been identified. Therefore, a potential exists for elevated concentrations emanating from the penetrations in these pits.

Table 3.7. Dispersion of Radiological Constituents DEEP Phases 2, 3, and 4				
	Under Meteorological Conditions Common to Southern Ohio		1-in-100 Year 75 MPH High Wind Event	
	Ratio of On-Site Concentration and Adjusted Derived Air Concentration	Ratio of Off-Site Concentration and Adjusted Derived Concentration Guides	Ratio of On-Site Committed Effective Dose Equivalent and 25 Rem Annual Dose Limit for Accident Conditions	Ratio of Off-Site Committed Effective Dose Equivalent and 25 Rem Annual Dose Limit for Accident Conditions
Wet Excavation				
Pit 1	0.0185	0.0835	0.00234	0.000348
Pit 2	0.0386	0.196	0.00470	0.000811
Pit 3	0.0384	0.175	0.00312	0.000719
Subtotal	0.0954	0.455	0.0102	0.00188
Dry Excavation				
Pit 1	0.0023	0.0417	0.00117	0.000174
Pit 3 Ramp and Pad	0.0875	0.400	0.00178	0.000410
Subtotal	0.0967	0.442	0.00295	0.000534
Total	0.192	0.896	0.0131	0.00246

Table 3.8. Estimated Release Fraction Based on an Extreme Wind Event of 75 MPH High DEEP Phases 2, 3, and 4						
	Surface Area, m^2	Stockpile Total Mass, kg	Mass of Material Removed Through Wind Erosion, kg	Estimated Release Fraction	DOE-STD-1027-92 Criteria	
					Release Fraction	Ratio of Estimated Release Fraction to DOE-STD-1027 Release Fraction
Wet Excavation						
Pit 1	433	1.14E+06	5.87E+02	5.15E-04	1.0E-03	0.5
Pit 2	433	1.14E+06	5.87E+02	5.15E-04	1.0E-03	0.5
Pit 3	649	1.47E+06	8.81E+02	5.99E-04	1.0E-03	0.6
Dry Excavation						
Pit 1	216	5.70E+05	2.94E+02	5.15E-04	1.0E-03	0.5
Pit 3 Ramp and Pad	368	8.32E+05	4.99E+02	5.99E-04	1.0E-3	0.6

Basis: 1. Emission rate = 0.377 g/m^2-s

2. Event duration = 1 hour

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Table 3.9. Recalculated Radionuclides of Concern					
Radionuclide	DOE-STD-1027-92 Category 3 Threshold Limit, Ci	Adjusted Material Stockpile Inventories based on Table 6, Ci (Note: Shaded blocks indicate that the threshold is not exceeded.)			
		Pit 1	Pit 2	Pit 3	Pit 3 Ramp and Pad
Thorium-230	6.2E-01	9.10E-01	3.08E+00	1.95E+00	3.35E+00
Thorium-232	1.0E-01	8.20E-02	5.70E-02	6.78E-02	1.16E-01
Uranium-234	4.2E+00		3.04E+00		
Uranium-238	4.2E+00	2.7E+00	2.99E+00	2.92E+00	5.00E+00

Table 3.10. Estimated Radon Releases DEEP Phases 2, 3, and 4			
	Radon Release Rates Based on Historical Data, $\rho Ci/m^2$-s	Surface Area, m^2	Estimated Quantity of Radon Released, Ci
Wet Excavation			
Pit 1	75.2	433	1.17E-04
Pit 2	81.0	433	1.26E-04
Pit 3	48.0	649	1.12E-04
Dry Excavation			
Pit 1	75.2	216	5.83E-05
Pit 3 Ramp and Pad	48.0	368	6.36E-05
Basis: 1. Event duration = 1 hour			

The highest radon flux measurement for Pit 1 was 75.2 $\rho Ci/m^2$-s with a pit mean of 9.1 $\rho Ci/m^2$-s. The highest radon flux measurement for Pit 2 was 81.0 Ci/m^2-s with a pit mean of 6.4 $\rho Ci/m^2$-s. The highest radon flux measurement for Pit 3 was 48.0 $\rho Ci/m^2$-s with a pit mean of 2.6 $\rho Ci/m^2$-s. The requirements for radon monitoring on-site are governed by DOE Order 5400.5 and NESHAPS. Under these guidelines the following limits for wastes and residues are imposed:

- 100 ρCi/l at any given point
- An annual average concentration of 30 ρCi/l over the facility site
- An annual average concentration of 3 ρCi/l at or above any location outside the facility site
- Flux rates greater than 20 $\rho Ci/m^2$-s from the storage of radon producing wastes.

The limit of concern for DEEP Phases 2, 3, and 4 is the 100 ρCi/l maximum radon concentration emanating from the temporarily reopened areas.

3.4.2.3 Chemical Constituents

The chemical constituents of concern were screened as described on the "Chemical Hazard Screening Criteria" flow chart. The results of this screening are summarized on Tables 3.11 and 3.12. Calculations were made for wet and dry excavations. There was little variation between the wet and dry excavation results, therefore, only the wet excavations is provided here. The on-site exposure criteria is 0.1*IDLH; the off-site exposure criteria is the NIOSH REL-TWA.

Under meteorological conditions common to southern Ohio, the predicted concentrations of arsenic from Pit 3 is estimated to exceed the NIOSH REL-TWA of 0.002 mg/m^3 for both on-site and off-site receptors. It is not estimated to exceed the 0.1*IDLH limit of 0.5 mg/m^2.

During the extreme wind event of 75 mph, the results are as follows:

- Pit 1: Uranium on-site and off-site is estimated to exceed the NIOSH REL-TWA but remain below 0.1*IDLH
- Pit 2: Arsenic on-site is estimated to exceed the NIOSH REL-TWA but remain below 0.1*IDLH

CHEMICAL HAZARD SCREENING CRITERIA

DEEP PHASES 2, 3 AND 4

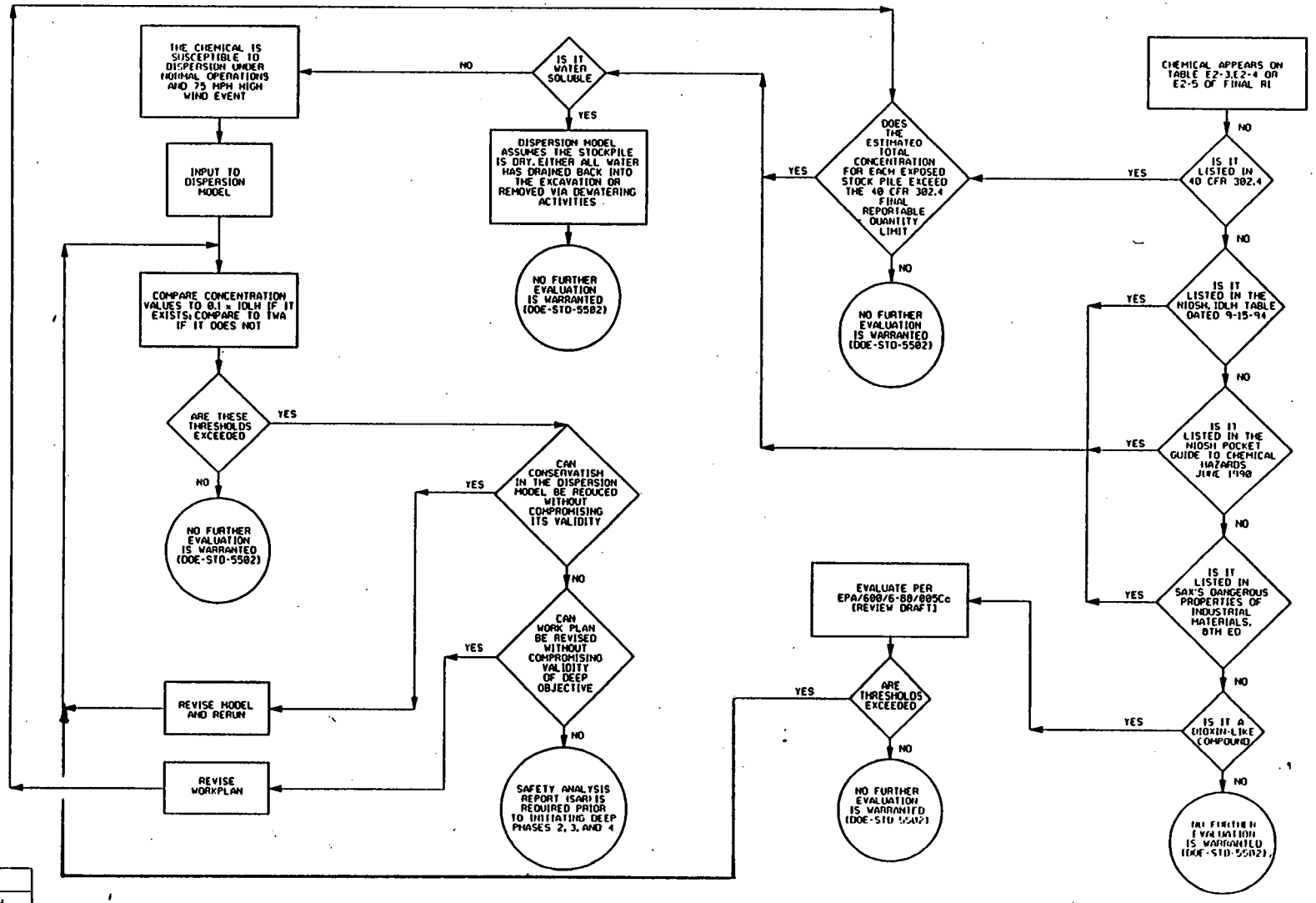

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Table 3.11. Results of Chemical Hazard Screening Under Meteorological Conditions Common to Southern Ohio DEEP Phases 2, 3, and 4

(Note: Shaded blocks indicate that the chemical either does not have an IDLH or NIOSH REL-TWA or is not present in the waste pit indicated.)

Chemical Constituent	0.1*IDLH, mg/m³	NIOSH REL-TWA, mg/m³	Pit 1, mg/m³		Pit 2, mg/m³		Pit 3, mg/m³	
			On-Site	Off-Site	On-Site	Off-Site	On-Site	Off-Site
Arsenic	0.5	0.002 (15 min)	1.98E-06	3.78E-07	5.15E-05	1.11E-05	8.14E-3	2.07E-03
Beryllium	0.4	0.0005	1.65E-06	3.15E-07	3.28E-06	7.06E-07	5.25E-06	1.33E-06
Cadmium	0.9	0.2 (OSHA)	2.45E-06	4.67E-07	1.56E-06	3.36E-07	8.45E-06	2.14E-06
Chromium	2.5	0.5	4.59E-05	8.75E-06	3.44E-05	7.40E-06	5.12E-05	1.30E-05
Fluoride	2.5	2.5					5.14E-04	1.30E-04
Lead	10	0.05 (OSHA)	7.06E-06	1.35E-06	9.24E-05	1.99E-05	1.83E-04	4.65E-05
Manganese	50	1					4.42E-03	1.12E-03
Molybdenum	500	10			2.62E-05	5.64E-06	6.21E-05	1.58E-05
Nickel	1	0.015			2.12E-04	4.75E-05	1.10E-04	2.80E-05
4,4-DDT		0.5	2.11E-07	4.04E-08				
Aroclor 1248		0.001 (Skin)	1.32E-06	2.52E-07				
Aroclor 1254		0.001 (Skin)	1.72E-06	3.28E-07				
Aroclor 1260		0.001 (skin)	1.03E-06	1.97E-07				
Uranium	1	0.2	6.14E-03	1.22E-03	7.07E-04	1.52E-04	1.30E-03	3.30E-04
Benzo(A)Pyrene		0.2 (OSHA PEL)			1.46E-05	3.15E-06		
Chrysene		0.2 (OSHA PEL)			1.05E-05	2.26E-06		
Tributyl Phosphate	33.2	2.5			4.75E-06	1.02E-06		
Vanadium	3.5	0.05 (15 min)					1.26E-03	3.20E-04
Vinyl Chloride		2.6			2.32E-07	4.99E-08		

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Table 3.12. Results of Chemical Hazard Screening
1-in-100 Year 75 MPH High Wind Event
DEEP Phases 2, 3, and 4

(Note: Shaded blocks indicate that the chemical either does not have an IDLH or NIOSH REL-TWA or is not present in the waste pit indicated.)

Chemical Constituent	0.1*IDLH, mg/m³	NIOSH REL-TWA, mg/m³	Pit 1, mg/m³		Pit 2, mg/m³		Pit 3, mg/m³	
			On-Site	Off-Site	On-Site	Off-Site	On-Site	Off-Site
Arsenic	0.5	0.002 (15 min)	1.48E-04	2.20E-05	3.65E-03	6.30E-04	4.94E-01	1.14E-01
Beryllium	0.4	0.0005	1.23E-04	1.83E-05	2.32E-04	4.01E-05	3.18E-04	7.34E-05
Cadmium	0.9	0.2 (OSHA)	1.82E-04	2.71E-05	1.10E-04	1.91E-05	5.12E-04	1.18E-04
Chromium	2.5	0.5	3.41E-03	5.08E-04	2.43E-03	4.20E-04	3.11E-03	7.15E-04
Fluoride	2.5	2.5					3.12E-02	7.18E-03
Lead	10	0.05 (OSHA)	5.25E-04	7.82E-05	6.54E-03	1.13E-03	1.11E-02	2.56E-03
Manganese	50	1					2.68E-01	6.18E-02
Molybdenum	500	10			1.86E-03	3.20E-04	3.77E-03	8.68E-04
Nickel	1	0.015			1.50E-02	2.59E-03	6.69E-03	1.54E-03
4,4-DDT		0.5	1.57E-05	2.34E-06				
Aroclor 1248		0.001 (Skin)	9.84E-05	1.46E-05				
Aroclor 1254		0.001 (Skin)	1.28E-04	1.90E-05				
Aroclor 1260		0.001 (Skin)	7.67E-05	1.14E-05				
Uranium	1	0.2	4.77E-01	7.10E-01	5.01E-02	8.65E-03	7.88E-02	1.82E-02
Benzo(A)Pyrene		0.2 (OSHA PEL)			1.04E-03	1.79E-04		
Chrysene		0.2 (OSHA PEL)			7.42E-04	1.28E-04		
Tributyl Phosphate	33.2	2.5			3.37E-04	5.81E-05		
Vanadium	3.5	0.05 (15 min)					7.64E-02	1.76E-02
Vinyl Chloride		2.6			1.64E-05	2.83E-06		

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- Pit 3: Arsenic on-site and off-site is estimated to exceed the NIOSH REL-TWA. Off-site concentration are expected to remain below 0.1*IDLH; on-site concentrations will approximately equal 0.1*IDLH. Vanadium concentration on-site is estimated to exceed the NIOSH REL-TWA but remain below 0.1*IDLH

3.4.2.4 Dioxins

Dioxins in Pit 1 were not present in quantities that exceed thresholds established in EPA/600/6-88/005Cc (REVIEW DRAFT). Three dioxins present in Pits 2 and 3 exceed the thresholds: 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-HpCDD); octachlorodibenzofuran (OCDF); and octachlorodibenzo-p-dioxin (OCDD).

3.4.3 Unearthing Unidentifiable Materials

These pits were a remote dump site. It is possible for items such as an intact drum of hazardous material, a cylinder of UF6, or a derby to be unearth during these excavations. Personnel assigned to DEEP field activities will wear personal protective equipment (PPE) as directed in the project specific health and safety plan.

The wet excavations in Pits 1, 2, and 3 and dry excavation in Pit 1 are deep with narrow walls. They will be easy to close if something unidentifiable is uncovered. Closing the Pit 3 ramp and pad excavation if an unidentifiable item is uncovered is not practical due to the broad, shallow area involved.

Actions to be taken when something unidentifiable is unearthed are listed in Section 5.3 of this ASR.

4.0 Inadvertent Nuclear Criticality

NLCO-694, Rev. 2, "Standard Operating Procedure for The Operation of the Chemical Pits", April 1960, states that "if the need arises to dump any enriched residues, these residues will be dumped on "like" normal materials, (i.e., enriched filter cake on normal filter cake, enriched graphite molds on normal graphite molds, etc.)". Process knowledge indicates that enriched materials would be low concentration solids, no high concentrated enriched uranium was to be dumped here. If enriched material is present in these pits, it is assumed that it is currently in a critically safe configuration because these pits have been closed for several years. The possibility that, during the various tasks and subtasks associated with DEEP the critically safe conditions are disturbed and a critically unsafe condition is created, has been reviewed by the Nuclear Criticality Safety (NCS) and determined to be an incredible event.

The history of enriched material production at the Feed Materials Production Center (FMPC), now the Fernald Environmental Management Company (FERMCO) is as follows:

Chemical Processing

- Plant 2/3 (Refinery) started in 1965
- Plant 4 (Green Salt) started in 1963
- Plant 8 (Refinery Feed) started in 1963
- Pilot Plant (UF4 Production) started in 1958

Metal Production and Machining

- Plant 5 (Metal Production) derby production began in 1958; ingot casting began in 1966
- Plant 6 (Metals Fabrication) rod production began in 1958; machining of enriched cores and target elements began in 1966
- Plant 9 (Special Products) began ingot casting in 1958; cores and target element production began in 1958

Table 3.13. Average U-235 Isotopic Content of Waste Pits 1, 2, and 3
(Ref: NLCO-1143, "Study of Radioactive Waste Storage Areas at the Feed Materials Production Center, April 1977)

Location	Period Used	Approximate % U-235
Pit 1	1952 - mid-1959	0.712
Pit 2	1952 - mid-1964	0.209
Pit 3	Mid-1959 - Nov. 1968	---
	Jan 1975 - (1977)	0.785

No criticality safety concerns exist with disturbance of the pit material because of the low uranium concentration, as identified by records and pit material sample data. Additionally, raffinates and other filtrates which could extract and concentrate the uranium were neutralized prior to being discharged to the pits. The minimum critical concentration for an infinite system under optimum conditions, assuming a maximum credible enrichment of 2.0 weight percent (wt%) of uranium-235 is 900 grams U/liter. The highest uranium concentration of a pit material sample is 7.1 mg U/liter. This results in a safety margin of over 2 orders of magnitude. A reduction of the safety margin of this magnitude is not considered credible.

The expected radionuclide content of the storage tank containing pit water removed during the dewatering activities is below Category 3 thresholds (Tables 3.4 and 3.5). It is not credible that water removed from these pits during the dewatering activities could contain enough U235 to cause an inadvertent nuclear criticality during precipitation of the heavy metals prior to processing the water through the Plant 8 sump. An operating history will be created by sampling this water for total uranium content prior to precipitation of the heavy metals. If the total uranium content exceeds a threshold established in Criticality Safety Assessment/Approval (CSA) 94-009, then further processing of this batch of water will cease and nuclear criticality safety will be contacted.

The gravitational settling done as part of the waste reslurry and pumping test may lead to an increase in concentration of uranium in the settled sludge. NCS requires that Pit 2 be processed before Pits 1 and 3. Material Control and Accountability (MC&A) records and process knowledge indicate that Pit 2 does not contain enriched uranium (Table 3.13) and, therefore, does not pose a criticality safety concern no matter what the concentration. Samples of pit waste material will be collected from the top and bottom of the settled slurry and analyzed for total uranium concentration. If a valid sample can be taken in the middle, then a third sample will be collected. Analytical results will be forwarded to Nuclear Criticality Safety (NCS) for review. Work may continue on Pit 2 while waiting for these results, however, work may not proceed to another pit until approval is given by NCS.

5.0 Commitments

5.1 Excavation will begin on Pit 2 and proceed to either Pit 1 or 3.

5.2 Material loss from the exposed stockpile(s) will be controlled to as low as reasonable possible.

This will be accomplished by limiting the duration of the open excavations, controlling the size of the stockpile(s), and protecting the stockpile surface(s) from wind erosion. Specific steps taken are:

- One excavation will be open at any time. Only one Pit will be worked on at one time.
- Wet excavations in Pits 1, 2, and 3 and the dry excavation in Pit 1 will be open no longer than 72 hours. The ramp and pad excavation in Pit 3 will be open no longer than 288 hours.
- The individual stockpiles will not exceed 315 yd^3 for wet excavations and the dry excavation in Pit 1. The stockpile(s) for Pit 3 ramp and pad excavation will not exceed 535 yd^3. The CRU1 Field Operations Lead will document the stockpile size and how it was determined (e.g. direct measurement; estimated size of backhoe bucket times the number of bucket loads).

- Surfactants will used to stabilize the stockpile surface for resistance to wind erosion. Refer to Attachment 3 for further information concernihg use of surfactants.

- Tarps will be staged in the DEEP construction area to be used to cover the stockpiles if the surfactants prove less than adequate

- In the event of adverse weather conditions (e.g. wind gusts or prolonged high wind conditions of 30 mph or greater, heavy rain), the Field Operations Lead may direct the following:

  - Additional protective covering over or around the material stockpiles

  - Closing (reclaiming) an excavation

5.3 The non-dispersible condition of the stockpiles will be verified.

Verification will consist of a combination of area monitoring and visual inspection. Airborne concentrations greater than 10% DAC will be investigated by Radiological Control. However, airborne monitoring results will not be available until 24-to-48 hours after the monitoring period. Therefore, visual inspection is also required.

- Radiological Control Technicians (RCTs) will provide mobile area air monitors. The location of these monitors will vary with stockpile location and prevailing wind direction.

- Breathing zone monitoring of workers will be provided by Radiological Control and Industrial Hygiene.

- Area monitoring for radon will be provided by Environmental Monitoring. Refer to Section 3.4.2 of this ASR for further information on radon monitoring.

- The work area will be inspected periodically during the off-shift to verify that the stockpile(s) condition has not changed. These inspections will be the responsibility of the CRU1 Field Operations Lead. He may delegate this action to other qualified personnel.

  <u>Inspector Qualifications</u>

  - Functional knowledge of the DEEP project objectives.

  - Functional knowledge of the DEEP Health and Safety Plan with particular emphasis on who to contact in the event of an emergency.

  - Functional knowledge of the DEEP Auditable Safety Record.

  - Meets access requirements to the DEEP project area as stated in the Health and Safety Plan.

- The CRU1 Field Operations Lead will provide training to selected personnel on the inspection requirements. A list of qualified off-shift inspectors will be maintained in the DEEP project files.

Inspection Frequency

- The purpose of these inspections is to verify condition of the material stockpiles, therefore, frequency of inspection will depend upon current weather conditions and the geotechnical characteristics of the stockpiled material. The CRU1 Field Operations Lead, with concurrence from the CRU1 Health and Safety Manager and CRU1 System Safety Analyst, will determine the off-shift inspection schedule. The qualified inspectors have the option to inspect the area more frequently if conditions indicate the need, however, they may not decrease the number of inspections scheduled. The CRU1 Field Operations Lead may provide supplemental direction or actions to be taken if certain conditions arise (e.g. if the surfactant does not appear to be affective, then cover the stockpile with the tarp staged in the area for this purpose) with the inspection schedule. Copies of the inspection schedules will be maintained in the DEEP project files.

Inspection Requirements

- Performance of these inspections will be accomplished without entering the posted exclusion area.

- Document that the weather conditions have not changed since the previous inspection.

- Document that the condition of the material stockpile has not changed. Has the stockpile configuration changed (height, width, length). If a surfactant has been used and if the surfactant has a visual indicator such as color, sheen, or texture, has that color, sheen, or texture diminished since the previous inspection. If a tarp has been used, has the tarp position shifted.

- Document that the berms and liners used to contain the stockpile(s) remain intact.

- Document that the open excavation has not collapsed.

- If the condition of the stockpile(s), berms and liners, or open excavation has changed, then the inspector will contact the CRU1 Field Operations Lead for further action.

- The adequacy of area lighting for inspection will be documented. The condition of the excavation barricades and exclusion zone barrier will be documented.

- Copies of the inspection documentation will be kept in the DEEP project files.

Additional Project Requirements Resulting from this Commitment

- Adequate lighting will be provided during the off-shift so that the inspectors have adequate illumination with which to verify the condition of the stockpiles and open excavation.

- The open excavation will be barricaded at the end of shift. The exclusion zone will be clearly indicated so that inspectors do not enter it.

5.4 Actions will be taken if an unidentifiable item is uncovered during excavation

- If an unidentifiable item is uncovered and appears to be leaking, off-gassing, or creating an immediately unsafe condition, personnel are to respond as directed in Section 9. Emergency/Contingency Plans of the project Health and Safety Plan.

- If an unidentifiable item is uncovered during any of the DEEP activities, and it appears to be in a stable condition, then an attempt will be made to identify it. An item will be considered identified when the CRU1 Field Operations Lead, Health and Safety Lead for Field Operations, and the Radiological Control Field Lead Technician supporting DEEP agree on what it is.

  - If it cannot be identified, then work will stop and the AEDO will called in.

  - If the item is identified as an intact drum or cylinder, then the item will be removed, overpacked, and set aside. The AEDO will be contacted to determine final disposition of the overpacked item.

  - If the item is identified as a solid metal item, then it may be removed, placed on the material stockpile, and covered with more material so it is not exposed to air, wind, or water. If an item is placed on the material stockpile, it will be noted in the off-shift inspection schedule, and the inspector will document during the inspections that it remains covered.

Additional Project Requirements Resulting from this Commitment

- Drums for overpacking will be staged in the DEEP project area.

5.5 Lessons learned from each test will be distributed to the workers and project support personnel.

- Tail-gate safety meetings will include lessons learned from previous excavations when the work is moved from one pit to another.

- Lessons learned from excavations in each pit will be documented in the

project logbook. A final report will be issued at the completion of DEEP.

- The CRU1 System Safety analyst will be informed of any accidents or reportable events prior to the event critique.

5.6 Bags of contact waste will be labeled with the isotope-of-concern.

- The isotope-of-concern is Thorium-230 unless directed otherwise by Radiological Control. The CRU1 Field Operations Lead will verify that the isotope-of-concern has not changed when work moves from one pit to another.

5.7 Water removed from the waste pits will be sampled in accordance with Criticality Safety Analysis/Approval (CSA) 94-009 prior to sending this water to the Plant 8 Sump for treatment and disposal.

5.8 Samples of settled sludge from the Pit 2 reslurry and pumping tests will be collected and analysed for total uranium content.

- A sample of pit waste will be collected at the top and bottom of the sludge layer. If a valid sample can be collected in the middle, a middle sample will also be collected.

- Results will be forwarded to NCS for review.

- Work may continue on Pit 2 while waiting for analytical results to return, however, work may not proceed on either Pit 1 or 3 without approval from NCS.

6.0 References

1. Operable Unit 1 Dewatering Excavation Evaluation Program (DEEP) Treatability Study Work Plan, August 1994

2. NLCO-1021, "Standard Operating Procedure for On-Site Shipment and Discard of Depleted Uranium Materials", June 20, 1968; Rev. 1, May 21, 1973; Rev. 3, December 10, 1980

3. NLCO-694, "Standard Operating Procedure for the Operation of the Chemical Pits", Rev. 2, August 1, 1959

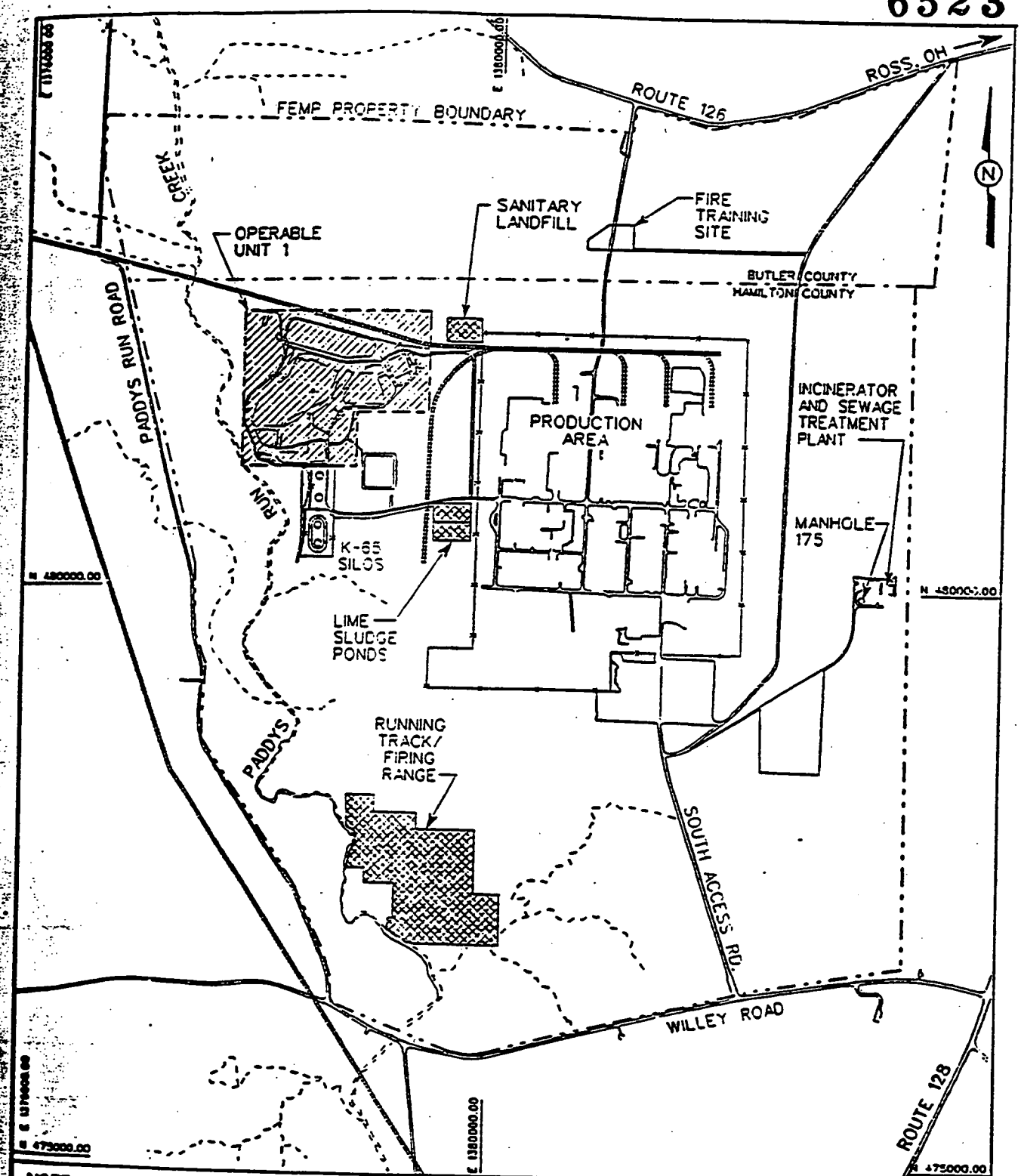
4. Meeting Notes "CRU1 Dewatering Excavation Evaluation Program (DEEP) held April 26, 1994; Issued 5/06/94

5. Meeting Notes "DEEP Inadvertent Criticality", held June 9, 1994, issued June 21, 1994

6. CSA-SD-94-0008, "Nuclear Criticality Safety Evaluation Summary of DEEP Project", 12/19/94

7.0 Attachments

1. FEMP Site Map
2. CRU1 Area Map
3. Dust Suppressant Testing



NOTE:

1. OPERABLE UNIT 3 INCLUDES ALL BUILDINGS, PIPELINES, AND ABOVE-GROUND STRUCTURES IN THE PRODUCTION AREA. OPERABLE UNIT 5 INCLUDES GROUNDWATER, SURFACE WATER, SOILS, FLORA AND FAUNA, IN THE REGIONAL AREA AS WELL AS THE PRODUCTION AREA.

LEGEND:

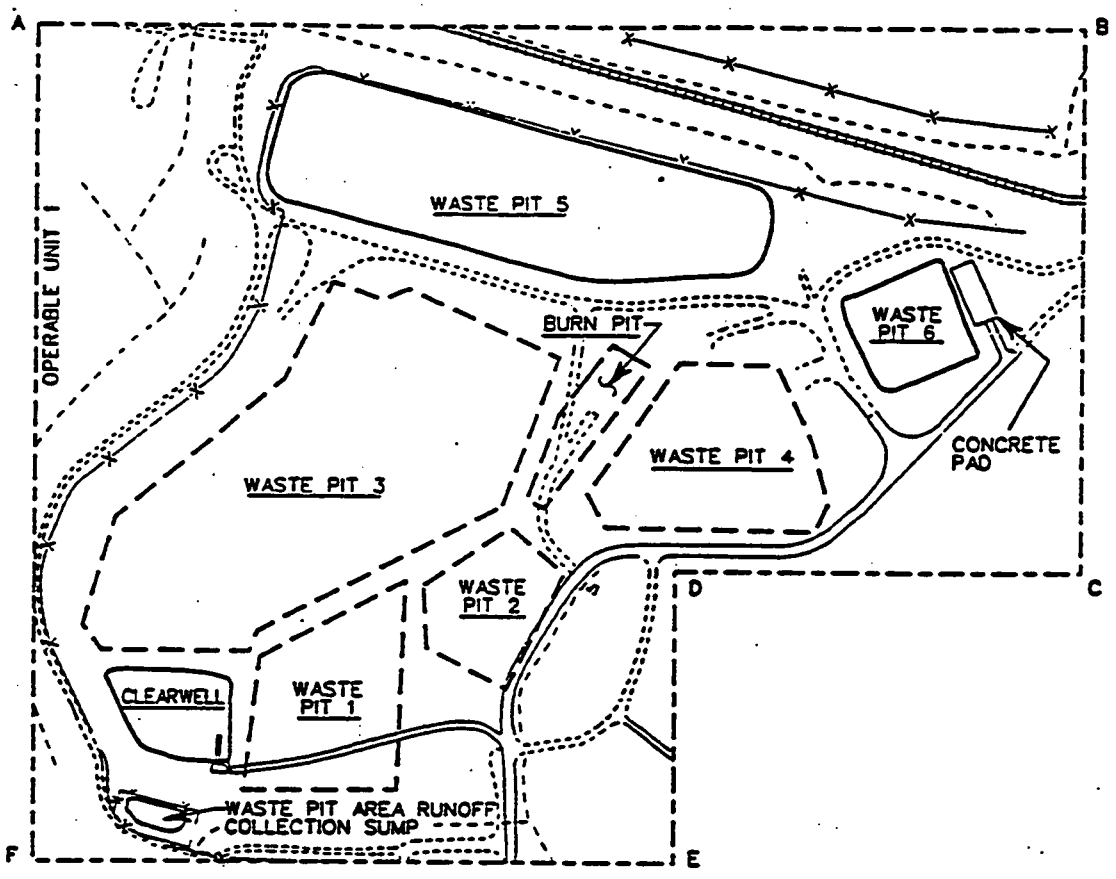
- —x—x— FENCE LINE
- DRAINAGE WAY
- CSX RAIL LINE
- OPERABLE UNIT 1 OUTLINE
- FEMP PROPERTY BOUNDARY
- OPERABLE UNIT 1
- OPERABLE UNIT 2
- OPERABLE UNIT 4

SCALE: 0 — 1200 FEET

LOCATION OF OPERABLE UNIT 1 WITHIN THE FEMP

Attachment 1

FER/OU1WP/DEEP.CH1/GSS/6/16/94



NOTES:

1. PITS 1, 2, 3 AND THE BURN PIT ARE COVERED WITH SOIL CAPS AND VEGETATED.
2. PIT 4 HAS AN INTERIM CAP.
3. PITS 5, 6 AND CLEARWELL ARE WATER COVERED
4. COORDINATES SHOWN ARE OHIO STATE PLANAR COORDINATES, ADJUSTED PER THE NORTH AMERICAN DATUM (NAD) OF 1983.

OU1 STATE PLANAR COORDINATES		
POINT	NORTHING	EASTING
A	482364	1377824
B	482364	1379432
C	481499	1379432
D	481499	1378812
E	481033	1378812
F	481033	1377824

LEGEND:

- —X—X— FENCE LINE
- DRAINAGE WAY
- CSX RAIL LINE
- PAVED ROADWAY
- GRAVEL ROADWAY
- OPERABLE UNIT 1 OUTL
- COVERED PIT OUTLINE
- OPEN PIT OUTLINE

SCALE: 0 — 300 FEET

OPERABLE UNIT 1 SITE MAP

Attachment 2

FER/OU1WP/DEEP.CH1/GSS/6/16/94

Attachment 3

DUST SUPPRESSANT TESTING

INTRODUCTION

FERMCO personnel will conduct field tests to evaluate the effectiveness of six commercially available coating agents in controlling the generation of dust during wet and dry excavation activities. The effectiveness of using pit supernatant water for dust control will also be evaluated. These agents, together with the pit water, will be applied to excavation working surface, stockpiles, and roadways. It is anticipated that as a result of this test, two agents will be identified for controlling the generation of dust during excavation activities associated with final remediation of the Waste Pit Area.

EXECUTION TEST

Excavation activities associated with final remediation of the Waste Pit Area are expected to generate significant amounts of dust which must be controlled. Dust control can be accomplished using coating agents applied directly to excavation working surfaces, stockpiles, and roadways. These agents include hazardous/mixed waste barrier systems (foams or films) and commercial dust suppressants. The use of available pit supernatant water for dust control will also be evaluated.

Prior to initiating excavation activities, commercially-available agents from various vendors will be preliminarily screened for applicability to the field testing activities. Potential vendors include the following:

Aquadyne	Reef Industries
Georgia Pacific Chemical	Johnson March Systems
Witco Corp.	Martin Marietta
Intersystems	Bartlett
Iron Mountain Tech.	Rusmar Foam Tech.
American Cyanamid Co.	3M

The preliminary screening criteria include:

1. Type of equipment required for application (including manpower requirements)
2. Anticipated ease of application
3. Product constituents
   a. material handling requirements
   b. environmental impacts
   c. agents' compatibility with waste
4. Storage life of product
5. Duration of effective control
6. Quantitative information (non-visual) on particulate control
7. Effective temperature/humidity ranges for application and service
8. Suitability to thermal treatment (drying and/or incineration)

Based upon preliminary screening, six agents will be selected for field performance testing. The selected agents will be applied and evaluated at

each of the seven wet and the one dry excavation locations. Evaluation is required at both wet and dry excavation locations due to varying moisture conditions.

Specific applications sites at each excavation location include working excavation surfaces, stockpiles, and roadways. Within each specific application site, six test cells will be identified and delineated for application of the selected agents. Each test cell will be approximately 5 square feet. The locations of the test cells will be determined in the field by the field team leader. Application of the agents within these cells will occur following excavation activities. Each agent will be applied in accordance with the manufacturers' specifications.

The performance of the applied coatings will then be visually monitored over a 24 hour period. The performance period of the tests may be extended by the field team leader, but will be limited by the duration of the excavation activities themselves. Due to safety concerns, excavation activities have been limited to 72 hours at each excavation site. Longer performance periods may be obtained by applying the selected agents to the restored pit surface following backfilling operations. Agents may be re-applied, as necessary, to areas exhibiting wear or cracking. At the discretion of the field team leader, the selected agents may also be employed during actual excavation operations. Testing under these conditions, however, may be restricted due to site-specific health and safety requirements which may limit the distances within which personnel may approach excavation boundaries and operating equipment. Since standardized testing procedures for monitoring the performance of these agents in the field have not been identified at this time, performance will be based primarily on visual observations.

It is estimated that each agent will be required to coat an area of approximately 75 square feet within the test cells and an additional 250 square feet during actual excavation operations (if initiated) at each excavation location. Allowing for 10 percent waste, each selected agent would be required to coat approximately 360 square feet per excavation.

Upon the conclusion of excavation activities, the six selected agents will be evaluated against the following criteria:

1. Cost per square foot
2. Ease of application
3. Ease of cleanup
4. Amount and type of waste generated (including disposal requirements)
5. Applicability to the full range of particulate control needs - effectiveness of the selected agents in controlling particulate releases that may be caused by wind, rain, and equipments operation
6. Adhesion to waste
7. Durability and integrity of applied coating

The two most effective agents, as identified during the previously described wet and dry excavation activities, will be utilized for

controlling the generation of dust during ramp excavation activities. For estimating purposes, each of the two selected agents will be applied to approximately 1,500 square feet of surface area. Each agent will be re-evaluated against the seven above-identified criteria. Testing will be carried out in a manner similar to that previously described; however, the performance period of the test will be longer due to the longer duration of this excavation activity.