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OPERABLE UNIT 4 PILOT PLANT PHASE I TREATABILITY STUDY WORK PLAN REVISION 0 FEBRUARY 1994

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PILOT PLANT PHASE I
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Revision 0
WP-18-0007

Fernald Environmental Management Project
Fernald, Ohio

February 1994

U.S. DEPARTMENT OF ENERGY
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OPERABLE UNIT 4
PILOT PLANT PHASE I
TREATABILITY STUDY WORK PLAN

APPROVED FOR ISSUE

2-23-94

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OPERABLE UNIT 4 PILOT PLANT PHASE I TREATABILITY STUDY WORK PLAN

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LIST OF ACRONYMS

ACA	Amended Consent Agreement
ACOE	United States Army Corps of Engineers
ARARS	Applicable or Relevant and Appropriate Requirements
ASL	Analytical Support Level
ASTM	American Standards for Testing and Materials
AWWTS	Advanced Wastewater Treatment System
BAT	Best Available Technology
BDAT	Best Demonstrated Available Technology
BMP	Best Management Practices
CAT	Construction Acceptance Testing
CEP	Controls for Environmental Pollution, Inc.
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CRARE	Comprehensive Response Action Risk Evaluation
CRU4	CERCLA/RCRA Unit 4
CWID	Construction Waste Identification/Disposition
CX	Categorical Exclusion
DOE	United States Department of Energy
DOE-FN	Department of Energy Fernald Field Office
DQO	Data Quality Objective
EDE	Effective Dose Equivalent
EIE	Engineered Isolation Enclosure
EIS	Environmental Impact Statement
EP	Extraction Procedure
EPA	United States Environmental Protection Agency
ERMC	Environmental Restoration Management Contractor
FEMP	Fernald Environmental Management Project
FERMCO	Fernald Environmental Restoration Management Corporation
FFCA	Federal Facilities Compliance Agreement
FRESH	Fernald Residents for Environmental Safety and Health

FS	Feasibility Study
HEPA	High Efficiency Particulate Air
LLRW	Low Level Radioactive Waste
MEF	Material Evaluation Form
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NDE	Non-Destructive Evaluation
NDT	Non-Destructive Testing
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NTS	Nevada Test Site
OEPA	Ohio Environmental Protection Agency
OTD	Office of Technology Development
OU4	Operable Unit 4
PCT	
PNL	Pacific Northwest Laboratory
PP	Proposed Plan
PPE	Personal Protective Equipment
PSAR	Preliminary Safety Analysis Report
QA/QC	Quality Assurance/Quality Control
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
RI	Remedial Investigation
ROD	Record of Decision
RSE	Removal Site Evaluation
RTS	Radon Treatment System

SCQ	Sitewide CERCLA Quality Assurance Project Plan
SCR	Silicon Control Rectifier
SOT	Systems Operability Testing
SSOP	Site Standard Operating Procedure
SWCR	Sitewide Characterization Report
TBC	To Be Considered
TBD	To Be Determined
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
USEPA	United States Environmental Protection Agency
VOA	Volatile Organic Analyte
WBS	Work Breakdown Structure
WMCO	Westinghouse Materials Company of Ohio

LIST OF WEIGHTS AND MEASURES

Ci	Curie
cm	centimeter
d	day
ft^3	cubic feet
gpm	gallons per minute
ha	hectares
in	inch
g	gram
kg	kilogram
km	kilometer
lb	pound
Lpm	liters per minute
m^3	cubic meter
mi	mile
pCi	pico Curie
ppm	parts per million
wt	weight
hr	hour
pCi/m^2 - S	pico Curies per square meter - second

LIST OF CHEMICAL SYMBOLS

B	Boron
C	Carbon
K	Potassium
Li	Lithium
Na	Sodium
Pb	Lead
Po	Polonium
Ra	Radium
Rn	Radon
Si	Silicon
Th	Thorium
U	Uranium

LIST OF ISOTOPES OF INTEREST OR CONCERN

Ra-226	Radium-226
Pb-210	Lead-210
Th-230	Thorium-230
Po-210	Polonium-210
U-234	Uranium-234
U-235	Uranium-235
U-236	Uranium-236
U-238	Uranium-238
Th-228	Thorium-228
Th-232	Thorium-232
Rn-222	Radon-222
Rn-220	Radon-220

1.0 PROJECT DESCRIPTION

1.1 OPERABLE UNIT 4 BACKGROUND

The Fernald Environmental Management Project (FEMP) is a contractor-managed federal facility once used for the production of purified uranium metal for the U.S. Department of Energy (DOE). The FEMP is located on 425 hectares (ha) (1050 acres) in a rural area approximately 27 km (17 mi) northwest of Cincinnati, Ohio. On July 18, 1986, a Federal Facilities Compliance Agreement (FFCA) was jointly signed by the U.S. Environmental Protection Agency (USEPA) and the DOE to ensure that environmental impacts associated with past and present activities at the FEMP are thoroughly investigated so that appropriate remedial actions can be assessed and implemented. This is a requirement under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). In 1989, the FEMP was added to the USEPA's National Priorities List (NPL) as one of the sites most urgently requiring remedial response.

The process of investigating the site and developing remedial actions is known as the Remedial Investigation/Feasibility Study (RI/FS). The RI/FS schedule for the FEMP was established in a Consent Agreement (signed in 1990 and amended in 1991) between the DOE and USEPA. To make this process more efficient, the FEMP has been segregated into five sections, depending on physical location and types of waste. These sections are known as operable units. Operable Unit 4 (OU4) is defined as a geographic area that includes Silos 1 and 2 (K-65 Silos), Silo 3 (metal oxide silo), the unused Silo 4, and their ancillary structures. Remediation of OU4 will address all of these items as well as any contaminated soils within the geographic boundary, and any contaminated perched water encountered while conducting OU4 remedial activities.

OU4 is located at the western periphery of the site, south of the waste pit area. The Remedial Investigation (RI) was conducted to determine the nature and extent of contamination in OU4 and to establish remedial action objectives. The Feasibility Study (FS) for OU4 evaluates remedial action alternatives for the silo structures, the materials stored in the silos, and contaminants in the surrounding soils, perched water and all structures within the OU4 boundary. Through the FS process, a wide range of potential remedial actions were developed and screened. Reasonable alternatives underwent detailed and comparative analyses. The "preferred alternative" for OU4 remediation will be proposed and submitted for public review in the Proposed Plan (PP). The Record of Decision (ROD), which is the final step in the RI/FS process, formally approves the alternative(s) that will be used for remediation. For OU4, the approval of the ROD is scheduled to occur in October, 1994.

In addition, it is DOE policy to integrate the National Environmental Policy Act (NEPA) into the procedural and documentation requirements of CERCLA wherever practicable. On May 15, 1990, a

Notice of Intent (NOI) was published in the Federal Register indicating that DOE planned to prepare an Environmental Impact Statement (EIS) consistent with NEPA to evaluate the environmental impacts associated with the cleanup actions for each of the five FEMP operable units. Consistent with the Notice of Intent, the resulting integrated process and documentation package are termed a Feasibility Study/Proposed Plan-Environmental Impact Statement (FS/PP-EIS).

Currently, the five FEMP operable units are at different stages for evaluating cleanup alternatives; however, each operable unit has identified a leading remedial alternative (see Appendix K of the FS Report for Operable Unit 4). As the cleanup process moves ahead, the leading remedial alternatives may be modified based on new information or on public comments and support agency [EPA and Ohio Environmental Protection Agency (OEPA)] comments. Functioning as the lead CERCLA/NEPA integrated document, the Operable Unit 4 FS/PP-EIS addresses cumulative environmental impacts for implementing the leading remedial alternatives for each FEMP operable unit. The NEPA cumulative analysis focuses on the potential impacts to human health and the environment as the result of implementing one or all of the leading remedial alternatives for the five FEMP operable units. The CERCLA/NEPA integrated documents prepared subsequent to Operable Unit 4 will be derived from, or be fully encompassed by, the impact analysis presented in the Operable Unit 4 FS/PP-EIS. If the leading remedial alternatives for any of the operable units change, additional NEPA review will be performed and documented as appropriate to evaluate the impacts to human health and the environment. This additional analysis will be presented in the integrated CERCLA/NEPA documents for the remaining operable units where appropriate.

1.2 HISTORY AND OPERABLE UNIT DESCRIPTION

Constructed in 1951, Silos 1 and 2 were used for the storage of radium-bearing residues which are by-products of uranium ore processing. Silos 1 and 2 received approximately 6120 m^3 (216,300 ft^3) of residues from 1952 to 1958. Raffinate filter cake (residue from a uranium solvent extraction process) was pumped into the silos as a slurry where the solids settled. The free liquid was decanted through a series of valves and piping vertically spaced symmetrically at various levels along the height of the silo wall. This pumping of slurry, followed by the settling and decanting, continued until the waste material was approximately 1.2 meters (four feet) below the top of the vertical wall. Historic analyses of the K-65 Silo residues indicate elevated levels of Ra-226, Pb-210, Th-230 and natural uranium are present in Silos 1 and 2.

Radon and the elements resulting from its decay (referred to as daughter products or progeny) are the nuclides of concern from a health and environmental perspective. Radon is known to be emanating from the silos through cracks and at structural joints. Radon and its daughter products are relatively mobile and capable of migrating through air and water. Through the RI characterization effort, it was found that the berms and subsoils contain localized areas of elevated levels of Pb-210 and Po-210, which are daughter products of radon.

As part of the Silos 1 and 2 Removal Action (Removal Action Number 4 per the Consent Agreement), a layer of Bentogrout (consisting of 30% bentonite clay in water) was placed over the K-65 residues in Silos 1 and 2 to attenuate radon releases to the environment and, in case of a structural failure of the silo dome, reduce the risk of uncontrolled airborne contamination. It is presupposed that the added Bentogrout will be remediated in the same manner as the K-65 material.

Silos 3 and 4 were constructed in 1952 in a manner similar to Silos 1 and 2; however, Silos 3 and 4 were designed to receive dry materials. Raffinate filtrate from refinery operations was dewatered in an evaporator and spray-calcined or kiln-dried to produce a dry powdery waste for placement in Silo 3. Silo 3 was filled using a positive pressure, pneumatic conveying system that blew the metal oxide powder into the silo. A bag house filter, which was removed in December 1991, was used during the filling process to remove particulates from the off gas.

Silo 3 contains approximately 3900 m^3 (137,500 ft^3) of calcined residues consisting of aluminum, calcium, iron and magnesium oxides; sodium salts; 18,000 kg (39,500 lbs) each of uranium and thorium; and a very small amount of radium and other metal oxides. Silo 3 is a minor radon source (relative to Silos 1 and 2) and is not believed to be a source of contamination to the surrounding areas and underlying soils. Nevertheless, Silo 3 will be considered a potential hazard because its contents are radioactive and, in their dry, powdery state, are susceptible to airborne dispersal if exposed to wind and due to the free-standing condition of Silo 3.

Silo 4 was never used. Except for rainwater infiltration, which has been observed in the past, it remains empty today.

1.3 INTRODUCTION TO THE PILOT PLANT PROGRAM

1.3.1 Purpose of the Pilot Plant Program

Operable Unit 4 personnel are currently preparing for the third tier of the USEPA-outlined approach for conducting treatability studies at a Superfund site (refer to Section 1.5). (Although the FEMP is not utilizing Superfund monies, this approach is applicable to the Pilot Plant program.) The third tier

(Remedial Design/Remedial Action [RD/RA] Treatability) consists of the design, construction, and operation of a one metric ton (1.1 tons) per day pilot scale facility for vitrification of K-65, bentonite clay, and Silo 3 material. Waste retrieval from the silos and sufficient control of radon gas will also be demonstrated with the demonstration being significant and critical to the final remediation effort. This third tier of treatability testing will be conducted in phases. Phase I of the OU4 Pilot Plant program will utilize bentonite and surrogate materials, the pilot scale vitrification facility, and the empty Silo 4 as a test bed for demonstrating both vitrification and waste retrieval technologies. Phase II, which follows Phase I, will utilize bentonite, actual K-65, and Silo 3 materials which will be retrieved from the silos. A separate work plan will be developed for Phase II. Phase II will address the treatment of radon gas since actual radon emitting materials will be processed. The results of this third tier treatability testing will be used to develop the design of facilities and equipment for the final remediation of Operable Unit 4.

As stated above, the OU4 program for vitrification, waste retrieval, and radon treatment is to be conducted in two phases. While both vitrification and waste retrieval demonstrations are included in the Phase I pilot program, their operation will be independent of each other.

Phase I is the equipment, process, and methodology proving stage for the vitrification facility and waste retrieval. The waste retrieval demonstration(s) will include hydraulic mining and material handling, silo dome modification (enlargement of the center manway), and equipment support and deployment methods to emulate an environmentally controlled process within the silo. Waste retrieval will require as much as 1,500 metric tons (1,650 tons) of surrogate material to be placed in Silo 4 to fully demonstrate the success and effects of a hydraulic mining process. Phase I will utilize a non-radioactive surrogate material, consisting of silty sands (or washed soil), Bentogrout, and water, that will be placed in Silo 4. Prior to being fed to the vitrification furnace, a metallic stream (in trace amounts) and sulfates will be added to the surrogate material to more closely simulate K-65 material. The vitrification facility will be designed for a one metric ton (1.1 tons) per day of product and will likely operate over a three month period. It is anticipated that Phase I will require approximately 20-30 metric tons (22-33 tons) of surrogate material to adequately demonstrate vitrification.

The following is a summary of the activities included in the scope of Phase I:

- Superstructure and Equipment Room Construction
- Silo 4 center manway enlargement
- Silo 4 surrogate material loading
- Hydraulic material retrieval demonstration(s) (Silo 4)
- Pilot scale vitrification facility construction
- Operation of the vitrification facility with surrogate materials

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Phase II of pilot scale testing for vitrification will be implemented in the vitrification facility constructed for Phase I. All lessons learned during Phase I, with regard to the process control and equipment operation, will be incorporated into Phase II. The Phase I design is being developed for the utilization of actual K-65 and Silo 3 material; therefore, the facility should require minimal modification for Phase II operation.

In addition to the hydraulic removal of actual K-65 material and the pneumatic removal of material from Silo 3 (both to be used for Phase II vitrification), Phase II will demonstrate radon control for the Silos 1 and 2 headspace gas. Radon control and off-gas treatment for the vitrification facility will be an independent treatment system.

As testing dictates, Silo 3 material will be mixed in with K-65 material at a predetermined ratio, then vitrified. Similar to Phase I, it is anticipated that adequate testing will require approximately 20 metric tons (22 tons) of K-65 material and 10 metric tons (11 tons) of Silo 3 material. Glass formulations currently being developed and optimized will be tested and further optimized (if required) during this phase of pilot scale testing. In addition to several process sampling points, the final glass product will be sampled and tested to ensure that it meets the process acceptance criteria to be addressed in the Phase II Work Plan. The following is a preliminary list of the major activities to be included in the scope of Phase II:

- K-65 Silo Radon Treatment System (RTS) upgrade
- Vitrification facility modification (if required)
- K-65 hydraulic material retrieval
- Silo 3 pneumatic material retrieval
- "Hot" operation of the vitrification facility

Information obtained from the Phase I & II Pilot Plant program will be used to generate quantitative performance data and to further refine the cost estimate for full-scale remediation. The design will focus on the following remedial alternatives:

- vitrification treatment (Alternatives 2A and 3A.1 for Silos 1 and 2);
- hydraulic waste removal (Alternatives 2A and 3A.1 for Silos 1 and 2);
- pneumatic removal and vitrification treatment of Silo 3 material (Alternatives 2B and 3B.1 for Silo 3).

The remedial alternatives considered for OU4 are described in Section 2.

5 4 3 5

1.3.2 Organization of the Work Plan

This work plan describes Phase I of the OU4 Pilot Plant program for waste retrieval and vitrification. It is organized in accordance with USEPA guidance (1992) and includes the 15 USEPA-suggested sections. In addition, a discussion of the regulatory requirements governing construction and operation of the Pilot Plant, including a permit information summary for Phase I, is included.

This Phase I work plan describes the initial use of surrogate material as a substitute for the silo material to perform system operability testing and readiness reviews of the waste retrieval and vitrification processing equipment prior to the introduction of radioactive materials during Phase II. The Phase II work plan will address the implementation actions required for the hydraulic removal of the K-65 material from Silo 1 or 2, the pneumatic removal of the metal oxide material from Silo 3, and vitrification of the actual K-65 and metal oxide material.

1.4 PREVIOUS VITRIFICATION STUDIES

The OU4 RD/RA Treatability Study for vitrification of the silo materials is being conducted based on encouraging results from previous laboratory and bench-scale testing. The following sections summarize these results.

1.4.1 Laboratory Testing by PNL in 1991

In February 1991, Westinghouse Materials Company of Ohio (WMCO) published the results of FEMP K-65 residue vitrification tests in the Treatability Study Report, "Characteristics of Fernald's K-65 Residue Before, During, and After Vitrification." The following, which is extracted from that report, details the background for conducting the vitrification tests, as well as several key findings and test results:

"*. . . Vitrification of radioactive and hazardous wastes has been under thorough investigation since the mid-1950s. During the high-level waste development program, the U.S. Department of Energy accumulated over 40 years of operating experience with the vitrification process (Chapman and McElroy, 1989). Vitrification has endured international scrutiny and is the preferred international treatment method for the most radioactive and hazardous high-level radioactive wastes (DOE/RL-90-27). Other compelling factors support the use of vitrification for treating many types of hazardous and radioactive wastes:*

- *The USEPA has promulgated vitrification as the treatment standard {i.e., best demonstrated available technology (BDAT)} for high-level radioactive mixed waste (Federal Register, June 1, 1991), and a BDAT for arsenic-containing hazardous wastes (Federal Register, ca. May, 1990).*

- *The glass, formed with, at most, minor chemical additions to the waste, generally tests by the Toxicity Characteristic Leachate Procedure (TCLP) or by the Extraction Procedure (EP) toxicity criteria as nonhazardous.*

- *Volume reduction for solids is typically greater than 60 percent."*

"In a vitrified matrix, the diffusion of gases with atomic radii equal to or greater than krypton (1.03 angstrom) and xenon (1.24 angstrom), such as radon (1.34 angstrom), is nil. Thus, once vitrified, release of radon from the residue will be limited to the modest amount of externally exposed surface area. It has been found that volcanic glass has the highest radon retention ability of the 59 rock samples studied. Based upon these favorable processing and product characteristics, vitrification of the K-65 residue is an environmentally progressive and technically sound option for treating this material."

"For the work reported in February 1991, Pacific Northwest Laboratory (PNL) received approximately 15 lbs (7 kg) of the K-65 residue from Silo 1 for vitrification tests. The objectives of the tests were to determine the quantity and composition of off-gas evolved during vitrification, the radon emanation rate from both the original K-65 residue and the vitrified product, and the leachability of the vitrified material.

- *Vitrified K-65 residue (Specific Gravity = 3.1) has a volume that is 35 percent of dried, tamped K-65 residue (Specific Gravity = 1.06), a 65 percent volume reduction.*

- *The radon emanation flux from the K-65 residue was reduced by more than 33,000 times when vitrified. The flux from the original material was measured to be 1.5 million pCi/hr or 52,400 pCi/m^2-S, while glass was 48 pCi/hr or 1.56 pCi/m^2-S (an order of magnitude below the USEPA limit of 20 pCi/m^2-S). We predict that during full-scale processing, the flux may be further reduced by a total factor of up to 90,000 to 2,400,000 because the test crucible had both unmelted material and a coat of glass on the crucible walls. Therefore, the actual surface area exceeded the assumed surface area by a factor of more than 3.*

- *The off-gas data indicate that for the chemicals present, 99.5 percent to 99.95 percent is retained in the glass. This is typical of results obtained during thousands of hours of melter testing with simulated high-level radioactive waste slurries.*

- *As measured by the TCLP, the vitrified K-65 residue tests as nonhazardous. The two TCLP heavy metals present in the glass were barium at 4.4 wt% and lead at 9.9 wt%. The leachate concentrations were 0.98 ppm and 0.3 ppm for barium and lead, respectively, which is well below the limits of 100 and 5 ppm for barium and lead. Results from EP toxicity tests for this (untreated) K-65 residue show a leachate concentration of 0.76 and 630* *ppm for barium and lead, respectively. Thus, the vitrified product improved the leach resistance for lead by a factor of over 2000.*

- *The vitrified product is so durable that it could not be dissolved in a hot mixture of concentrated nitric and hydrofluoric acid by Controls for Environmental Pollution (CEP), Inc., during their analyses of the glass."*

The TCLP leachate results from the previous laboratory test for the vitrified K-65 waste are presented in Figure 1-1. The results are well below the established TCLP limits.

1.4.2 Treatability Study for the Vitrification of Residues from Silos 1, 2, and 3

As seen in 1.4.1, preliminary vitrification tests for the K-65 material yielded promising results. This supported the development of a more comprehensive vitrification treatability study program for the treatment of all OU4 silo materials. The objective of this subsequent vitrification treatability testing (bench-scale), as described in the vitrification work plan [DOE 1992b- "OU4 Treatability Study Work Plan for the Vitrification of Residues from Silos 1, 2, and 3" (approved by the USEPA in April, 1992)],was to provide data to allow comparison of vitrification to other remediation treatment technologies based upon the following criteria:

- leachability of the final product;
- reduction in volume achieved through processing; and
- reduction in radon emanation from the waste material.

Physical and chemical characterization of the silo material was performed to evaluate vitrification performance. Initial laboratory screening melts were carried out to investigate different glass formulations. Bench-scale melts were then performed. For this, glass formulations were developed for four different mixtures of the K-65, Silo 3, and Bentogrout material. A vitrified product was made and tested in duplicate for each of these mixtures (see Table 1-1). The study results [OU4 Treatability Study Report for the Vitrification of Residues from Silos 1, 2, and 3 (May, 1993)] included the following findings:

- *"The measured radon emanation rate from the glass is approximately equal to the emanation rate from natural building materials such as brick and concrete, even though the radium content of the waste glass is 10^3 to 10^6 times greater than that of natural building materials. A reduction in the radon emanation of about 500,000 times was obtained in the bench-scale vitrification tests."*

- *"Essentially all of the radon initially present in the sample is released during vitrification, providing an upper bound to the expected radon concentration in the off-gas from the vitrification system."*

- *"The final glass product (density from 2.7 to 2.9 g/cm³) has a volume of about 32 percent to 50 percent of the initial waste volume, representing a volume reduction of 50 percent to 68 percent."*

- *"The PCT results show the durability of the glasses from all four sequences to be comparable to the durability of glasses developed for high-level waste. The normalized leach rates for the elements considered (K, Na, Si, Li, B, U, Th, Ra-226 ranged from 0.0002 to 0.09 g/m²/d. Leaching of radium-226 was one to two orders of magnitude less than the leaching of the major constituents of the glass."*

- *"The vitrified residue from all sequences tested nonhazardous as measured by the TCLP. Previous testing found the untreated K-65 and Silo 3 materials to test hazardous for several metals (lead for K-65; arsenic, cadmium, chromium, and selenium for Silo 3). Lead concentrations in the leachate from the glass were reduced several hundred times relative to the untreated K-65 material, while for the Silo 3 material, arsenic was reduced about 100 times, and cadmium, chromium, and selenium were reduced to less than or near less than detection limits."*

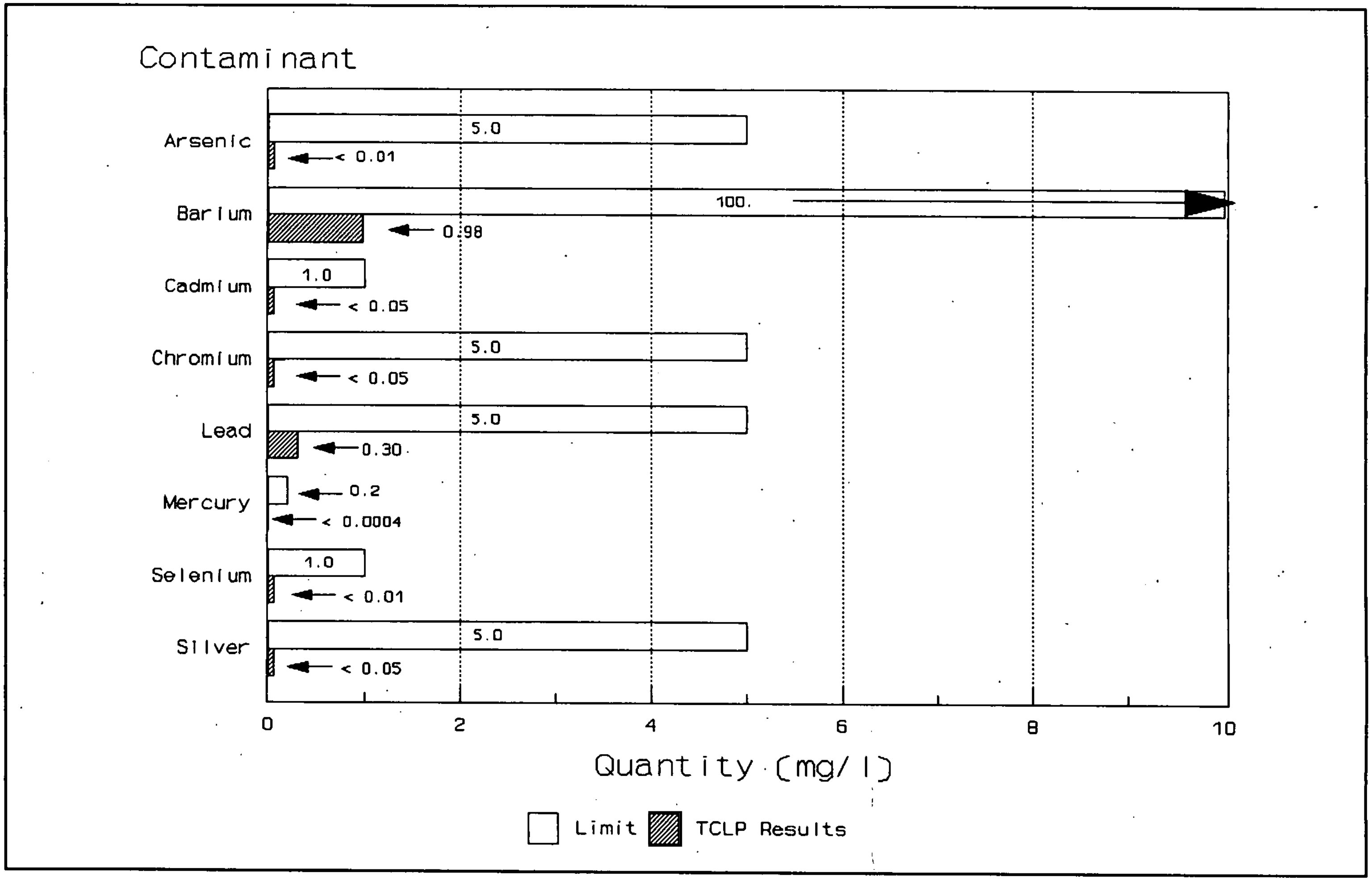

FIGURE 1-1
1991 Laboratory Vitrification Testing TCLP Leachate Results for Vitrified K-65 Material: Concentration of Metals in Leachate

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TABLE 1-1

Summary of Vitrification Tests for OU4 Bench-Scale Treatability Testing

SEQUENCE	TEST*	TYPE OF MATERIAL	APPROX. AMOUNT OF MATERIAL	DESCRIPTION
0		K-65 Silo 3 Bentogrout	As required	Small melts of approx. 100 to 150 grams each to develop glass formulations for the Sequence A through D tests and to test the system and operating procedures.
A	Open	K-65	1.0 kg	K-65 material and glass forming reagents as determined in the Sequence 0 tests. Radon concentration monitored in the off-gas stream.
A	Closed	K-65	1.0 kg	Duplicate of open system test. Off-gas collected for analysis.
B	Open	K-65 Bentogrout	0.5 kg 0.5 kg	K-65 material, Bentogrout, and glass forming reagents as determined in the Sequence 0 tests. Radon concentration monitored in the off-gas stream.
B	Closed	K-65 Bentogrout	0.5 kg 0.5 kg	Duplicate of open system test. Off-gas collected for analysis.
C	Open	Silo 3	1.0 kg	Silo 3 material and glass forming reagents as determined in the Sequence 0 tests.
C	Closed	Silo 3	1.0 kg	Duplicate of open system test. Off-gas collected for analysis.
D	Open	K-65 Silo 3	0.7 kg 0.3 kg	K-65/Silo 3 material and glass forming reagents as determined in the Sequence 0 tests. Radon concentration monitored in the off-gas stream.
D	Closed	K-65 Silo 3	0.7 kg 0.3 kg	Duplicate of open system test. Off-gas collected for analysis.

*Open and closed refers to off-gas system configuration

- *"The fractional release of radionuclides from the glass was similar to that of the major constituents of the glass, indicating that selective leaching of radionuclides did not occur."*

Some of the report's recommendations follow:

- *"Appropriate glass formulations should be developed and acceptable limits of material variability of the waste determined."*

- *"Small-scale tests of systems for removal of radon from the off-gas stream are needed to provide data for designing a radon control system for processing operations."*

- *"Pilot-scale testing in a continuous melter should be carried out to validate the glass formulations developed in crucible melts and to provide data necessary for sizing and design of the full-scale system."*

The first item is currently being pursued under an OU4 glass development project. A radon adsorption experiment utilizing granular activated carbon is currently being implemented by CRU4 and data should be available later this year. Title II design for Phase I of the OU4 pilot-scale testing is currently nearing completion.

1.4.3 Glass Development Program

The development of glass formulas is currently nearing completion. The scope of work for the bench-scale treatability study for vitrification of residues from Silos 1, 2, and 3 addressed the basic glass development work. These bench-scale results were very promising; however, further development of the glass formulation was deemed necessary prior to conducting pilot-scale testing. Optimization of glass formulations reduces risk and will improve the Pilot Plant operational performance. Optimization addresses formulating a glass that has acceptable durability, viscosity, conductivity, and phase stability properties. The program will also determine acceptable ranges of additives to respond to the variability in the waste composition at lowest practical furnace temperatures. TCLP results will be obtained for the optimized formulation and processability and robustness will be the basis for defining the operating envelope for the Pilot Plant tests (Phase II).

Glass formulations are being developed in conjunction with glass scientists at PNL using data from the previous bench-scale melts performed as part of the treatability study testing with a reference waste composition material. During the screening tests, 100 g (0.22 lb) test melts were made with several different glass formulations. Most melts were made with nonradioactive simulants; however, the melt at the reference composition for each composition will be duplicated using the actual K-65 material. The criteria for deciding on the optimum formulation will be based on the TCLP results of the reference glass, the processability, the phase stability and the ability to handle variation in the waste feed composition. The formulation chosen from these screening tests will be quantitatively studied during optimization of the formulation.

Optimization of the chosen formulation will help define the operating envelope for the Phase II pilot-scale tests. This will be accomplished through a statistically designed series of tests over a range of credible waste stream compositions. These melts will include testing with simulants and testing with the actual waste material. The response of TCLP and glass viscosity and conductivity to waste variations will be quantitatively determined, and acceptable limits for variability in the waste stream will be determined.

1.5 USEPA TREATABILITY GUIDANCE

According to USEPA guidance on conducting Treatability Studies, as many as three tiers of treatability testing may be required (see Figure 1-2):

- Remedy Screening (Laboratory Screening)
- Remedy Selection (Bench-scale or Pilot-scale Testing)
- RD/RA (Pilot-scale or Full-scale)

Operable Unit 4 is currently preparing for the third tier, RD/RA treatability testing for vitrification. RD/RA treatability studies are conducted after the Record of Decision (ROD), which states the selected remedial action for the operable unit. The post-ROD study is intended to provide the detailed design, cost and performance data required to optimize the treatment process and the design of a full-scale treatment system. It complements the information obtained during the RI/FS phase; which in the case of Operable Unit 4, is the earlier laboratory and bench-scale treatability studies (see Figure 1-3). As the figure shows, Phase I and II of the pilot-scale testing will occur after the ROD.

The USEPA Guide for Conducting Treatability Studies under CERCLA (1992) lists potential reasons for performing RD/RA treatability testing, including "to support the design of treatment trains." Previous OU4 laboratory and bench-scale treatability study results indicate that vitrification of OU4 materials is a viable treatment alternative. However, the proposed vitrification process must still be proven on a continuous, pilot-scale level prior to performing a full scale facility design. Phases I and II of the Pilot

Plant program will accomplish this by providing information on continuous operation performance, maintainability, constructability, equipment sizing, material handling, process upset and recovery, side-stream and residuals generation and treatment (i.e. waste water, radon), energy and reagent usage (i.e process additives), and sampling and analysis of the process and the final product.

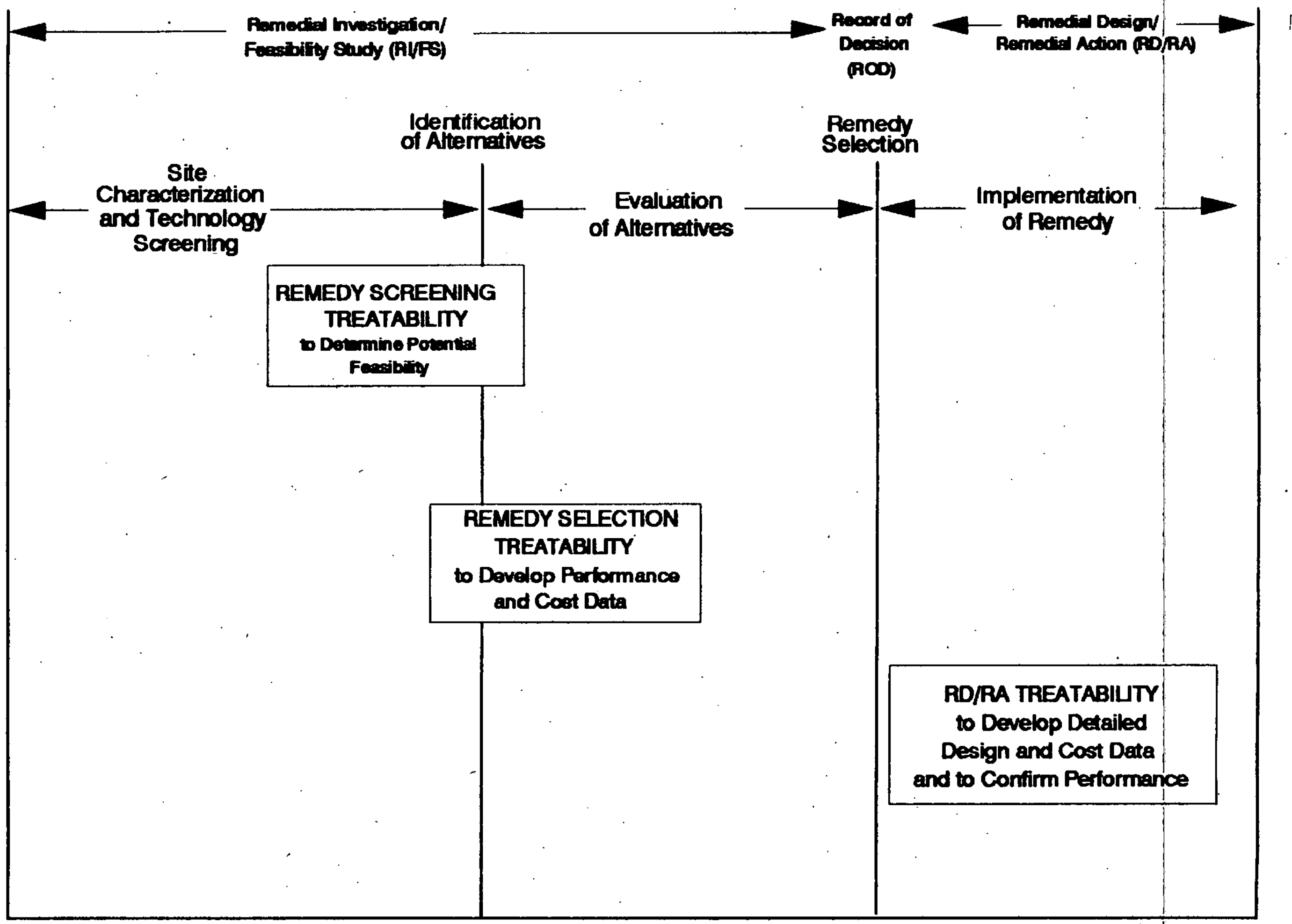

FIGURE 1-2

The Role of Treatability Studies in the RI/FS and RD/RA Process

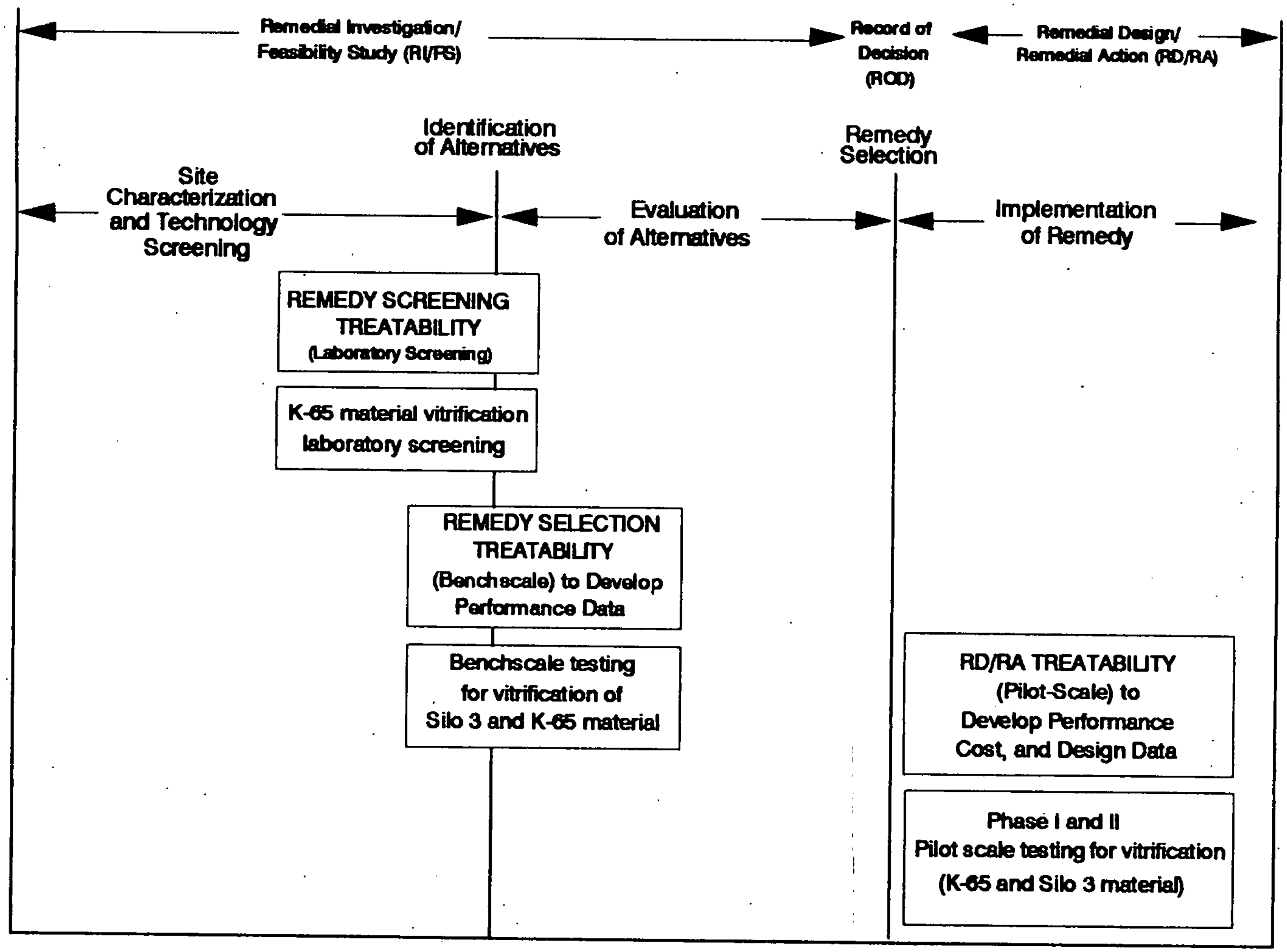

FIGURE 1-3

Relationship of the OU4 Vitrification Treatibility Studies to the RI/FS and RD/RA

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2.0 REMEDIAL TECHNOLOGY DESCRIPTION

Several remediation technologies are being considered for Operable Unit 4. These alternatives have been described in detail in the DOE report "Initial Screening of Alternatives for Operable Unit 4, Task 12 Report, October 1990." In this report, Silos 1 and 2 are treated by the same alternatives because the silo contents are similar. Silo 3 is treated in separate alternatives. The alternatives have since been revised and included in the Final Feasibility Study for Operable Unit 4, dated February 1994.

The Phase I Pilot Plant program includes demonstrating the technology for:

- silo dome modification;
- removal of surrogate material from Silo 4;
- vitrification of surrogate K-65 material; and
- off-gas control and treatment (i.e., radon treatment).

The following descriptions of alternatives include implementation of the following technologies: hydraulic removal of the material from Silos 1 and 2; pneumatic removal of the material from Silo 3; and material vitrification. Phase II of the Pilot Plant Program will utilize the actual K-65 material from Silo 1 or 2, and metal oxide material from Silo 3.

The vitrification technology considered in the following alternatives consists of heating the residues to sufficient temperatures to induce the formation of glass-like mass. The resulting vitreous solid would have a reduced volume. The mobility (leachability) of the constituents of concern in the K-65 and Silo 3 residues would be greatly reduced, and the stabilized waste form would have a greatly reduced radon emanation rate. The vitrified material would be well suited for long-term disposal.

The following remedial alternatives have been developed and were retained for detailed and comparative analysis in the Operable Unit 4 Feasibility Study.

2.1 ALTERNATIVE 2A - REMOVAL, STABILIZATION, AND ON-PROPERTY DISPOSAL

This alternative involves the removal of the Silos 1 and 2 contents, the stabilization of the contents either by vitrification or cement stabilization, and the on-property disposal of the stabilized waste. The technologies implemented by this alternative are hydraulic mining, waste stabilization, on-property disposal, monitoring, and access controls.

Under this alternative, the silo contents would be removed with a hydraulic mining device introduced through the silo domes. This equipment would be supported by a platform that spans the silo. The material would then be pumped to a waste processing facility for cement stabilization or vitrification. The containerized, stabilized waste would then be disposed in an above-grade disposal vault constructed at a suitable location at the FEMP.

The following is a description of the technologies and process options considered for this alternative:

Hydraulic Removal

The silo contents would be removed with a remotely operated hydraulic mining device suspended from a superstructure constructed over the silos and deployed through the modified dome opening. A primary containment enclosure would be used at the silo dome interface. The hydraulic mining device would consist of a circumferential jetting ring, which would use high pressure water to dislodge and liquify the wastes, and a slurry pump to pump the slurried wastes from the silos to the waste processing facility. The majority of the water used would be recycled to the hydraulic removal system.

The hydraulic mining device would sluice and transport the bulk of the K-65 material. To remove the heel, a remotely operated tracked vehicle [developed by the DOE Office of Technology Development (OTD) Program] could be deployed to continue a more controlled hydraulic mining process. After all pumpable material is removed, the tracked vehicle could work in conjunction with the 5-ton monorail crane to mechanically remove residual debris (i.e., glass sample jars, plastic glove bags, and other non-pumpable materials).

A radon treatment system (RTS) would utilize dehumidifiers, carbon adsorbers, and High Efficiency Particulate Air (HEPA) filters to reduce the radon in the silo dome void space during removal operations. The system would maintain the silo headspace under negative pressure to minimize the possibilities of leakage to the environment.

Treatment

A waste processing facility would be constructed to house the waste processing, packaging, and waste from sampling/assaying operations. It would incorporate shielding to reduce personnel exposure doses, air treatment systems, and negative ventilation to minimize emissions. All wastes would be staged at this facility prior to disposal.

Waste stabilization - the silo contents would be stabilized by vitrification or cement stabilization. The vitrification process would add glass-making additives, such as soda ash and lime, to produce a glass product with excellent wear and leach characteristics. The process would utilize a thickener, additive storage silos, an additive and waste slurry mixer, a glass melter, a fume hood/cap, and an off-gas treatment system. The cement stabilization system would add cement and flyash to produce a monolithic concrete product with reduced leaching characteristics. The majority of the water used in removing the wastes would be used in the cement stabilization process. The process would require a thickener, additive storage silos, screw feeders, a pug mill, a fugitive emission treatment system, and drying/drumming equipment.

On-Property Disposal

Above-Grade Disposal Vault - the resultant stabilized waste would be disposed on-property at the FEMP in an on-property, above-grade disposal vault. This facility would be constructed at grade and would utilize a leachate collection/detection system, a multimedia cap, a radon barrier, and an inadvertent intrusion barrier.

Monitoring

Radon monitors would be installed around the disposal facility containing the stabilized waste to detect radon that emanates from the facility. Also, a series of groundwater monitoring wells would be installed around the cap of the above-grade disposal vault and the waste processing facility and sampled on a routine basis to monitor the containment system performance. A leachate collection/detection system would be installed and be routinely monitored to assess the performance of the facilities.

Access Controls

A security fence topped with barbed wire would surround the multimedia cap to discourage intruders. A security force would patrol the area during the period of active institutional controls. During this period, access to the site would be posted and confined to authorized personnel only. Permanent physical markers, identifying the disposal area, would also be used. To provide added insurance against any future activities by man to inadvertently intrude into the disposal vault, permanent markers would be installed to identify the vault and restrictions would be placed in the site deed. Additionally, the affected disposal areas at the FEMP would be placed under the perpetual ownership of the federal government.

2.2 ALTERNATIVE 3A.1 - REMOVAL, STABILIZATION AND OFF-SITE DISPOSAL

This alternative involves the removal of the Silos 1 and 2 contents, the stabilization of the contents by either vitrification or cement stabilization, and the off-site disposal of the stabilized wastes. This alternative is identical to Alternative 2A with the exception that the on-property disposal, monitoring, and access controls technologies have been replaced by the waste transportation and off-site disposal technologies. The wastes would be transported to the disposal facility either by rail and/or truck. The following is a description of the additional technologies and process options developed for this alternative:

Waste Transportation

The FEMP can support rail transport to a location near the disposal facility by using existing on-site rail spurs. Currently, there are no direct rail lines to the Nevada Test Site (NTS). From a location in the vicinity of the NTS, the containers carrying the treated material would be transferred to trucks for over-the-road transportation to the NTS. Truck transport can offer portal-to-portal service with the road system available at the FEMP. Improvements to the existing road system in the vicinity of the FEMP may be required to accommodate the increased truck activity.

Off-Site Disposal

The stabilized waste would be shipped to the NTS for disposal. The NTS is a DOE-owned facility that currently accepts low-level radioactive waste (LLRW) from DOE facilities. It is located approximately 3219 km (2000 miles) from the FEMP in an arid environment. The waste stream would meet the applicable NTS waste acceptance criteria.

2.3 ALTERNATIVE 2B - REMOVAL, STABILIZATION, AND ON-PROPERTY DISPOSAL

This alternative involves the removal of the Silo 3 contents, the stabilization of the contents by vitrification or cement stabilization, and the on-property disposal of the stabilized waste. The technologies implemented by this alternative are pneumatic removal, waste stabilization, on-property disposal, monitoring, and access controls.

A waste processing facility would be constructed to house the waste processing, packaging, and waste form sampling/assaying operations. It would incorporate shielding, air treatment systems, and negative ventilation to minimize emissions.

The silo contents would be removed with a pneumatic device introduced through the silo domes. This equipment would be supported by a work platform that would span the silo. The material would then be pneumatically conveyed to a waste processing facility for cement stabilization or vitrification. The stabilized waste would then be disposed of in an above-grade disposal vault. The following is a description of the additional technologies and process options developed for this alternative:

Pneumatic Removal

The silo contents would be removed with a vacuum and cutter-head device. The device would be supported by a work platform spanning the silo and would be introduced into the silos through the four perimeter manways and the off-center, central manway. The device consists of a cutter-head which would dislodge the wastes, and a vacuum nozzle that would pneumatically remove the waste.

Treatment

Waste stabilization - the silo contents would then be stabilized by vitrification or cement stabilization. The vitrification process would add glass-making additives, such as soda ash and lime, to produce a monolithic glass product with excellent wear and leach characteristics. The process would utilize additive storage silos, an additive and waste mixer, a glass melter, a fume hood/cap, and an off-gas treatment system. The cement stabilization system would add cement and flyash to produce a monolithic concrete product with reduced leaching characteristics.

On-Property Disposal

Above-Grade Disposal Vault - the resultant stabilized waste would be disposed on-property at the FEMP in an on-property, above-grade disposal vault. This facility would be constructed at grade and would utilize a leachate collection/detection system, a multimedia cap, a radon barrier, and an inadvertent intrusion barrier.

Monitoring

Radon monitors would be installed around the disposal facility containing the stabilized waste to detect radon that emanates from the facility. Also, a series of groundwater monitoring wells would be installed around the cap of the above-grade disposal vault and the waste processing facility and sampled on a routine basis to monitor the containment system performance. A leachate collection/detection system would be installed and be routinely monitored to assess the performance of the facilities.

Access Controls

A security fence topped with barbed wire would surround the multimedia cap to discourage intruders. A security force would patrol the area during the period of active institutional controls. During this period, access to the site would be posted and confined to authorized personnel only. Permanent physical markers, identifying the disposal area, would also be used. To provide added insurance against any future activities by man to inadvertently intrude into the disposal vault, permanent markers would be installed to identify the vault and restrictions would be placed in the site deed. Additionally, the affected disposal areas at the FEMP would be placed under the perpetual ownership of the federal government.

2.4 ALTERNATIVE 3B.1 - REMOVAL, STABILIZATION AND OFF-SITE DISPOSAL

This alternative requires the removal of the Silo 3 contents, the stabilization of the contents by vitrification or cement stabilization, and the off-site disposal of the stabilized wastes. This alternative is identical to Alternative 2B with the exception that the on-property disposal, monitoring, and access controls technologies have been replaced by the waste transportation and off-site disposal technologies. The wastes would be transported to the disposal facility by rail and/or truck. The following is a description of the additional technologies and process options developed for this alternative:

Waste Transportation

The FEMP can support rail transport to a location near the disposal facility by using existing on-site rail spurs. Currently, there are no direct rail lines to NTS. From a location in the vicinity of NTS, the containers carrying the treated material would be transferred to trucks for over-the-road transportation to NTS. Truck transport can offer portal-to-portal service with the road system available at the FEMP. Improvements to the existing road system in the vicinity of the FEMP may be required to accommodate the increased truck activity.

Off-Site Disposal

The stabilized waste and the demolition debris would be shipped to the NTS for disposal. NTS is a DOE-owned facility that currently accepts LLRW from DOE facilities. It is located approximately 3219 km (2000 mi) from the FEMP in an arid environment. The waste stream would meet the applicable NTS waste acceptance criteria.

2.5 ALTERNATIVE 4B - REMOVAL AND ON-PROPERTY DISPOSAL

This alternative requires removal of the Silo 3 contents, packaging, and on-property disposal of the untreated material. This alternative is identical to Alternative 2B, with the exception that it does not include treatment. Under Alternative 4B, approximately 3895 m^3 (5093 yd^3) of contaminated materials would be removed from Silo 3 and packaged in containers for disposal in an on-property above-grade concrete disposal vault with multi-media cap.

3.0 TEST AND DATA QUALITY OBJECTIVES

3.1 OVERALL PILOT PLANT PHASE I OBJECTIVE

The overall program objective for Phase I of the Pilot Plant project is to demonstrate waste retrieval and the vitrification process and its support systems prior to engaging in the treating of radioactive materials in Phase II. This will involve the construction and "cold" operation of a pilot scale vitrification facility and the use of Silo 4 as a surrogate test bed. Phase I, and ultimately Phase II, will provide data to support the technologies and methodologies being proposed for the remediation of the K-65 Silos and Silo 3.

Section 3.3 of this work plan identifies the Phase I Data Quality Objectives (DQOs) for sampling activities including soil, water, and concrete characterization, geotechnical sampling for facility siting and design, and operation of the Pilot Plant equipment using surrogate materials. The DQOs for Section 3.3 were developed using program requirements from the EPA fully approved FEMP Sitewide CERCLA Quality Assurance Project Plan (SCQ) and other EPA treatability guidance. Optimum process parameters for the treatability of K-65 and Silo 3 material will be identified in Phase II. As required by the SCQ, the engineering design and environmental program DQOs for this project are provided in this work plan. Data will be documented in the appropriate regulatory report or engineering design document.

3.2 PERFORMANCE OBJECTIVES

This section addresses the performance objectives that must be achieved to successfully demonstrate hydraulic waste retrieval from Silo 4 and vitrification on a continuous basis. The Phase I objectives include the successful demonstration of the Silo Material Retrieval and Transport System, Slurry Dewatering System, Melting System, and Offgas Treatment System. Elements of these and their specific objectives are presented below.

3.2.1 Silo Dome Modification

The dome on Silo 4 will be modified to accommodate deployment of in-silo hardware for surrogate material retrieval. This requires enlarging the existing center access manway. The manway enlargement will be accomplished in a way that duplicates the requirements for enlarging the access to Silos 1 and 2 at a later date, allows for control of off-gas, and ensures structural stability of the silos.

3.2.2 Superstructure

An independently supported superstructure will be installed over the center section of the Silo 4 dome. The superstructure supports a work platform and includes an Equipment Room to be used as a deployment pod for the hydraulic mining device (see Section 3.2.3). Use of the superstructure and Equipment Room relative to silo dome modification and waste retrieval operations will be demonstrated, including offgas control. In addition, it can be used as a training ground prior to conducting operations on Silos 1, 2, and 3.

3.2.3 Hydraulic Mining

To demonstrate hydraulic mining, Silo 4 will be filled with approximately 1,300 metric tons (1,430 tons) of sand (or washed soil) at 30% moisture. Then, approximately 173 metric tons (190 tons) of Bentogrout will be placed on the K-65 simulant to emulate the bentonite cap in Silos 1 and 2. Total depth of material in the silo will be as much as 1.8 meters (6 feet).

The hydraulic mining device will be deployed through the enlarged center manway of Silo 4 to demonstrate the ability to slurry and pump material from as far away as 40 feet from the deployment point. This will provide information in support of final remediation design and operations.

There will be a second demonstration during Phase I. A smaller hydraulic mining device will be fitted through an existing silo perimeter manway. Its deployment and operation methodology will be tested prior to its use during Phase II. Its primary purpose is to supply 20 metric tons (44,000 lbs) of K-65 material to the vitrification facility during Phase II.

3.2.4 Solids Dewatering

Solids dewatering consists of the thickener which is designed to increase the slurry solids content from 15-20% solids to 50%. This equipment will be tested on the surrogate material mined from Silo 4. The solids content target must be met within about 8 hours of transferring solids to the thickener.

3.2.5 Vitrification

The rate at which the dewatered material can be successfully vitrified is the biggest unknown. The dewatered material is transferred from the thickener to a slurry mixing tank. Also added to the tank is about 10 wt percent (dry basis) additives (i.e, sodium carbonate) and trace amounts of metallic elements and sulfates, as testing dictates. The mixed solids are fed directly as a slurry (40 to 45% moisture) into the vitrification furnace. The target vitrification rate is 1,000 kg (2,200 lbs) of glass product per 24-hour day.

Vitrification testing will be conducted to determine achievable throughput rates, glass viscosity versus furnace temperature, whether or not and to what extent foaming and phase separation occurs, the results of metals separation in the molten glass, leachability of the final product, the required furnace retention time, and the relative effect of mechanical agitation on the glass product and required furnace temperature.

3.2.6 Support Systems

Support systems include all other equipment in support of vitrification and waste retrieval, i.e. offgas systems, tanks, pumps, fans, filters, cooling systems, etc. Operation of all support systems will be tested to ensure design requirements are met.

3.3 DATA QUALITY OBJECTIVES

DQOs for Phase I activities have been developed and are shown in Table 3-1. Included are characterization of the soil, water, and concrete prior to construction, and sampling activities during start-up and operation of the Pilot Plant equipment using surrogate materials.

Prior to construction, site characterization is required to determine the proper action, i.e. Removal Action required, and proper disposition of the disturbed media. The soil in the area of construction and the Silo 4 concrete, which will be removed from the dome during dome modification, requires characterization. If it is determined that insufficient Resource Conservation and Recovery Act (RCRA) or radiological data and/or process knowledge exist for any of these media, then sampling will be required. This determination is made by the FEMP Site Characterization organization.

As shown in Table 3-1, sampling performed on the soil and concrete will meet Analytical Support Level (ASL) C. Also requiring sampling is the water (if any) that has accumulated in Silo 4. This will determine the required treatment (if any) to ensure that the FEMP National Pollutant Discharge Elimination System (NPDES) requirements will be met upon discharge. Sampling performed on the water is specified as ASL B. Preconstruction requires geotechnical sampling to determine soil design data such as soil classification, moisture content, specific gravity, grain size analysis, Atterberg Limits, consolidation, California Bearing Ratio, and maximum density. This sampling activity has been

TABLE 3-1
Sampling and Analysis Activities for Pilot Plant Phase I

PARAMETERS	RATIONALE/ OBJECTIVE	SAMPLE METHODOLOGY	FREQUENCY (MIN)	SAMPLE PREP	ANALYTICAL METHODS	ASL	QC SAMPLES
SOIL	GEOTECHNICAL ENG/DESIGN	PER ASTM	9 SAMPLES TOTAL	PER ASTM	ASTM 2487, 2488, 2216, 854, 422, 4318, 2435, 1883, 4253	A	PER ASTM
SOIL	CHARACTERIZATION FOR RCRA/RAD	EM&S-SMPLN-93-278	PER SAMPLE PLAN	PER SAMPLE PLAN	PER SW-846, TCLP - METALS/VOA/SVOA RAD-TOTAL U, $^{233/236}$U, ^{238}U, TOTAL THORIUM, ^{230}Th, ^{232}Th, ^{226}Ra	C	FIELD: EM&S SMPLN 93-278 LAB: PER SW-846 AND RAD METHODS
SILO 4 RAINWATER	NPDES CHARACTERIZATION	EM-SMPLN-EC&S-REG-91-067	PER SAMPLE PLAN	PER SAMPLE PLAN	40 CFR 136.3, TABLE 1A, 1B, 1C, 1D, 1E	B	FIELD: EM-SMPLN EC&S-REG 91-067 LAB: PER METHODS
CONCRETE	NON-DESTRUCTIVE EVALUATION ENGINEERING DESIGN	PER ASTM OR VENDOR METHODS		PER ASTM	ASTM PULSE ECHO, IMPULSE RADAR, IMPACT ECHO, PACHOMETER	A	PER ASTM OR VENDOR METHODS
CONCRETE	WASTE CHARACTERIZATION TCLP RCRA/RAD	SCARIFY (CHIP)	TBD	TBD	PER SW-846, TCLP - METALS/VOA/SVOA RAD-TOTAL U, $^{233/236}$U, ^{238}U, TOTAL Th, $^{230/232}$Th, ^{226}Ra	B	FIELD: EM&S SMPLN 93-278 LAB: PER SW-846 AND RAD METHODS
PROCESS SLURRY	ENGINEERING DESIGN PROCESS OPTIMIZATION	GRAB SAMPLE	1 PER BATCH	PER METHOD	ASTM 2216 OR 4643 PERCENT SOLIDS	B	DUPLICATES
GLASS	ENGINEERING DESIGN COMPRESS STRENGTH; VISUAL FOR PHASE SEPARATION	GRAB SAMPLE	1 PER BATCH	PER ASTM	ASTM FOR COMPRESSIVE STRENGTH; VISUAL FOR APPEARANCE	B	DUPLICATES
GLASS	LEACHABILITY - TCLP	GRAB SAMPLE	1 PER BATCH	PER METHOD	TCLP	C	DUPLICATES
PROCESS OFF-GAS	PROCESS DESIGN	REAL TIME MONITORING	REAL TIME	N/A	40 CFR 61 (ISOKINETIC SAMPLER) APPENDIX B, METHOD 114	B	N/A
RECYCLED WATER	PROCESS DESIGN	GRAB SAMPLE AT VARIOUS SAMPLE LOCATIONS IN PROCESS	1 PER BATCH	PER ASTM	TDS - METHOD 160 FROM MCAWW OR 2540C FROM STANDARDS METHODS; TSS - 160.2 OR 2540D	B	DUPLICATES
COOLING WATER	PROCESS DESIGN	GRAB SAMPLE	1 PER BATCH	PER ASTM	METHOD 160 FROM MCAWW OR 2540C FROM STANDARDS METHODS	B	DUPLICATES
RADIOLOGICAL SURVEY	FIELD ASSURANCE SURVEY	GEIGER-MULLER METER	CONTINUOUS	N/A	GEIGER-MULLER METER	A	NONE

categorized as ASL A. In addition, concrete non-destructive testing will be performed to determine current silo concrete thickness, compressive strength, and reinforcement quality using Impulse Radar, Pulse Echo, Impact Echo and Pachometer for the Silos. ASL A is specified for this work.

Start-up and operational objectives include sampling of the process flows (except glass) for percent solid analyses to determine achievable and expected ranges of percent solids of the slurry, Total Dissolved Solids (TDS) and Total Suspended Solids (TSS) testing of the recycle water and cooling tower blowdown to determine the expected solids accumulation, compression testing, TCLP testing, and visual inspection of the final glass product to determine the optimum operating parameters of the furnace, and process off-gas sampling utilizing an isokinetic sampler to determine and quantify the particulate emissions and calibrate the sampler.

Validation of ASL A and B samples during Phase I is not required. All samples will be collected, analyzed and documented for the appropriate DQOs and analytical support levels as identified by this work plan and applicable sections of the SCQ. Data collected for RI/FS or RCRA programs will be reported in the appropriate regulatory report. Engineering design data will be documented and maintained for internal design use. If additional sampling and analysis requirements are identified as detailed engineering design is completed, these will be provided as addenda or changes to this work plan as required by the SCQ.

4.0 EXPERIMENTAL DESIGN AND PROCEDURES

4.1 DESIGN ACTIVITIES/DESIGN BASIS

The Silo 4 dome will be evaluated to determine the feasibility of removing a section of reinforced concrete at the center of the dome. The dome penetration shall be of sufficient size to accommodate the deployment of a hydraulic mining device.

An independently supported superstructure shall be designed to accommodate waste removal and transfer activities. The structure shall be designed to support the work platform and to span the center section of the Silo 4 dome.

The hydraulic mining device, to be deployed through the modified Silo 4 center manway, consists of slurry pumps, spray nozzles, and cables and piping, combined into one compact and portable assembly. This assembly will be specified to sluice the material from as far away as the silo walls ($\sim$40 feet) to the center of the silo, where the slurry pump will transport it out through the top. This will demonstrate a K-65 material retrieval method proposed for final remediation. Also, glovebag deployment during this Silo 4 operation will be utilized to demonstrate radon control as is required for final remediation.

In addition, a smaller scale hydraulic mining device will be demonstrated prior to its use in Phase II. Its primary purpose will be to supply K-65 material as feed material for the vitrification facility in Phase II testing. Since current plans are not to modify (enlarge) the center manway of Silos 1 or 2 for this pilot program, this smaller mining device will be specified to fit through the existing manway. The small scale pump is expected to erode only a small opening in the bentonite cap which will minimize the amount of bentonite needed to repair the breach.

The pilot-scale vitrification facility will be located east of the K-65 Silos (see Figure 4-1) and will include interim storage of vitrified product. The majority of the holding tanks and vitrification support equipment will be located outside the building on concrete, diked pads. However, the melter and product forming equipment along with the process control system and other support functions will be housed in a pre-engineered metal building. The preliminary list of equipment and materials required are listed in Section 5.0. An approved process flow diagram for the vitrification process, which is included in a condensed form as Figure 4-2, has been developed.

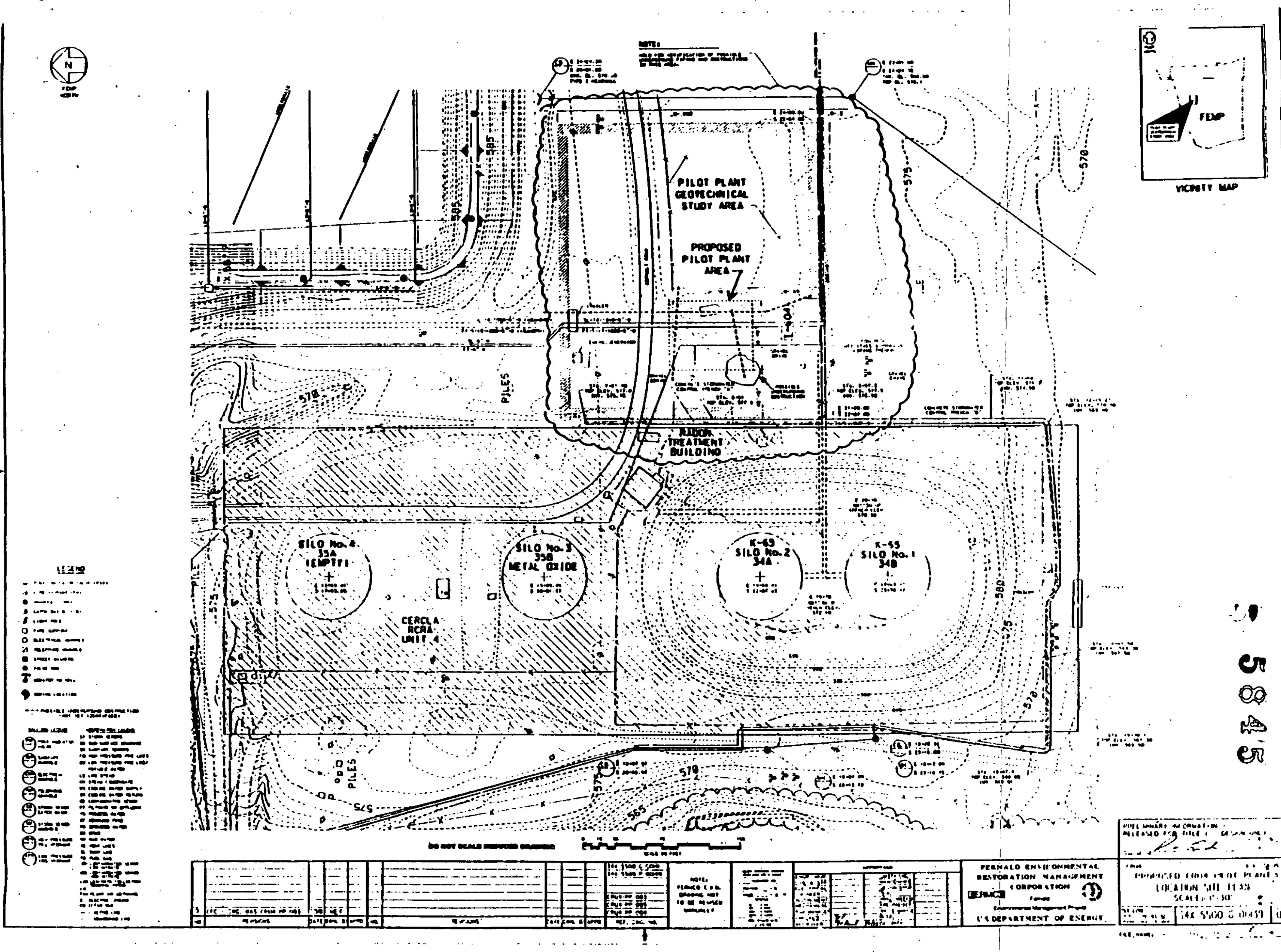

FIGURE 4-1

CRU4 Pilot Plant Site

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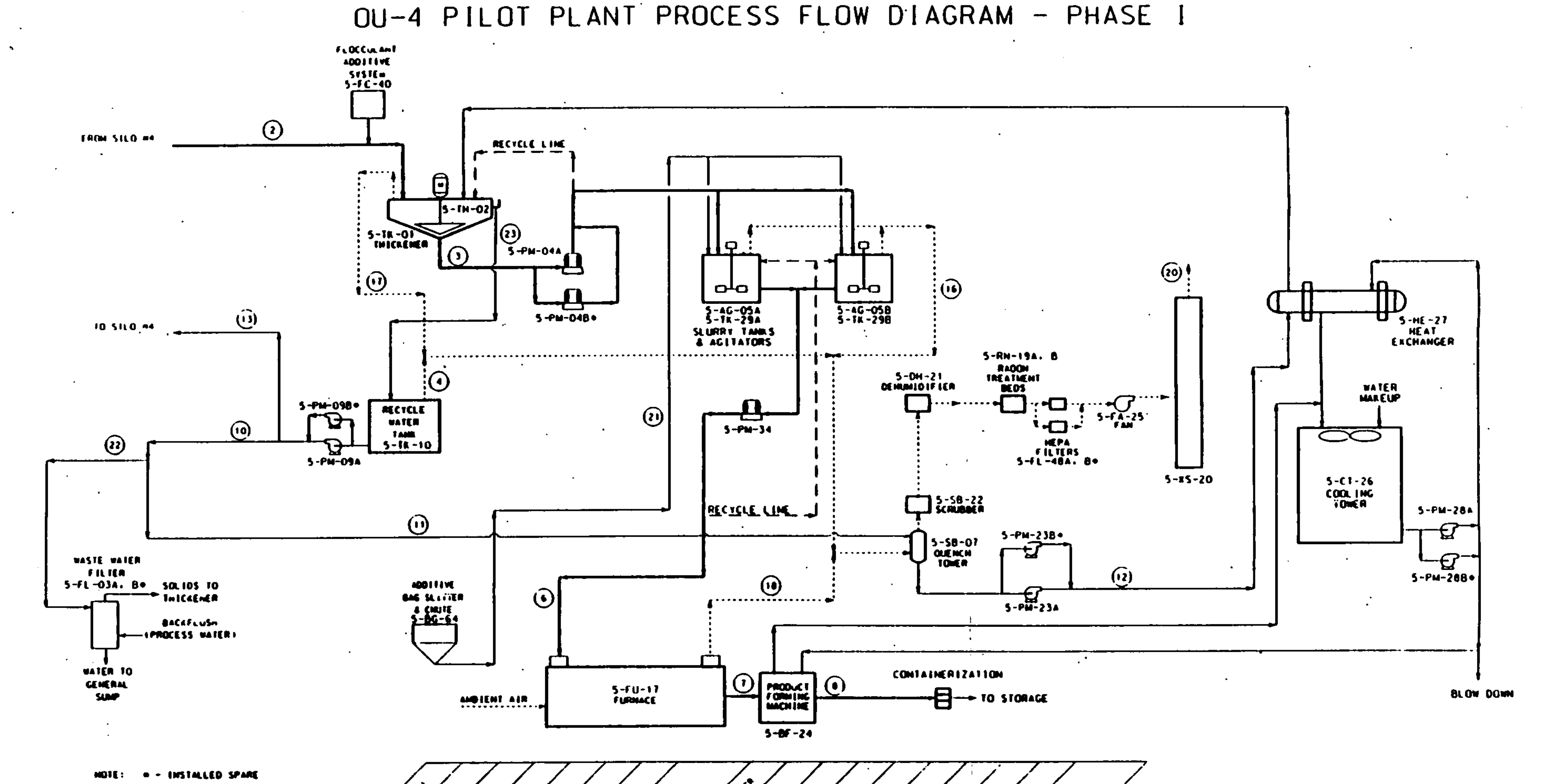

FLOW NO.	1	2	3	4	6	7	8	10 (a)	10 (b)	11	12	13	16	17	18	20	21	22	23 (a)	23 (b)
Description	Silo 4 material (surrogate)	Slurried material	Slurry tank feed	Offgas from water tank	Furnace feed	Furnace product	Final glass product	Recycle water		H2O for offgas quench tower	Water from quench tower	H2O for hydraulic removal	Offgas from slurry tanks	Offgas from thickener	Offgas from furnace	Offgas to atm	Furnace feed additives	H2O to be treated	Thickener overflow	
AIR (SCFM)				50									100	50	50	250				
SOLIDS (LBS/HR)	4450	4450	4450	0	92	92	92	0	0	0	0	0	0	0	0	0	1000	0	0	0
WATER (LBS/HR)	1910	17000	4450	0	14	0	0	21910	20000	20000	20074	15890	0	0	74	0	0	1910	33424	20074
OPER. TIME (HRS/DAY)	0.4	0.4	0.4	24	24	24	24	0.4	23.6	24	24	0.4	24	24	24	24	0.4	0.4	0.4	23.6

SKETCH: CRU4-PP-SK026
REV. 0 DATE 9/04/93

DATE–Aug. 4, 1993

FIGURE 4-2

CRU4 Pilot Plant Process Flow Diagram - Phase I

4.1.1 Design for Silo Activities

Dome Segment Removal

A major activity will be designing the methodology to remove a minimum 1.8 m (6 ft) diameter section of reinforced concrete from the center of the Silo 4 dome. If required, a compression ring shall be designed to maintain stability of the dome structure after the segment is removed. The dome modification design will include a conical metal transition (Silo Insert) mounted and suspended from the superstructure work platform with an inflatable barrier between the perimeter of the conical transition and the concrete dome. The hinged doors above the insert will isolate the dome headspace from the Equipment Room (which is integrated into the superstructure design).

Prior to cutting the dome section, a compression ring may be installed, if necessary. Waterjet cutting (low-volume, high pressure water) shall be the primary method considered to cut through the concrete and steel mesh during the dome section removal to reduce excessive and unwanted vibratory loading that would result from conventional concrete cutting methods. Other dome cutting methods will be considered provided justifiable arguments show they are superior to the reference method. A 4.5 metric ton (5 ton) truss monorail crane shall be used to remove the cut section of concrete.

Superstructure

An independently supported superstructure shall be designed to span the center of the Silo 4 dome (in alignment with three of the five manways), accommodating waste removal and transfer activities (see Figure 4-3). The superstructure shall be a truss design of sufficient width to support the work platform and shall clear the top of the silo dome. Consideration shall be given to obtaining operational flexibility during system installation, deployment, maintenance and initial decontamination. The superstructure could possibly reflect a modular design so that design costs for remedial support structures can be reduced.

The design basis shall combine the dead load of the structure with equipment weights and operational loads. Foundations shall be designed to account for uplift forces at the footings due to naturally occurring wind and seismic forces.

The superstructure design shall include a 4.5 metric ton (5 ton) electric winch to support equipment installation and maintenance. The structural design shall include an Equipment Room to be used as the deployment pod for in-silo hardware installation and shall be sweep-ventilated to demonstrate the ability

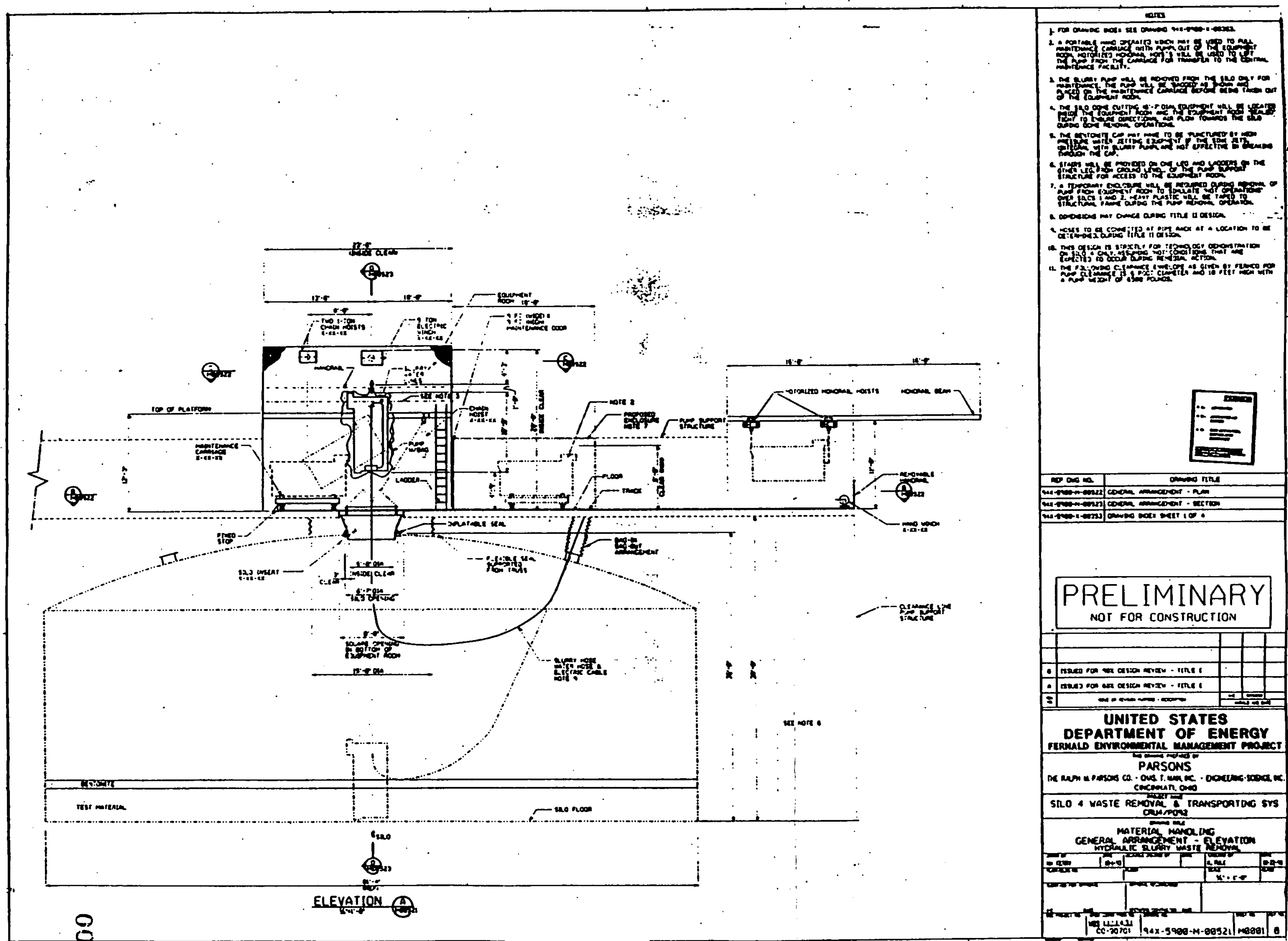

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FIGURE 4-3

CRU4 Pilot Plant Silo 4 Superstructure

to keep radon levels below occupational limits. The Equipment Room shall be equipped with an initial water decontamination spray down system and allow subsequent wastewater drainage to return to the silo. In addition to the use of glovebags during dome segment removal and silo insert installation, the Equipment Room will feature an accordion-style transition curtain that will attach the Equipment Room opening to the dome to simulate radon control.

A stair/landing, supported by the superstructure, will be designed to extend beyond the 6.1 m (20 ft) center diameter of the dome. The stair/landing will provide a means of access to the remaining dome structure (outside the 6.1 m diameter center circle) during on-silo operations.

Hydraulic Mining and Deployment Equipment

The large (full-scale) hydraulic mining device shall be totally supported by the superstructure. This hydraulic mining device shall be deployed, using the over head wire rope winch, through the enlarged center manway. The slurry pump system will be lowered through a motorized split trap door designed to close around the cables and hoses to provide a reasonable seal during sluicing operations. The sluicing operation will be operated remotely and will be continuously monitored by video cameras mounted in the silo headspace.

The pressurized spray nozzle radial discharge shall dislodge and mobilize material from the silo walls to the pump inlet located at the silo center (~ 40 feet). The slurry pump shall be capable of operating in submersible conditions, provide an 18 m (60 ft) pressure head minimum, and remove slurry at up to 568 Lpm (150 gpm) of 15 to 20 wt percent solids.

The smaller (pilot-scale) sized hydraulic mining device will be deployed through an existing (unmodified) manway and supported by a mobile crane. This will demonstrate the K-65 material retrieval method to be used during Phase II. The pressurized spray nozzle discharge shall dislodge 2020 kg/hr (4450 lb/hr) dry weight solids to the pump inlet. The slurry pump shall be capable of operating in submersible conditions, provide an 18 m (60 ft) minimum pressure head, and remove slurry at up to 190 Lpm (50 gpm) at 15 to 20 wt percent solids. The cutting action of the pump will be directed downward rather than radially to form a cylindrical cut into the bentonite cap and material using a "sink ring" cutting of an approximate diameter of the pump. Off-gas control will be demonstrated via a glove-bag type barrier.

4.1.2 Design for Vitrification Facility

The vitrification facility will use an electric-heated melter capable of melting a wide range of waste materials, with minimal additives, at moderately high temperatures. It will be designed to produce a consistent, durable, stabilized glass with minimal effluent. The melter will be lined with high temperature refractory bricks and will generally operate in the range of 1,100 to 1,350°C (2,012 - 2,462 °F).

The pilot-scale electric melter is the heart of the vitrification process. The molten glass will be fed to a product forming machine that will produce a glass product of shape and size that is flexible for containerization and anticipated or foreseen final packaging. Melter and melt chamber temperatures will be controlled by power adjustments to the heating electrodes and supplemental area heaters.

Included will be an off-gas system composed of standard industry components such as a quencher to reduce melter off-gas temperature, scrubber, desiccant tower, carbon beds, HEPA filter, and blower. The off-gas air will be discharged to the atmosphere through a stack. The stack will be equipped with an isokinetic sampler and a Pylon radon monitoring device. The system will be monitored to establish parameters to treat the off-gases during the future vitrification testing of actual radioactive material in Phase II.

Feed Materials and Additives

The vitrification furnace feed (surrogate material) will consist of uncontaminated silty sand of similar grain size to the K-65 material (or washed soil), bentonite, water, and trace metallic elements and sulfates as testing dictates. The Pilot Plant Process Flow Diagram for Phase I (Figure 4-2) shows preliminary flows and a mass balance that will be required for operation of the system.

Approximately 2020 kg (4450 lb) per hour (for about 0.4 hours each day) of surrogate material, previously placed inside Silo 4, will be pumped to a thickener at 15 to 20% solids by weight. Thickened underflow at approximately 50% percent solids will be fed to one of the two agitated slurry tanks. Meanwhile, the other slurry tank will be feeding the melter at a rate of approximately 42 kg (92 lb) dry solids per hour.

Chemical additives, such as sodium carbonate, needed for the vitrification process will be weighed and then fed to the slurry tanks and blended with the surrogate material. In addition, trace amounts of metallic elements and sulfates will be added, as testing dictates, to more closely simulate K-65 material. The final slurry will be 55-60% solids.

Feed Make-Up

The glass formulation (i.e., the required amount of additives) for Phase I will be based on the results of the current OU4 glass development program. The material will be melted and the resultant glass analyzed and tested. If the glass is determined to have characteristics that indicate poor durability, i.e., phase separation, excessive leachability, improper viscosity at the desired temperature, adjustments to the formulation (and/or furnace temperature) will be made.

Thickener

The slurried surrogate material will be delivered from Silo 4 to the thickener tank through process piping. The feed will enter the centerwell of the thickener. Slurry flow rates and percent solids will be measured by a flow indicator installed in the feed line.

Control of thickened solids in the underflow will be by an adjustable air-operated diaphragm pump that will pump the material to one of two slurry tanks. A density controller in the thickener underflow line will control the density of the solids by adjusting the diaphragm pump flow rate. A 50% solid underflow is assumed. The thickener overflow will, by gravity, flow to the water recycling tank where it will be used to supply the quench tower and the hydraulic miner (as required). A flow indicator similar to the one in the feed line will be installed in the thickener discharge (underflow) line.

A flocculent may be necessary to ensure an adequate settling rate of the solids in the thickener; in this case, a flocculent mixing and feeding system will be required. A settling test utilizing bentonite is planned under a separate support project, and the results will be used to make this determination.

The thickener mechanism will be supplied with protective instrumentation to lift and lower the rakes automatically, depending on torque. Appropriate high torque alarm annunciation and high-high torque automatic shutdown will be provided.

Slurry Tanks

The two agitated slurry tanks will alternate between feed preparation and melter feed functions. While one tank feeds the melter, the other tank will receive about 810 kg (1780 lb) of solids as thickener underflow. This represents about one day's production, so the complete cycle of slurry tank fill, additive addition, mixing, and verification will have to take place in 24 hours (or less).

Melter

The slurry (surrogate material and additives) will be delivered from the slurry tank to the melter by an air operated diaphragm pump. The feed will enter the melting chamber and be deposited onto the molten glass surface. The materials will be melted by a series of electrodes and mechanically agitated and will be retained for the necessary retention time in order to attain homogeneous vitrification. Determination of the required retention time is a major objective of the treatability testing.

Melter Glass Discharge

While feeding is in progress, molten glass inventory will be accumulated in the melting cavity and discharged into the product forming machine.

Melter Pressure

The melter will normally be kept at a slightly negative atmospheric pressure. This will be accomplished using a once-through off-gas system.

Off-Gas System

The off-gas system will consist of a quench tower, scrubber, desiccant tower, radon adsorption carbon beds (necessary for Phase II), HEPA filter, blower, and stack. The off-gas system will vent the thickener, slurry tanks, recycle water tank, and furnace. Air throughput will be minimized.

Design for the Wastewater Treatment System

The wastewater treatment system will be sized to handle approximately 15 Lpm (4 gpm) of wastewater as required. Treatment will consist of a multimedia filtration system. Backwash from the filter will go to the thickener. Only non-radioactive, non-hazardous particulates will be present in the wastewater for Phase I.

4.2 CONSTRUCTION ACTIVITIES

Construction and Installation of Superstructure Over Silo 4

An investigation of dome modification and design of an independently supported superstructure will be done in title design. At the completion of title design, a detailed construction plan will be developed. Based on conceptual ideas, the preliminary Scope of Work for construction includes the following:

- Installation of surrogate material in Silo 4
- Installation of concrete foundations and anchors
- Installation of superstructure, Equipment Room, and the transition curtain
- Installation of the dome modification compression ring (if required)
- Removal of dome segment
- Installation of waste retrieval and transport systems
- Construction acceptance testing
- Support of waste retrieval transport systems start-up

Construction work is planned to be carried out utilizing one or more qualified subcontractors, with the Fernald Environmental Restoration Management Company (FERMCO) CERCLA/RCRA Unit 4 (CRU4) Construction Department performing as the construction manager. Normal construction methods, adhering to all applicable regulations and standards, will be utilized in performance of the work.

Construction of Vitrification Facility

Once title design has been completed, a detailed construction plan will be developed. However, based on conceptual discussions, a preliminary Scope of Work for construction includes the following:

- Grading and earth work such as excavation and engineered fill for footings and grade beams
- Installation of site utilities
- Installation of concrete footings, equipment foundations and slabs
- Erection of building

- Installation of process equipment, piping, electrical, and instrumentation
- Construction acceptance testing
- Support of plant start-up

4.3 CHECKOUT AND START-UP ACTIVITIES

Following the successful completion of Construction Acceptance Testing (CAT), Systems Operability Testing (SOT) will occur for the waste retrieval and vitrification systems. Detailed CAT and SOT plans will be developed and approved prior to the start of test activities.

4.3.1 Checkout Activities

The following is a preliminary list of checkout activities to be included in the SOT plans.

A. Waste retrieval equipment (cranes, pumps, blowers, cameras, etc.) and the system as a whole will be tested for proper operation.

B. The thickener will be filled with water and allowed to overflow into the recycle water tank.

C. The recycle water tank level indication will be checked as the tank fills.

D. Flow indication to each slurry tank from the thickener will be calibrated against the rate of weight gain in each tank. Agitator operation will be checked concurrently.

E. Water will be pumped from the recycle water tank to the quench tower, and the flow control to the quench tower will be calibrated.

F. The level controller in the quench tower will be calibrated, and the quench tower water pump will be started, pumping water back to the thickener.

G. The exhaust fan will be started, and air flows from the process through the off-gas system will be measured and balanced.

H. The cooling tower will be filled with water and treatment chemicals will be added. The cooling tower pump will be run to purge air from the system. The cooling tower fan will be started and adequate air flow verified.

I. The filtration and transfer equipment for the glass additives will be operated to confirm proper operation.

J. Slurry tank discharge pumping will be tested in the recycle mode.

K. The furnace will be charged with appropriate glass frit, then heated to melt the frit and seal the refractory.

L. The wastewater filters will be water tested when sufficient feed is available in the recycle water tank.

M. During the checkout operations, the Distributed Control System will be monitored for correct indications of measured variables, control action, and status of motors and valves.

N. Safety alarms will be checked and emergency shut-offs will be tested for proper settings and function.

O. All support system components - such as pumps, valves, filters, and instruments - that are not tested via Items A through N of this list will be checked and/or tested for proper operation.

4.3.2 Start-up Activities

Start-up activities for vitrification involve introducing surrogate material from Silo 4 into the system and inventorying tanks and bins so that continuous operation can be achieved. These activities consist of the following essential steps:

A. Furnace temperature control will be tested.

B. Molten glass draw and the product forming equipment will be tested in short runs to gain experience and to establish preliminary control parameters.

C. The slurry feed to the thickener will be transferred to a slurry tank when target percent solids are reached.

D. Additives will be added to the slurry tank and mixed with the slurry. After the additives are sufficiently mixed in the slurry tank, short furnace feeding runs will be used to test the furnace feed system to get an initial assessment of the response of the furnace to actual feed.

E. The process water system, off-gas treatment system, wastewater filters (as required), and cooling tower will all be operating during this time.

F. These start-up activities will cease when all systems have been tested sufficiently such that continuous operation is judged to be viable.

4.4 PILOT PLANT TESTING

The objective of this operational phase is to achieve design rates on a continuous operation basis and to determine steady-state and optimum parameters. The majority of the Phase I testing will simply entail equipment operation, observation, and subsequent process correction. Phase I vitrification testing is targeted to end when approximately 20-30 metric tons of surrogate material has been vitrified. Prior to the completion of Phase I testing, trace metallic elements and sulfates will be added to the surrogate material prior to being fed to the furnace to more closely simulate the vitrification of K-65 material. The following identify the specific component testing that will occur.

Silo Material Retrieval (Hydraulic)

Testing of silo material retrieval will entail the successful manipulation of the hydraulic mining device(s) and demonstrating the off-gas and silo head space pressure and to remove silo material at the design rates. Slurry samples will be taken periodically to measure the variability in solids content. The mining device(s) operating pressure and volume flow will be adjusted to test their operating ranges and to determine optimum operating parameters.

Thickener

Thickener performance is mainly a function of achievable solids concentration. The solids effluent will be sampled and tested for weight percent solids (targeted at 50%). The overflow of 100% water will also be sampled for clarity. The addition of polymer flocculation agents to the thickener feed, at various rates, will be tested to determine the reagent consumption for desired settling efficiencies.

Slurry Tanks

The alternating batch operation of the two agitated slurry tanks will be tested. The ability to substantially empty the slurry tank to the furnace before receiving the next batch from the thickener will be demonstrated.

The agitator co-mingles the surrogate material and the additives so that a homogeneous mix is fed to the vitrification furnace. The slurry tank product will be inspected to ascertain the agitator's effectiveness.

Vitrification Furnace

Furnace operation will be carefully monitored and adjustments to temperature, hold time, feed, etc., will be made as required to ensure an acceptable glass product. Operation of the melter at its lower temperature range coupled with the use of mechanical agitation will be tested to determine the minimum temperature required to produce a good glass product. Also, trace metallic elements and sulfates will be added to the furnace feed to better simulate the K-65 material and test the furnace operation, i.e. heavy metal drain, effectiveness of mechanical agitation on glass phase separation. Final product testing will include compression testing and TCLP analysis to determine leachability.

Temperature Control

The furnace is expected to operate between 1,100 and 1,350°C (2,012 - 2,462 °F). The ability to maintain a constant glass melt temperature during operations will be tested due to its importance to producing a uniform glass product that flows out of the furnace at a constant rate.

Foaming

Foaming occurs in a glass furnace with the release of decomposition gases at high temperature, mostly carbon dioxide from carbonates. The extent of foaming will be observed by remote video monitoring (if available) and the glass formulation adjusted accordingly since it is critical to be able to continuously operate the furnace without foaming problems.

Molten Glass Removal

Controlling the molten glass flow out of the furnace is important to the subsequent product forming operation. Testing will involve changing the flow rate to ensure that reasonable control of the glass level in the furnace can be maintained.

Product Forming

The product forming equipment will be a mechanical device which will cut molten glass streams from the furnace into small pieces and cool the pieces in a controlled way to produce a product with acceptable physical (crush strength) chemical (leach resistance) and radiological (radon retention-Phase II) properties. The operation and mechanical reliability of the system will be tested.

Quench Tower and Scrubber

The function of the quench tower and scrubber is to condense the water vapor produced in the furnace and remove any acid gases produced in the furnace. During testing, it will be monitored for pressure drop, water inventory control, and water temperature rise.

Radon Treatment System (RTS)

Although there is no radon concern in Phase I, the RTS must be tested to demonstrate reliability and capability of handling the design throughput. It will consist of a dehumidification section, a carbon bed adsorption section, and a final HEPA filtration section. During testing, the parameters to be monitored are the temperature and humidity of the air entering the carbon bed and the pressure drop through the system.

Cooling Tower

Cooling water will be needed to cool the furnace electrodes, parts of the product forming equipment, and the quench tower effluent being recycled to the thickener. Cooling towers are generally simple and reliable and require minimal attention. Full-rate testing of the process will verify that adequate cooling capacity exists in the cooling tower.

Wastewater Treatment

The net amount of water removed from the process will exit through the recycle water tank and the wastewater filters. Suspended solids will be the only items requiring treatment in this water; therefore, treatment will consist only of a multimedia filtration system. Although this is well-known technology, the ability to successfully handle the bentonite clay must be tested.

Distributed Control System

The control system will gather data from the vitrification operations for display on screens in the control room. Likewise, control devices (valves, dampers, Silicon Control Rectifiers [SCRs] for furnace electrodes) and motors will have their status displayed. Pilot Plant operations testing will determine the reliability of this equipment and demonstrate its user friendliness.

5.0 EQUIPMENT AND MATERIALS

Table 5-1 provides a preliminary list of equipment required to complete the Pilot Plant Phase I testing. All of the items identified shall be provided by FERMCO. Note that several of the items listed have been identified as existing at the FEMP Site (Detail: "Use on site equipment"), and the feasibility for their potential use is being investigated by FERMCO.

TABLE 5-1

CRU4 PILOT PLANT - PHASE 1
PRELIMINARY EQUIPMENT LIST
WASTE RETRIEVAL AND VITRIFICATION

EQUIP NO.	DESCRIPTION	QTY	HP	SPEC (RHN-)	CAPACITY	DETAIL ARO = After Receipt of Order
	SILO 4 WASTE RETRIEVAL					
4-PM-01	PILOT PLANT SILO RESIDUE PUMP	1	5	02-40-001	50 GPM	
4-PM-02	SILO 4 RESIDUE REMOVAL PUMP	1		01-40-002	75 GPM	
4-PT-05	SILO SUPERSTRUCTURE (SILO 4)	1		01-40-005		
4-HS-03	CHAIN HOIST (PUMP MAINT.)	1			2 TON	
4-WN-04	ELECTRIC WINCH (ER-SILO 4)	1		01-40-004	5 TON	
4-HS-07	CHAIN HOIST (PUMP DOOR)	1		01-40-007	200 LB	
4-IN-11	SILO INSERT (SILO 4)	1		01-40-011		
4-WN-19	HAND WINCH (ER-SILO 4)	1		01-40-019	500 LB	
4-CN-20	MONORAIL HOIST	1	10		5 TON	
4-CA-21	MAINTENANCE CARRIAGE (SILO 4)	1		01-40-021	6,000 LB	
4-CM-08A,B	CAMERA - SILO	2				Use on site equipment
4-SU-23	SILO 4 DECANT SUMP	1			500 GAL	
4-PM-24	SUMP PUMP - SILO 4	1			75 GPM	Use on site equipment
4-FA-35	EXHAUST FAN (SILO 4)	1		01-40-035	2,050 SCFM	
4-FA-36	EXHAUST FAN (EQUIPMENT ROOM)	1		01-40-035	3,000 SCFM	
4-DP-37	INTAKE AIR DAMPER (ER)	1		01-40-037	2,450 SCFM	
	VITRIFICATION					
5-TK-01	THICKENER TANK	1		02-40-010		14 wks ARO to site
5-TH-02	THICKENER MECHANISM & RAKES	1	5	02-40-002	18 FT DIA	16 wks ARO to site

CRU4 PILOT PLANT - PHASE 1
PRELIMINARY EQUIPMENT LIST
WASTE RETRIEVAL AND VITRIFICATION

EQUIP NO.	DESCRIPTION	QTY	HP	SPEC (RHN-)	CAPACITY	DETAIL ARO = After Receipt of Order
5-FL-03A,B	WASTE WATER FILTER	2			10 GPM	Use on site equipment
5-PM-04A	RESIDUE SLURRY PUMP - THICKENER	1		02-40-004	40 GPM	10 wks ARO to site
5-PM-04B	PUMP - INSTALLED SPARE	1		02-40-004	40 GPM	10 wks ARO to site
5-AG-05A	SLURRY TANK AGITATOR	1	5	02-40-005		12 wks ARO to site
5-AG-05B	SLURRY TANK AGITATOR	1	5	02-40-005		12 wks ARO to site
5-SB-07/22	QUENCH TOWER AND SCRUBBER	1		02-40-007/022	120 SCFM	
5-PM-09A	RECYCLE WATER PUMP	1	75	02-40-009	130 GPM	9 wks ARO to site
5-PM-09B	PUMP - INSTALLED SPARE	1	75	02-40-009	100 GPM	9 wks ARO to site
5-TK-10	RECYCLE WATER TANK	1			5,800 GAL	
5-FU-17	VITRIFICATION FURNACE	1		02-40-062	1 METRIC TON/DAY	
5-VL-18	DIVERTER VALVE - ADDITIVES	1		02-40-018	6,000 LB/HR	
5-RN-19A,B	CARBON BED VESSEL	2		02-40-019	250 SCFM	
5-XS-20	EXHAUST STACK	1			6,600 CFM	
5-DH-21	DESICCANT TOWER	1	1/3	02-40-021	250-500 SCFM	8 wks ARO to site
5-PM-23A	QUENCH TOWER PUMP	1	3	02-40-009	60 GPM	9 wks ARO to site
5-PM-23B	PUMP - INSTALLED SPARE	1	3	02-40-009	60 GPM	9 wks ARO to site
5-BF-24	PRODUCT FORMING MACHINE	1	2	02-40-063	1 METRIC TON/DAY	
5-FA-25	EXHAUST FAN (VIT. OFF GAS)	1	10	02-40-025	250-500 SCFM	14 wks ARO to site
5-CT-26	COOLING TOWER	1	5	02-40-026	200 GPM	14 wks ARO to site
5-HE-27	HEAT EXCHANGER	1		02-40-027	300 SQ. FT	10 wks ARO to site
5-PM-28	COOLING TOWER PUMP	1	10	02-40-009	220 GPM	9 wks ARO to site
5-TK-29A,B	SLURRY TANK (VITRIFICATION)	2		02-40-029	700 GAL	
5-TF-30	TRANSFORMER	1			2,000 KVA	Use on site equipment
5-SG-31	MEDIUM VOLTAGE SWITCHGEAR	1				Use on site equipment
5-SG-32	LOW VOLTAGE SWITCHGEAR	1				Use on site equipment
5-MC-33A,B	MOTOR CONTROL CENTER	2			600 AMP	Use on site equipment
5-PM-34A,B	SLURRY TANK PUMP	2		02-40-004	40 GPM	10 wks ARO to site
5-FC-40	FLOCCULANT ADDITIVE SYSTEM	1	1	02-40-040	1.2 GPM	Use on site equipment

CRU4 PILOT PLANT - PHASE 1 PRELIMINARY EQUIPMENT LIST WASTE RETRIEVAL AND VITRIFICATION						
EQUIP NO.	DESCRIPTION	QTY	HP	SPEC (RHN-)	CAPACITY	DETAIL ARO = After Receipt of Order
5-CN-41	FURNACE ROOM MONORAIL	1		02-40-041	2 TON	
5-GE-43	EMERGENCY GENERATOR	1		02-40-043	150 KVA	16 wks ARO to site
5-CM-44	AIR COMPRESSOR	1	60	02-40-044	220 SCFM	
5-BH-46	CONTAINERIZING EQUIP. (DRUMS)	1			1 METRIC TON/DAY	Use on site equipment
5-CS-47	DATA ACQUISITION & CONTROL	1			400 PTS	Use on site equipment
5-FL-48A	HEPA FILTER - (VIT. OFFGAS)	1			250-500 SCFM	
5-FL-48B	HEPA - INSTALLED SPARE	1			250-500 SCFM	
5-PM-50A	BUILDING SUMP PUMP	1	5		25 GPM	Use on site equipment
5-PM-50B	PUMP - INSTALLED SPARE	1	5		25 GPM	Use on site equipment
5-TK-56	SPARE STORAGE TANK	1			11,600 GAL	
5-PM-57	SPARE STORAGE TANK PUMP	1		02-40-057	90 GPM	
5-PM-58	SPARE STORAGE CONTAIN. PUMP	1	5		25 GPM	Use on site equipment
5-BG-64	BAG DUMP STATION - ADDITIVES	1	1/2	02-40-064	6,000 LB/HR	
5-DC-65	FILTER/RECEIVER - ADDITIVES	1		02-40-065	6,000 LB/HR	
5-BL-66	VACUUM BLOWER SYSTEM	1		02-40-066	350 CFM	
5-PO-69	U.P.S. (DACS)	1		02-40-069	12.5 KVA	
5-RV-71	ROTARY AIRLOCK - ADDITIVES	1	1.5		6,000 LB/HR	
5-SC-72	PLATFORM SCALE - ADDITIVES	1			400 LB	Use on site equipment
5-VL-73	DIVERTER VALVE (SILO 3 MATERIAL)	1		14501	6,000 lb/hr 8"	
5-VL-75	DIVERTER VALVE (PNEUMATIC TRANSFER SYS.)	1			3"	
5-AU-76	MAKE-UP AIR HANDLING UNIT	1	7.5	15855	3,200 CFM	
5-AC-77	AIR CONDITIONING UNIT - COMPUTER ROOM	1	1/2	15785	1,250 CFM	
5-AC-78	AIR CONDITIONING UNIT - COMPUTER ROOM	1	1/2	15785	1,250 CFM	
5-AU-79	HEATING & VENTILATION - AIR HANDLING UNIT	1	3	15855	1,480 CFM	
5-CB-80	CONDENSING UNIT	1	0.2	15671	3 TON	
5-CB-81	CONDENSING UNIT	1	0.2	15671	3 TON	

5.8.4.5

CRU4 PILOT PLANT - PHASE 1 PRELIMINARY EQUIPMENT LIST WASTE RETRIEVAL AND VITRIFICATION						
EQUIP NO.	DESCRIPTION	QTY	HP	SPEC (RHN-)	CAPACITY	DETAIL ARO = After Receipt of Order
5-FA-82	EXHAUST FAN - CENTRIFUGAL BLOWER	1	30 (20)	15860	6,000 CFM	Use on site equipment
5-FA-83	EXHAUST FAN - WALL MOUNTED	1	<1		150 CFM	
5-FA-84	EXHAUST FAN - ROOF MOUNTED	1	3		15,000 CFM	
5-FL-85A, B	HEPA/MEPA FILTERS (BUILDING HVAC)	2		15885	6,000 CFM	Use on site equipment
5-HT-86	DUCT HEATER	1	53kw		3,200 CFM	
5-HT-87	DUCT HEATER	1	21kw		1,480 CFM	
5-HT-88	UNIT HEATER	1	15kw		1,100 CFM	
5-HT-89	UNIT HEATER	1	15kw		1,100 CFM	
5-HT-90	UNIT HEATER	1	7.5 kw		700 CFM	
5-TK-91A,B,C	PORTABLE DUMPSTER TANKS	3			500 GAL	
5-SU-74	BUILDING SUMP TANK	1			750 GAL	

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6.0 SAMPLING AND ANALYSIS

6.1 PRECONSTRUCTION SAMPLING AND ANALYSIS

Geotechnical sampling was performed to determine soil characteristics, which will in turn determine Pilot Plant building requirements for the vitrification facility. Analyses performed for this activity included soil classification, moisture content, specific gravity, grain size analysis, Atterberg Limits, consolidation, California Bearing Ratio and maximum density. Results indicated the designated site is suitable for the planned building and construction activities. In addition, data from soil samples and borings taken from the areas around the silos over the last ten years were reviewed by a subcontracted geotechnical firm. Recommendations for bearing capacity, excavation slopes, lateral earth pressures, and settlements for design of the superstructure's foundations were made. No additional soil sampling is required for geotechnical characterization.

Preconstruction soil sampling was to be performed in accordance with the site Sampling Plan to establish RCRA waste characteristics (EM&S-SMPLN-93-278) and radiological contamination of the soil east of the K-65 Silos was measured. Soil samples were taken at surface, one foot and five feet depths. The soil was to be analyzed for TCLP metals, TCLP Volatile Organic Analytes (VOAs), TCLP semi-VOAs, and the following radiological constituents:

Total uranium
U-234
U-235
U-236
U-238
Total thorium
Th-228
Th-230
Th-232
Ra-226

Based on the results of these analyses and the RCRA determination, the soil will be remediated (as required) to provide an acceptable location for the vitrification facility. (Presently, the sampling activity has been completed, however, the results and summary of the sampling activity are not yet available.)

Preconstruction sampling of the Silo 4 dome will be performed if process knowledge is insufficient to characterize the concrete to be removed. The analytical results will support a RCRA determination and provide the radiological contamination levels of the Silo 4 dome. This information is required to determine waste management requirements of the concrete that will be removed from the Silo 4 dome.

In addition, non-destructive testing (NDT) will be performed on all four silos to confirm previous test results and provide input for the performance of new structural analyses. Concrete strength, thickness, and steel reinforcement data will be obtained. Results from these tests will then be employed to enhance the viability of the work platform/Equipment Room and support structure.

Prior to placement of the surrogate material in Silo 4, the silo will be inspected to determine the extent of rainwater infiltration, if any. The rainwater, if any, in Silo 4 will be sampled in accordance with Sampling Plan EM-SMPLN-EC&S-REQ-91-067, Rev. 0, which was prepared to support the recent Silo 4 Integrated Demonstration (Silo mapping) Project. The water will be analyzed to verify that, upon pumping of the water from Silo 4 and treatment (if required), it will meet the requirements for a permitted NPDES discharge.

6.2 START-UP AND OPERATIONAL SAMPLING AND ANALYSIS

The main sampling and analysis activity during start-up and operation of the Pilot Plant during Phase I will be for percent solids. Achievable percent solids will be determined during the hydraulic mining demonstration. For the vitrification facility, each process stream will be sampled for percent solids during start-up, and then at least once per shift during operation and at higher frequencies as needed to identify optimum operating parameters. Table 6-1 delineates this approach.

The feed to the furnace will also be visually inspected for homogeneity due to the importance of a uniform feed to good glass-making.

The glass products will be sampled at least once per shift and more frequently during early operations. The products will be visually inspected for a "glassy", well-vitrified appearance and for evidence of phase separation and then tested for crush strength. It is believed that a simple compression tester will give useful information on the success of the vitrification process. Higher strength glass should indicate a more uniform glass product with higher durability. Glass with lower crush strength may not be completely vitrified. Visual examination of the fracture surfaces will also provide clues as to the uniformity of the glass product. In addition, TCLP analysis will be conducted to test the glass leachability.

TABLE 6-1

Sampling and Analysis for Percent Solids

Process Stream	Nominal wt% Solids	Controlling Parameters
Slurry into thickener	16	Slurry water rate; Slurry machine depth in silo
Slurry out of thickener	55	Rake speed; Slurry draw rate
Additives feed	95	None
Feed to furnace	60	Thickener outlet moisture
Thickener overflow	<1	Feed rate from silo; Flocculent addition
Water from quench tower	<1	None
Water from wastewater filter	<50 ppm	Backflush frequency

An isokinetic sample will be used to continuously withdraw a sample from the stack. The sample will be drawn through a filter to collect a particulate matter for analysis. Although no radionuclide particulates will be present during Phase I, the isokinetic sampler will be calibrated and tested under operating conditions in preparation for Phase II.

The cooling tower blowdown will be regularly sampled and analyzed for total dissolved solids. Dissolved solids will be maintained, via the amount of blowdown, at a low enough level to prevent fouling of heat exchange surfaces.

6.3 SAMPLING AND ANALYSIS QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Start-up and operational sampling and analysis are key elements of this project. These aspects of the treatability testing program will provide important data for use in Phase II and remedial design. All sampling and analysis activities will be subject to QA/QC requirements applicable under the designated ASL in Table 3-1 of Section 3.0.

7.0 DATA MANAGEMENT

Data and records generated by the Phase I Pilot Plant Project used to support the OU4 Feasibility Study alternatives for treatment via vitrification will be managed in accordance with Section 4.4 and Appendix F (applicable sections) of the FEMP Records and Document Control Administration procedures (as applicable) and the SCQ, respectively. Field and laboratory data collected as part of Phase I will be maintained and recorded in accordance with applicable SCQ requirements. Phase I process operational tests and engineering design data will be managed in accordance with FEMP and CRU4 Records Management requirements where the SCQ is not applicable.

Where they are identified, field and laboratory records will be maintained in log books or on SCQ forms that are reviewed, signed and dated by the responsible persons. Currently identified reviews include Quality Control reviews of field generated records, laboratory reviews of analysis records generated, and data validation records generated on data required to be validated by this project plan. Where necessary, CRU4 will generate records using forms that will identify Phase I operation testing requirements, equipment calibration and preventative maintenance, verification of numerical results, checks for data entries, transcriptions and calculations, and records of training performed.

Computer programs for modeling in support of Phase I will be verified and validated. Data will be backed up on disks and printouts of processed data will be filed in appropriately labeled binders or notebooks as required by the SCQ.

Based on the requirements of Sections 12 and 14 of the SCQ, quality records generated for this project will be identified, and information on corrective actions taken will be provided in final reports, if applicable. These records will be managed in accordance with SCQ and CRU4 Document Control program requirements.

8.0 DATA ANALYSIS AND INTERPRETATION

Pre-construction data generated for engineering designs will be reviewed by engineering personnel for use in design work and require no futher analysis and interpretation.

Sampling and analysis data generated to provide characterization for RCRA and radiological programs will be validated according to FEMP Data Validation Program requirements for ASLs identified in Table 3-1 (Section 3.0). ASL B data resulting from the activities defined by this work plan will not require validation. Field sampling documents will be reviewed by the FEMP Quality Control organization to verify completeness and intercomparability of information.

Sampling and analysis data from start-up and operation will be analyzed based on performance and data quality objectives identified in Section 3.0. Operational sampling identified as ASL C will be validated using FEMP Data Validation program requirements. Data generated by the activities defined in this work plan under ASLs A and B will not require validation because it is limited to the support Phase I design and operation.

Data generated from this project plan will be used to support the OU4 Feasibility Study alternatives for treatment via vitrification. Results will be incorporated into the remedial design documents if vitrification is presented and approved as the remedial alternative in the ROD.

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9.0 HEALTH AND SAFETY

A General Health & Safety Plan for OU4 is being developed that will govern all OU4 activities. In addition, Project Specific Health & Safety plans will be developed for Phase I activities as addendums to the general OU4 Health & Safety Plan, as specific activities dictate.

Per DOE Order 5480.23, the Pilot Plant project requires a formal safety analysis and review. A "Preliminary Safety Analysis Report for Operable Unit 4" is currently under review. The Preliminary Safety Analysis Report (PSAR) provides the safety basis for the construction of the Operable Unit 4 Vitrification Pilot Plant. The safety basis includes the design objectives and those measures necessary to ensure that the facilities will be constructed and operated in a safe manner and in compliance with applicable laws, regulations, and DOE orders. Based on the analysis contained in this PSAR, the risks associated with construction and operation of the Vitrification Pilot Plant are within the limits defined in the applicable regulations, DOE orders, and proposed DOE-DP-STD-3005-93, "Definitions and Criteria for Accident Analysis."

10.0 RESIDUALS MANAGEMENT

10.1 WASTE CHARACTERIZATION

All waste characterization will be performed in accordance with existing site procedures and will indicate the type of waste management procedures required. Generally, it is desirable that all project waste be identified and characterized prior to its actual generation. Characterization of all waste generated during construction projects, including soils, is currently performed according to Site Standard Operating Procedure (SSOP)-0044. The project engineer initiates this process by completing the Construction Waste Identification/Disposition (CWID) form, which identifies the types of waste and approximate quantities that will be generated during the project. Characterization of all waste generated at the FEMP is documented on the Material Evaluation Form (MEF). The MEF and its associated documentation fully identify required regulatory identifications, restrictions and requirements that apply to each waste stream. Information contained in the MEF is used to identify the required container type, labels and markings, storage restrictions, and ultimately, the management/disposal method(s) that will be applied to the waste.

After the CWID is completed, it is forwarded to the FERMCO Waste Characterization group, where the waste identified on the form is matched to currently characterized waste streams documented in MEFs. This process may involve the use of any of the following techniques to verify that the waste to be generated during the project will match the waste stream profile documented in the MEF:

-Review of existing process knowledge, documentation and project files
-Review of historical sampling data which pertains to the project area or waste material
-Sampling and analysis of materials within the project area.

Continual contact between the project personnel and the Waste Characterization group is required to ensure that the necessary information, forms, and work assignments are communicated clearly and expeditiously. In the event that a waste material does not match an existing MEF profile, the Project Engineer is required to initiate a new MEF. This process is conducted according to Site Standard Operating Procedure (SSOP)-0002. When all waste materials identified on the CWID have been assigned to completed MEFs, the Waste Characterization group will issue a summary letter, which identifies the final characterization and specific MEF assigned to each. In the event that SSOPs, forms, group names, or responsibilities referenced above are changed, then waste generated through this project will be characterized according to those changes.

The following construction activities performed during Phase I will generate waste requiring characterization through SSOP-0044:

- Vitrification facility construction
- Silo dome modification
- Superstructure construction
- Equipment installation

The following waste streams are expected to be generated during the activities listed above:

Soil
Rubble (concrete, blocks, etc...)
Metal, scrap
Miscellaneous liquids (excess solvents, paints, thinners, etc...)
Rainwater accumulated in excavations and Silo 4
Wood, scrap
Miscellaneous trash (Personal Protective Equipment [PPE], paper, plastic, drywall, tile, etc...)
Conduit/wiring
Oil solvents and sweeping compounds

The following streams will be generated during operation of the Pilot Plant during Phase I and will require characterization through SSOP-0002:

- Vitrified surrogate material
- Waste water from the retrieval and vitrification processes
- Non-vitrified surrogate material, (i.e., bentonite, sand, water)
- HEPA filter cartridges
- Laboratory waste
- Miscellaneous trash (i.e., PPE, paper)

10.2 WASTE DISPOSITION

All waste disposition will be dictated by characterization of the waste stream as described in Section 10.1. Therefore, final disposition of the waste cannot be specified until characterization is complete. Listed below are possible categories of characterized waste with corresponding disposal options. These are not meant to be comprehensive but are based on currently available options.

- Process wastewater and accumulated rainwater - pumped to the FEMP Waste Water Treatment System and/or the stormwater runoff collection system.

- Soil and debris - all waste will be collected and managed in accordance with the requirements specified by FEMP SSOP-0044 and the Removal Action 17 Work Plan.

- Low Level Radioactive Waste - disposal at NTS or properly stored on site until appropriate disposal methods or facilities are identified.
- Nonhazardous - recycled, disposal at sanitary landfill or properly stored on site until appropriate disposal methods or facilities are identified.
- Hazardous - properly stored in RCRA permitted facility on site until appropriate disposal methods or facilities are identified.
- Mixed - properly stored in RCRA permitted facility on site until appropriate disposal methods or facilities are identified.

10.3 WASTE MINIMIZATION

As a National Priorities List (NPL) site, the FEMP is making efforts to reduce the generation of waste that requires special handling. By eliminating unnecessary waste generation, the FEMP reduces the cost, risk, and burden on available waste management facilities during management of the waste. Several aspects of Pilot Plant construction and operation provide opportunities to facilitate waste minimization practices.

Dumpsters will be used to collect non-contaminated (i.e., non-radioactive) and non-hazardous scrap for disposal at a commercial sanitary landfill. This will avoid the disposal cost of managing the material at NTS as LLRW and provide a means to segregate the material to avoid contamination as it is being accumulated.

The hydraulic mining process uses water to slurry the material to facilitate removal. The water will be collected and recycled through the process in a closed loop system, which substantially reduces the generation of wastewater requiring treatment before release. This further reduces cost for transferring the water to the site treatment system, and management of wastewater sludge generated in the water treatment system.

The goal of Phase I of the project is to test the system's ability to retrieve and vitrify surrogate silo residues. Uncontaminated bentonite and sand (or washed soil) will makeup the majority of surrogate material for the test demonstration. The use of uncontaminated materials for the test will reduce or eliminate the generation of contaminated waste from the waste retrieval and vitrification processes. Release of wastes generated during operation of the pilot plant, once they are characterized as non-RCRA and non-radioactive, will allow them to be managed at a commercial sanitary landfill off-site.

Additional waste minimization efforts may be identified as the project progresses and will be evaluated at that time. The minimization efforts referenced above may also be modified as the project progresses or as the need arises.

11.0 COMMUNITY RELATIONS

Treatability studies and community information and involvement activities are required in the CERCLA process. Community relations activities will be conducted to explain the role of treatability studies in the OU4 RI/FS. This will confirm confidence in the cleanup alternatives, technologies identified in the alternatives screening/analysis process and in the preferred alternative for OU4.

In accordance with CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), information regarding this document and the vitrification technology will be provided to individuals via Fernald site publications; briefings at community, township and Fernald Residents for Environment, Safety, and Health (FRESH) meetings; and public participation activities.

In addition to attending community meetings and participating in Fernald-related activities, individuals can also obtain information by examining the Administrative Record, which contains documents relevant to the RI/FS for the site, including OU4. The Administrative Record is located in the Public Environmental Information Center, 10845 Hamilton-Cleves Highway, just south of the Fernald site.

Public Environmental Information Center Hours

Phone: 513-738-0164

Monday and Thursday, 9 a.m. to 8 p.m.

Tuesday, Wednesday and Friday, 9 a.m. to 4:30 p.m.

Saturday, 9 a.m. to 1 p.m.

Although the law does not require a formal public comment period on treatability study work plans, individuals will have opportunities to provide input regarding the Vitrification Pilot Plant and other OU4 projects through public participation activities that will be conducted to promote communications between the FEMP and the community.

For more information about this document or the Fernald site, individuals may contact:

Mr. Ken Morgan
Public Information Director
DOE Field Office, Fernald
P.O. Box 398705
Cincinnati, OH 45239-8705
Phone: 513-648-3131

12.0 REPORTS

12.1 MONTHLY REPORTS

The monthly report will summarize the progress made in meeting the Pilot Plant Phase I Program milestones and present any technical issues which may develop during the course of work. These reports will be prepared by the Assistant CRU4 Director for Engineering and Construction and will be submitted to the DOE-FN by the tenth day of the following month. The first report will be due on the tenth day of the month that follows the approval of this Work Plan.

12.2 BI-WEEKLY STATUS MEETINGS

A bi-weekly status meeting with the DOE-FN will be scheduled to summarize the progress made in the Pilot Plant Phase I construction, start-up and operation and to discuss any relevant issues that may develop during the course of work. During the course of the project, the lead reporting responsibilities are as follows:

- Reporting of design and engineering aspects is the responsibility of the Engineering Manager.
- Reporting of construction aspects is the responsibility of the Construction Manager.
- Reporting of start-up and operational aspects is the responsibility of the Remedial Support Operations Manager.

12.3 FINAL REPORT

A final report will be generated following the completion of Phase II of the project. The report will include a description of all of the work performed in Phases I and II, along with data from both laboratory and site operations performed in the project, technical discussion, results, and conclusions. Preparation of this report is the responsibility of the Project Director and submittal to DOE-FN will be scheduled to occur within ninety (90) days after completion of the Phase II project. A suggested format of the final report is outlined in Table 12-1.

TABLE 12-1

Suggested Organization of the Treatability Study Final Report

1.0 Introduction
- 1.1 Site description
  - 1.1.1 Site name and location
  - 1.1.2 History of operations
  - 1.1.3 Prior removal and remediation activities
- 1.2 Waste stream description
  - 1.2.1 Waste matrices
  - 1.2.2 Pollutants/chemicals
- 1.3 Treatment technology description
  - 1.3.1 Treatment process and scale
  - 1.3.2 Operating features
- 1.4 Previous treatability studies at the site

2.0 Conclusions and Recommendations
- 2.1 Conclusions
- 2.2 Recommendations

3.0 Treatability Study Approach
- 3.1 Test objectives and rationale
- 3.2 Experimental design and procedures
- 3.3 Equipment and materials
- 3.4 Sampling and analysis
  - 3.4.1 Waste stream
  - 3.4.2 Treatment process
- 3.5 Data management
- 3.6 Deviations from the Work Plan

4.0 Results and Discussion
- 4.1 Data analysis and interpretation
  - 4.1.1 Analysis of waste stream characteristics
  - 4.1.2 Analysis of treatability study data
  - 4.1.3 Comparison to test objectives
- 4.2 Quality assurance/quality control
- 4.3 Costs/schedule for performing the treatability study
- 4.4 Key contacts

TABLE 12-1
(continued)

References

Appendices

A. Data summaries

B. Standard operating procedures

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13.0 SCHEDULE

Figure 13-1 includes activities required to complete the Phase I Pilot Plant program for waste retrieval and vitrification (surrogate program), the Phase II Pilot Plant Treatability Study (for vitrification of K-65 and Silo 3 material), and the Remedial Action programs for the silos and the OU4 area. The schedule of activities is driven by the RI/FS schedules that are incorporated in the Amended Consent Agreement (ACA) and the resource-loaded schedules included in the "FEMP Baseline for FY94-99" for Work Breakdown Structure (WBS) Element 1.1.1.1.4, which is titled "OU4, Silos 1-4."

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ACTIVITY ID	EARLY START	EARLY FINISH	REM DUR	ACTIVITY
4RRIM285		19OCT92A	0	RECEIVE ALL FIELD DATA ANALYSIS
4RRIM900		23FEB93A	0	Submit RI/BRA to DOE-HQ
4RRIM905		19APR93A	0	Submit RI/BRA to EPA (CA)
4RRIM910		28JUN93A	0	Receive RI/BRA from EPA
4RRIM915		23AUG93A	0	Submit final RI/BRA to EPA
4RIFM005		28MAY93A	0	Submit Draft FS/PP/EIS to DOE
4RIFM093		10SEP93A	0	Submit Draft FS/PP/EIS to EPA (CA)
4RIFM102		8NOV93	0	FERMCO - Receive EPA Comments - Draft FS/PP/EIS
4RIFM135		29DEC93	0	Submit Draft Final FS/PP/EIS to EPA
4RIFM214		9NOV94	0	EPA R-V - Sign Final ROD
4RIFM220	13DEC94		0	FERMCO - Begin Remediation
4RIFM920		27DEC93	0	Submit Draft Final FS/PP/EIS TO DOE
4RIFM925		28DEC93	0	Submit Draft Final FS/PP/EIS TO EPA
4RIFM945	7MAR94		0	Issue Proposed Plan to DOE-FN for Public Comment
4RIFM955		10JUN94	0	FERMCO - Submit Responsiveness Summary to EPA
4JP2H002	28OCT93	28JUN94	165	PHASE II WORK PLAN
4JP2H008	25FEB94	12DEC94	200	PHASE II PILOT PLANT DESIGN
4JP2H018	7DEC94	16MAY95	110	PHASE II CONSTRUCTION
4JP2H022	13SEP95	7NOV95	40	PHASE II OPERATIONS
4JP2M006		24FEB94	0	SUBMIT PHASE II WORK PLAN TO USEPA
4JP2M044		7NOV95	0	PHASE II PILOT OPERATIONS COMPLETE

FY92 | FY93 | FY94 | FY95 | FY96 | FY97 | FY98 | FY99 | FY00 | FY01 | FY02 | FY03

Plot Date 17FEB94
Data Date 27SEP93
Project Start 1OCT85
Project Finish 30SEP02

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

DOEW

Sheet 1 of 3

FEMP BASELINE SCHEDULE
CERCLA/RCRA UNIT 4
OU4 MASTER SCHEDULE

REV 942 WSP/WGF

Date	Revision	Checked	Approved

FIGURE 13-1

Pilot Plant Phase I Schedule

ACTIVITY ID	EARLY START	EARLY FINISH	REM DUR	ACTIVITY
4VP1H010	11MAR93A	28JAN94	84	PHASE I DESIGN
4VP1H014	9JUN94	8FEB95	167	PHASE I PROCUREMENT
4VP1H016	26AUG94	22MAY95	183	PHASE I CONSTRUCTION
4VP1H018	25MAY95	21AUG95	61	PHASE I OPERATIONS
4VP1M018		7JUN94	0	PSAR APPROVED BY DOE
4VP1M024		28JAN94	0	COMPLETE PHASE 1 TITLE II DESIGN
4VP1M028		8FEB95	0	COMPLETE PILOT PLANT PROCUREMENT (FURNACE)
4VP1M038	11JUL95		0	START PHASE I PILOT PLANT OPERATIONS
4VP1M212	8FEB94		0	DOE Begin PSAR Review
4XRSH010	23AUG93A	11JAN94	71	WASTE RETRIEVAL DESIGN
4XRSH016	19NOV93	14JUN94	140	WASTE RETRIEVAL EQUIPMENT FABRICATION
4XRSH018	10MAR94	30DEC94	203	WASTE RETRIEVAL CONSTRUCTION
4XRSH020	31OCT94	21FEB95	75	WASTE RETRIEVAL OPERATIONS/DEMONSTRATION
4XRSM012	10MAR94		0	START OF WR/TS CONSTRUCTION
4RIFM099		15DEC93	0	Submit Draft ROD to DOE
4RIFM198		10JUN94	0	Submit Draft ROD to EPA R-V (CA)
4RIFM201		11AUG94	0	Receive Draft ROD from EPA R-V
4RIFM213		9SEP94	0	Submit Final Draft ROD to EPA R-V
4CP3HH01	13JUN94	14JUN95	252	REMEDIAL DESIGN WORK PLAN
4CP3HH02	30AUG94	6JUN95	191	REMEDIAL ACTION WORK PLAN
4CP3MM00		11OCT94	0	SUBMIT RD WORK PLAN TO DOE

FY92 FY93 FY94 FY95 FY96 FY97 FY98 FY99 FY00 FY01 FY02 FY03

Plot Date 17FEB94
Data Date 27SEP93
Project Start 1OCT85
Project Finish 30SEP02

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

DOEW

FEMP BASELINE SCHEDULE
CERCLA/RCRA UNIT 4
OU4 MASTER SCHEDULE

Sheet 2 of 3

REV 942 WSP/WGF

Date	Revision	Checked	Approved

FIGURE 13-1 (cont.)

Pilot Plant Phase I Schedule

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ACTIVITY ID	EARLY START	EARLY FINISH	REM DUR	DESCRIPTION
4CP3MM01		9FEB95	0	SUBMIT RD WORK PLAN TO USEPA
4CP3MM02		13APR95	0	RECEIVE RD WORK PLAN FROM USEPA
4CP3MM03		12MAY95	0	SUBMIT FINAL RD WORK PLAN TO USEPA
4CP3H007	25JAN96	7MAR97	280	SILO REMEDIATION CONSTRUCTION
4CP3HH03	30AUG94	10JAN96	339	SILO REMOVAL/TREATMENT DESIGN
4CP3HH09	10MAR97	2JUN00	810	SILO REMOVAL/TREATMENT OPERATIONS
4CP3MM11	28SEP94		0	START REMEDIAL DESIGN (SILO CONTENTS RMVL/TRTMT)
4CP3MM17		10JAN96	0	CFC - CONTENT REMOVAL/TREATMENT DESIGN
4CP3MM39		3OCT96	0	DOE APPROVES FSAR FOR CONTENT RMVL/TRTMT
4CP3MM53	25JAN96		0	START CONSTRUCTION FOR CONTENT RMVL/TRTMT
4CP3MM61	10MAR97		0	START REMOVAL/TREATMENT OF SILO CONTENTS
4CP3MM69		8MAR00	0	COMPLETE REMOVAL/TREATMENT OF SILO CONTENTS
4FP4HH03	3JUN98	2DEC98	126	FINAL SITE REMEDIATION DESIGN
4FP4HH07	25FEB99	14SEP99	140	FINAL SITE REMEDIATION CONSTRUCTION
4FP4HH08	15SEP99	27SEP02	760	FINAL SITE REMEDIAL OPERATIONS
4FP4MM11	1JUL98		0	START TITLE I/II DESIGN FOR FINAL SITE REMD'N
4FP4MM51	25FEB99		0	START CONSTRUCTION FOR FINAL SITE REMED'N
4FP4MM69		27SEP02	0	COMPLETE REMEDIATION OF OU4
4MEDH006	27SEP93	18JAN94	76	300KG MELTER (HOT) RUNS OPERATION

Plot Date 17FEB94
Data Date 27SEP93
Project Start 1OCT85
Project Finish 30SEP02

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

DOEW

Sheet 3 of 3

FEMP BASELINE SCHEDULE
CERCLA/RCRA UNIT 4
OU4 MASTER SCHEDULE

REV 942 WSP/WGF

Date	Revision	Checked	Approved

FIGURE 13-1 (cont.)

Pilot Plant Phase I Schedule

14.0 MANAGEMENT AND STAFFING

This work supports the remediation of OU4 at the Fernald Environmental Management Project. The governing document is the Amended Consent Agreement between the DOE and the USEPA Region V, signed in September, 1991. As such, ultimate project management responsibility lies with these two agencies as defined by this agreement. In addition, the State of Ohio EPA has been granted regulatory authority over certain RCRA activities. Each agency has engaged contractors to perform identified scopes of work related to their prime areas of responsibility for site remediation. Figure 14-1 shows this responsibility matrix, and Figure 14-2 identifies the lead personnel.

Within each agency, various organizations and offices have been delegated specific program responsibilities. Direct management of this Pilot Plant Phase I program is delineated as described in Section 14.1.

14.1 PROJECT MANAGEMENT

The Pilot Plant program is being developed for, and will be implemented as, the third tier (RD/RA Treatability Study) of the U.S. EPA-outlined approach described in Section 1. Thus, the 1991 Amended Consent Agreement is the overall governing document, with the project being conducted in compliance with EPA guidance for CERCLA activities and site operations being conducted in compliance with DOE Orders.

The Phase I program will be conducted in compliance with this work plan document as approved by DOE. The DOE Office of Environmental Restoration will implement the program via its Fernald Field Office (DOE-FN). The DOE has retained the Fernald Environmental Restoration Management Company (FERMCO) as the Environmental Restoration Managing Contractor (ERMC) for site remediation. Remediation projects for Operable Unit 4 are managed by CRU4, so named in recognition of the principal legislation governing remedial activities.

FERMCO will implement the program for the DOE-FN via its own workforce and subcontractors. The Architectural/Engineering firm, Parsons, is under contract to FERMCO to perform engineering design services for remediation. When required, other subcontractors and FERMCO home office support from teaming partners is utilized to accomplish specialized tasks or unique scopes of work. Within FERMCO, the CRU4 Director has lead responsibility for implementing the overall Pilot Plant program.

FEMP OU4 Remediation

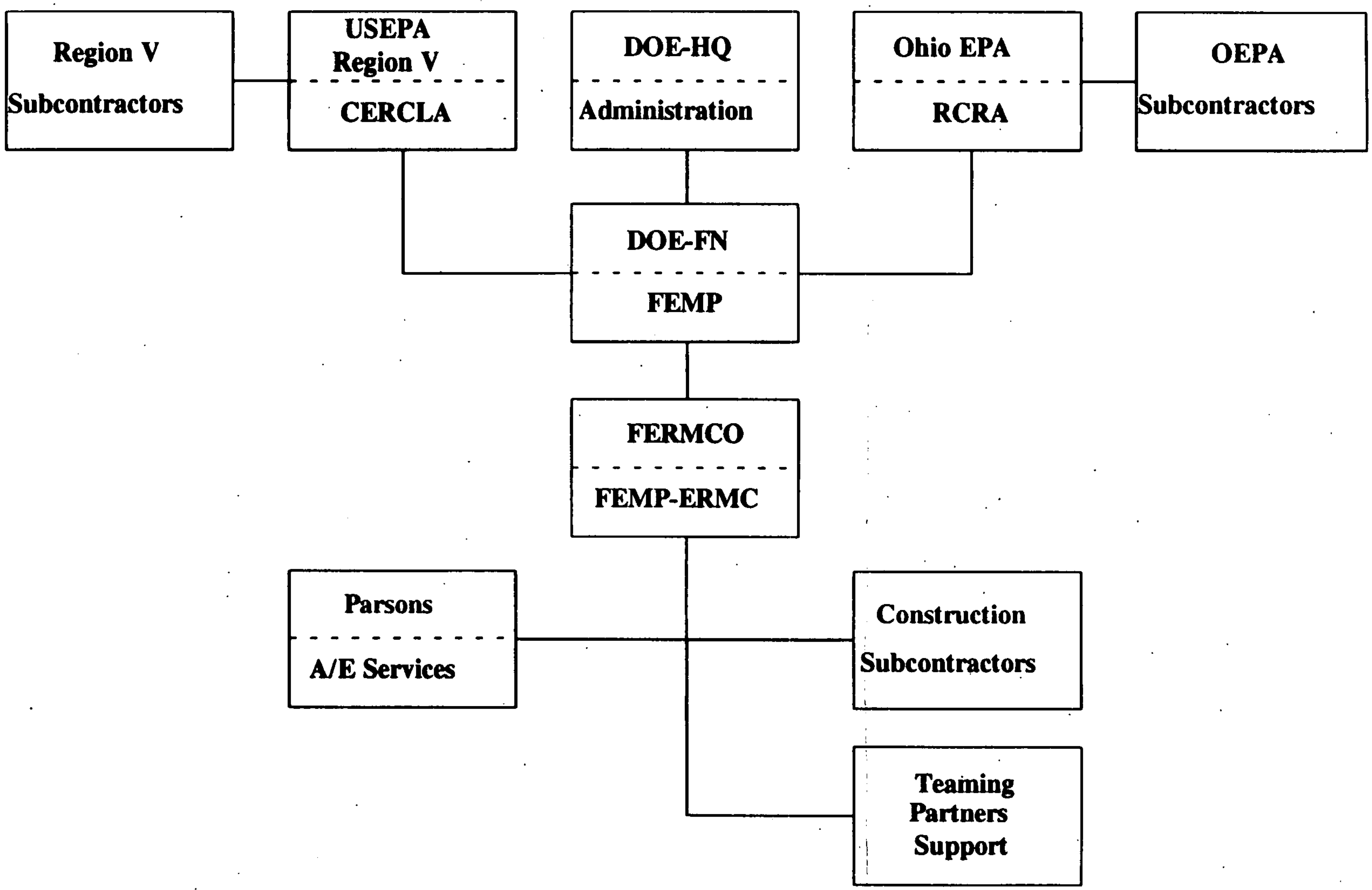

Figure 14-1 Administrative Relationship

CERCLA/RCRA Remediation

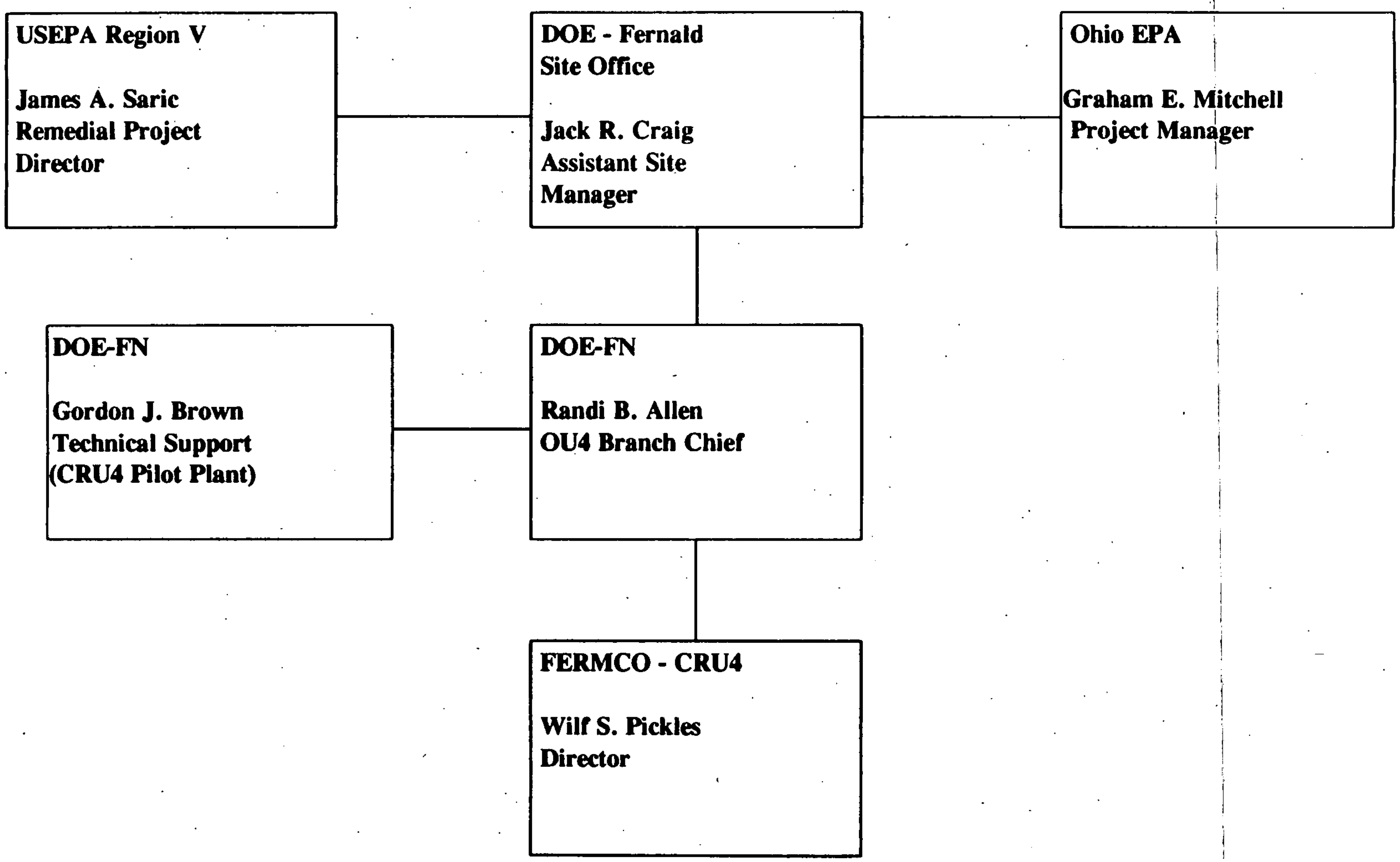

Figure 14-2 Operable Unit 4 Remediation

14.2 STAFFING

The FERMCO organization consists of project organizations (such as CRU4), support divisions (such as Engineering), and service departments (such as Analytical Services). The support divisions supply full-time personnel to the project on a matrix basis. This may range from a single point of contact (such as a procurement representative) to a full department (such as Environmental, Engineering or Construction). Service organizations (such as Analytical Services) provide support on a request-for-services basis from a document that is generated for each specific work request. Figure 14-3 is an organization chart that depicts the functional responsibilities for the Pilot Plant program activities together with the names of the individuals who currently hold these positions. Currently, the CRU4 Director acts as the Program Manager; the CRU4 Engineering Manager serves as the Pilot Plant Project Manager.

Within the CRU4 organization, the Assistant CRU4 Director, Operations and Remediation is responsible for all RI/FS program activities. The Engineering Department Manager is responsible for facility and process design, as well as Project Engineering support activities. The Construction Manager is responsible for facility construction. The Engineering and Construction Departments maintain responsibility through the check-out and start-up phases, and both departments report to the Assistant CRU4 Director, Engineering and Construction, who is responsible to delineating the individual responsibilities. As a treatability test program, the actual testing will be directed by professional staff; the CRU4 Remedial Site Operations Manager is responsible for supplying building services and equipment operators.

FERNALD ENVIRONMENTAL RESTORATION
MANAGEMENT CORPORATION
CERCLA/RCRA UNIT 4
PILOT PLANT PROGRAM

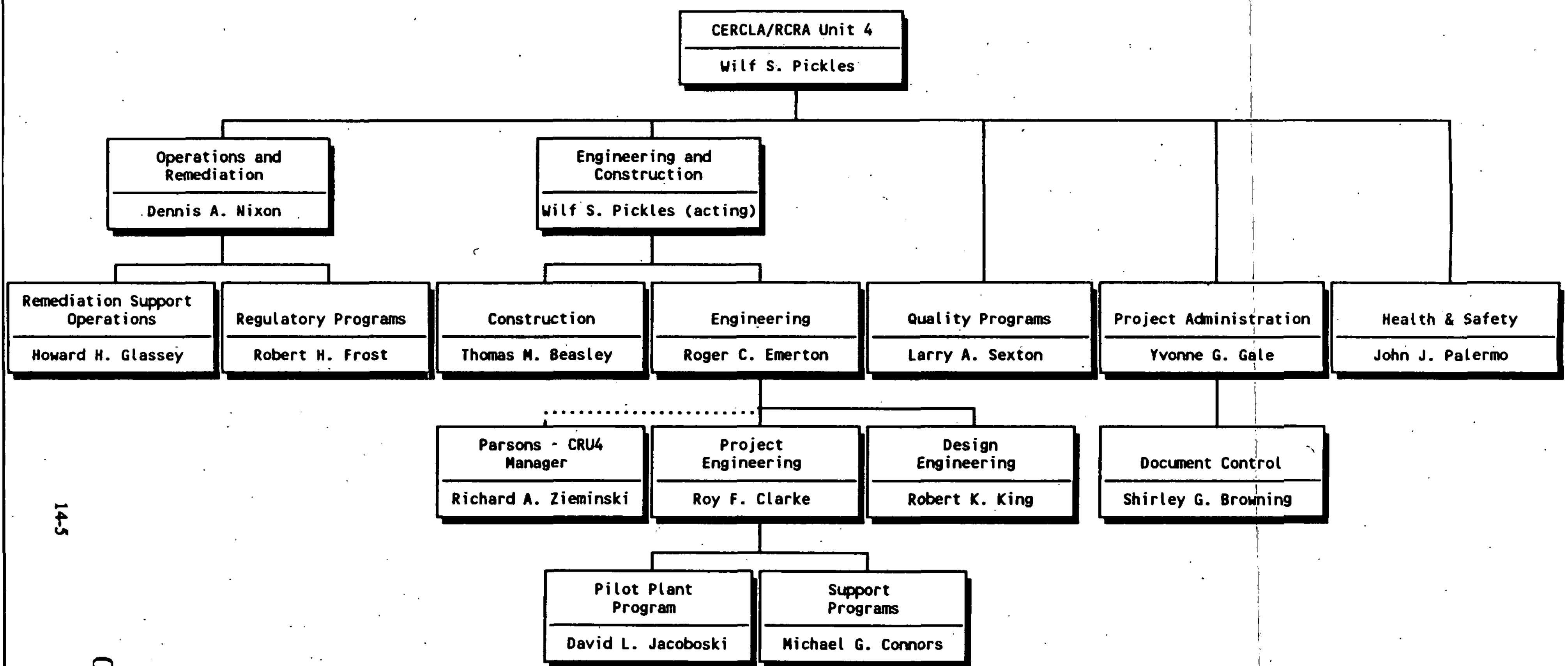

FIGURE 14-3

CRU4 Organization for Pilot Plant Program

UPDATED: 02/18/94

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15.0 BUDGET

The budget for the Pilot Plant project is contained in the "FEMP Baseline for FY 94 -99," WBS Element 1.1.1.1.4, which is titled "OU4, Silos 1-4." The FEMP Baseline document contains the resource loaded schedules for the individual components of the integrated program, and that document is the reference for the budget details. Summary level totals for each major component by fiscal year are shown here in Tables 15-1 through 15-5. These tables address the design and construction of the required facilities, but not the operation or eventual demolition and environmental restoration.

TABLE 15-1

Total Estimated Costs for the Integrated Pilot Plant Project

ITEM	FY-94	FY-95	FY-96	TOTAL
FERMCO Labor	1,170,171	715,955	10,076	1,896,202
Subcontractors	4,688,428	7,190,210	0	11,878,638
Materials	0	918,841	6,392	925,232
TOTAL ESTIMATED COST	5,858,599	8,825,006	16,467	14,700,073

TABLE 15-2

Pilot Plant Facility

ITEM	FY-94	FY-95	FY-96	TOTAL
FERMCO Labor	957,945	636,377	10,076	1,604,398
Subcontractors	2,340,085	5,980,311	0	8,320,396
Materials	0	918,841	6,392	925,233
TOTAL ESTIMATED COST	3,248,031	7,535,528	16,467	10,850,027

TABLE 15-3

Waste Retrieval & Transfer

ITEM	FY-94	FY-95	FY-96	TOTAL
FERMCO Labor	191,019	79,579	0	270,598
Subcontractors	2,313,133	1,209,899	0	3,523,032
Materials	0	0	0	0
TOTAL ESTIMATED COST	2,504,152	1,289,478	0	3,793,630

TABLE 15-4

Radon Adsorption Test System

ITEM	FY-94	FY-95	FY-96	TOTAL
FERMCO Labor	17,676	0	0	17,676
Subcontractors	0	0	0	0
Materials	0	0	0	0
TOTAL ESTIMATED COST	17,676	0	0	17,676

TABLE 15-5

Silo Concrete Non-Destructive Testing

ITEM	FY-94	FY-95	FY-96	TOTAL
FERMCO Labor	3,532	0	0	3,532
Subcontractors	35,209	0	0	35,209
Materials	0	0	0	0
TOTAL ESTIMATED COST	38,741	0	0	38,741

FERMCO labor includes the direct labor charges made by FERMCO employees and the site 8A contractor, Wise Construction. The "Subcontracts" costs represent the estimated costs of subcontracts for design and construction. The "Materials" costs represent the cost of materials purchased to operate the facility.

16.0 REGULATORY COMPLIANCE

Regulatory requirements governing construction and operation of the Phase I Pilot Plant for vitrification and waste retrieval are discussed in this section. The vitrification facility will be designed to produce a consistent stabilized glass with minimal effluent. In Phase I, the systems will be tested using surrogate material.

The project will include the Pilot Plant construction, removal of a portion of the Silo 4 dome, operation of the vitrification facility demonstration of material retrieval systems in Silo 4, and the disposition of construction rubble under existing site procedures.

16.1 REMOVAL SITE EVALUATION (RSE) GUIDANCE

Construction during this project will require excavation of soils, and will generate construction rubble and debris. Pursuant to the National Contingency Plan (NCP) under 40 CFR 300.410, a Removal Site Evaluation (RSE) must normally be conducted to assess the potential for an activity to release hazardous substances to the environment. The purpose of this requirement is to determine whether a removal action should be conducted prior to remediation of an unknown, or previously uncharacterized area. The activities proposed by this work plan are to be conducted in an area where there has been previous investigation and data collection under the RI for OU4. Based on analysis of these data, process knowledge of operations conducted in the area, and current knowledge of "hot spots," no Removal Action is warranted for activities conducted in this area prior to the remedial activities, including construction and operation of the Pilot Plant systems.

The activities proposed in this work plan will be conducted in support of the remediation of OU4 under CERCLA Section 104. Since treatability studies are part of the response action planned for OU4, a formal RSE is not required. A letter from the DOE, dated April 16, 1993 (see Appendix A), supports this position. Documentation of existing data and information, along with engineering controls and procedures described in this work plan, will meet the substantive requirements of an RSE as outlined in 40 CFR 300.410. The construction activities described in this work plan will comply with the requirements of site procedure SSOP-0044, Management of Soil, Debris, and Waste from a Project. If "hot spots" are encountered during construction, or if, at any time during this phase of operation, it is determined that a potential exists for release of hazardous substances to the environment, an RSE will be conducted to determine whether a Removal Action is warranted.

16.2 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) COMPLIANCE

The National Environmental Policy Act (NEPA) requires assessment of environmental impacts due to proposed DOE projects. The determination that a categorical exclusion (CX) is the appropriate class of action must be made by DOE in accordance with DOE Order 5440.1D (NEPA Compliance Program) and the NEPA Document Process (SSOP-0031). A request package containing the "Request for NEPA Services" and "Environmental Compliance Questionnaire" for a NEPA determination on Phase I, along with a project schedule and scope of work, was transmitted to the on-site NEPA work group for document preparation. On March 30, 1993, a determination was made by the DOE-FN that Phase I was categorically excluded from requirements to conduct further environmental impact assessments under NEPA. This determination is documented as Categorical Exclusion 412 (CX 412). However, Phase I construction will not proceed prior to the Phase II NEPA determination.

16.3 RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) COMPLIANCE

Silo 4, which will be utilized for Phase I, has never contained process residues or other waste material. However, project construction will result in the generation of soils or debris (i.e. concrete) that would require characterization. If the waste determination indicates the material contains hazardous waste constituents, the material would be subject to the substantive RCRA requirements for the generation, handling, management and storage of RCRA hazardous waste.

The residues in Silos 1, 2 and 3 are excluded from regulation under RCRA by 40 CFR 261.4. Under this exclusion, source, by-product and special nuclear materials are excluded from regulation under RCRA. Residues in the silos are by-product material resulting from the production of uranium metal from source material such as pitchblende ores. Therefore, the waste materials meet the exclusion, and the RCRA regulations are not applicable as ARARs. However, the materials processed and stored in the silos contained elevated levels of natural metals, such as Pb-210, and are, therefore, similar to RCRA hazardous waste (due to characteristic metals). Due to the hazard associated with the toxicity of the metals, the substantive requirements of RCRA are adopted as relevant and appropriate for protectiveness during this activity.

16.4 PERMITTING ISSUES

CERCLA Section 121(e)(1) states that no Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely on site, where such remedial action is selected and carried out in compliance with Section 121.

As a treatability study preceding CERCLA removal/remedial actions, this Pilot Plant project is not required to obtain any Federal, State, or local permits. However, the project must be conducted in accordance with the terms and conditions of those permits that otherwise would have been required.

Section XIII.B of the Amended Consent Agreement requires the DOE to identify those permits that would otherwise be required, along with the standards, requirements, criteria, or limitations that would have to have been met to obtain each permit. The DOE must report these findings to the USEPA, along with an explanation of how the response action will meet these standards, requirements, criteria, or limitations.

The following summarizes the permits, permit requirements and plans to meet those requirements for Phase I.

16.4.1 Air Permits

Construction and Phase I and II operation of the Pilot Plant may generate nuisance dust during construction, and off-gases from operating the vitrification furnace to melt the surrogate and waste materials. Releases of dust and particulates will be controlled by approved site standard operating procedures and best available technology, including off-gas control equipment.

A. Identification of Air Permits That Would Otherwise be Required

Federal Permits

NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP) - 40 CFR PART 61, SECTION 61.07(a): The owner or operator shall submit to the Administrator an application for approval of the construction of any new source or modification of any existing source. Unless exempted in a specific subpart, an application for approval would have to be submitted for sources subject to a NESHAP standard. The Operable Unit 4 Pilot Plant project is subject to the requirements of Subparts H and Q of 40 CFR Part 61.

40 CFR PART 61, SUBPART H - NATIONAL EMISSION STANDARDS FOR EMISSIONS OF RADIONUCLIDES OTHER THAN RADON FROM DOE FACILITIES - Section 61.96(b) states that an application for approval does not have to be filed for radionuclide sources if the effective dose equivalent (EDE) caused by all emissions from the new construction or modification is less than 0.1 mrem per year. Emissions from the Pilot Plant have not yet been determined. The EDE shall be determined using an approved USEPA computer model. The source term to be entered into the model, to determine the necessity of an application, shall be developed using Appendix D to Part 61 - Methods for Estimating Radionuclide Emissions.

40 CFR PART 61, SUBPART Q - NATIONAL EMISSION STANDARDS FOR EMISSIONS OF RADON EMISSIONS DOE FACILITIES - Subpart Q does not provide an exemption for new construction or modifications having the potential to emit radon. Ordinarily, an application would have to be submitted for approval.

State Permits

PERMIT TO INSTALL - OAC 3745-31-02 (A): Unless exempted by OAC 3745-31-03, no person shall cause, permit or allow the installation of a new source of air pollutants or cause, permit, or allow the modification of an air contaminant source without first obtaining a Permit to Install. Under ordinary circumstances, an air Permit to Install would have to be obtained for the proposed Vitrification Pilot Plant.

PERMITS TO OPERATE - OAC 3745-35-02 (A): Except as otherwise provided in paragraph H (Conditional Permits to Operate) of rule OAC 3745-35-02 and in OAC rules 3745-35-03 (variances) and 3745-35-05 (permit exemptions and registration status), no person may cause, permit, or allow the operation or other use of any air contaminant source without first applying for and obtaining a Permit to Operate. Under ordinary circumstances, Permits to Operate would have to be obtained for the proposed Vitrification Pilot Plant.

B. Identification of the Standards, Requirements, Criteria, or Limitations that Would Have to be Met to Obtain the Above Permits/Notifications

Federal Requirements

NESHAP SUBPART H - 40 CFR PART 61, SECTION 61.92: Emissions of radionuclides (except Rn-222 and Rn-220) to the ambient air from Department of Energy facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr.

NESHAP SUBPART H - 40 CFR PART 61, SECTION 61.93: Continuous measurement of radionuclide emissions is required for point sources having the potential to cause an EDE in excess of 0.1 mrem/yr. The EDE is again determined by an approved USEPA computer model. However, for the purposes of determining monitoring requirements, the estimated radionuclide release rates are based on normal facility operations, without the benefit of any pollution control equipment. Additionally, all radionuclides which could contribute greater than 10% of the potential EDE for a release point shall be measured.

NESHAP SUBPART Q - 40 CFR PART 61, SECTION 61.192: No source at a Department of Energy facility shall emit more than 20 pCi/-m^2-s of Rn-222 as an average for the entire source, into the air. This applies to the design and operation of DOE owned storage and disposal facilities that emit Rn-222 into the air.

State Requirements

PERMIT TO INSTALL - OAC 3745-31-05 (A): Installation of the proposed Pilot Plant facility must not prevent or interfere with the attainment or maintenance of applicable ambient air quality standards; and must not result in a violation of any applicable laws; and must employ the Best Available Technology (BAT) to control emissions.

PERMITS TO OPERATE - OAC 3745-35-02 (C): The proposed Pilot Plant facility must be operated in compliance with applicable air pollution control law; must be constructed, located or installed in compliance with the terms and conditions of a Permit to Install; and must not violate National Emission Standards for Hazardous Air Pollutants (NESHAPs) adopted by the Administrator of the U.S. EPA.

C. Explanation of How the Response Action Will Meet the Standards, Requirements, Criteria, or Limitations Identified in Item B Above

NESHAP Subpart H

The Pilot Plant emission control systems will be designed to prevent the facility from exceeding the 10 mrem/yr EDE standard. Emissions from the vitrification facility shall be vented through a vitrification off-gas system. Radon emissions from the silos shall be vented through a carbon bed/HEPA filter control system.

A stack monitoring program will be established for the vitrification exhaust gases. This monitoring program will conform to the sample collection and analytical requirements of 40 CFR Part 61, Appendix B, Method 114. An isokinetic sampler will be used to continuously withdraw a sample from the stack. The sample will be drawn through a filter to collect particulate matter for analysis. Using the results of the sample analyses, the annualized EDE shall be determined using an approved computer model and shall be incorporated into the sitewide annual NESHAP report.

Though not yet modeled, preliminary estimates of the source term derived under 40 CFR 61.96(b), indicate that the EDE will be greater than 0.1 mrem/yr. This, normally, would require the submittal of an application for approval.

The EDE used to evaluate stack monitoring requirements has not been calculated, though it is also expected to be greater than 0.1 mrem/yr. A continuous, isokinetic stack sampler will be installed to measure emissions from the vitrification process.

NESHAP Subpart Q

Data from the treatability study indicate that radon emissions from storage of the vitrified product will be less than 20 pCi/m^2/s. This will comply with the requirements of 40 CFR 61 Subpart Q.

Estimates of both Subpart H and Subpart Q emissions from the Pilot Plant project are being developed. These emission estimates, and the results of any associated computer modeling runs will be forwarded to the U.S. EPA as a separate document.

The off-gas system, described in Section 4.7, is being designed to meet the requirements of Best Available Technology for control of emissions. The vitrification unit will be heated electrically, and as such, will not be a major source of criteria pollutants. The material to be processed contains limited amounts of compounds that could produce an air toxic hazard. Ambient air quality will not be adversely impacted by emissions from this source.

The Pilot Plant will be operated in such a manner so as to not interfere with the attainment or maintenance of any applicable air quality standards, nor cause a violation of any applicable laws.

16.4.2 Wastewater Permits

This project will result in the generation of wastewater which will be discharged to the FEMP Advanced Waste Water Treatment System (AWWTS) under the NPDES permit.

Generated wastewater streams will include accumulated rain water pumped from Silo 4, the discharge of process wastewaters, and the potential accumulations of rain water caused by construction in the Pilot Plant area. Each of these wastewater streams will be characterized to determine the appropriate means of treatment in the site AWWTS, with the treated effluent being discharged under the NPDES permit.

Also, under the Clean Water Act, permits are required for activities that discharge material into US waters (including wetlands). Although the Pilot Plant will not be constructed in a wetland area, some wetland areas will be impacted by the installation of several utility lines to serve the proposed Pilot Plant.

A. Identification of Wastewater Permits that Would Otherwise be Required

Federal Permits

CLEAN WATER ACT - SECTION 404: Pursuant to Section 404 of the Clean Water Act, a permit from the U.S. Army Corps of Engineers (ACOE) would be required to discharge materials into the wetland areas.

State Permits

PERMITS TO INSTALL - OAC 3745-31-02 (A): Unless exempted by OAC 3745-31-03, no person shall cause, permit or allow the installation of a new disposal system, or cause, permit or allow the modification of a disposal system without first obtaining a Permit to Install. Under ordinary circumstances, a wastewater Permit to Install would have to be obtained for the proposed vitrification Pilot Plant.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) - OAC 3745-33-02 (A): No person may discharge any pollutant or cause, permit, or allow a discharge of any pollutant without applying for and obtaining an Ohio NPDES permit. The FEMP currently operates under an approved Ohio NPDES permit.

SECTION 401 WATER QUALITY CERTIFICATIONS - OAC 3745-32-02(A)(2): A Section 401 State Water Quality Certification is required to obtain a Section 404 permit from the ACOE.

B. Identification of the standards, requirements, criteria, or limitations that would have to be met to obtain the above permits/notifications

Federal Requirements

CLEAN WATER ACT - SECTION 404: The temporary sidecasting (up to three months) of excavated material into wetlands during construction of utility lines is authorized under Nationwide Permit (NWP) 12 as codified in Appendix B to 33 CFR Part 330, provided the following permit conditions are met:

- Navigation. The activity must not cause more than a minimal effect on navigation.
- Proper Maintenance. Fill authorized by the NWP must be properly maintained, including maintenance to ensure public safety.
- Erosion and Siltation Controls. Appropriate erosion and siltation controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills must be permanently stabilized at the earliest possible date.
- Aquatic Life Movements. The activity must not disrupt the movement of those species of aquatic life indigenous to the body of water (wetland) where the activity is being conducted.
- Equipment. Heavy equipment working in wetlands must be placed on mats or other measures must be taken to minimize soil disturbance.
- Wild and Scenic Rivers. The activity can not occur in a component of the National Wild and Scenic River System.
- Tribal Indian Rights. The activity must not impair reserved tribal rights including but not limited to reserved water rights and treaty fishing and hunting rights.
- Water Quality Certification. A State Water Quality Certification or waiver thereof is required.
- Endangered Species. The activity must not jeopardize the continued existence of any threatened or endangered species or adversely affect their habitats in any manner.

- Historic Properties. The activity must not affect historic properties listed or eligible for listing in the National Register of Historic Places.

- Water Supply Intakes. The discharge of excavated material must not occur in close proximity of a public water supply intake.

- Shellfish Production. No discharge of material is allowed in an area of concentrated shellfish production.

- Suitable Material. The discharged material must be free of unsuitable materials (trash, debris, etc.) and toxic pollution in toxic amounts as per Section 307 of the Clean Water Act.

- Mitigation. The discharge of material must be minimized or avoided to the maximum extent practicable at the project site.

- Spawning Areas. Discharges in spawning areas during spawning season must be limited to the maximum extent practicable.

- Obstruction of High Flows. To the maximum extent practicable, discharges must not permanently restrict or impede the passage of normal or expected high flows or cause relocation of the water.

- Waterfowl Breeding Areas. Discharge into breeding areas for migratory waterfowl must be avoided to the maximum extent practicable.

- Removal of Temporary Fills. Any temporary fills must be removed in their entirety and the affected areas returned to their preexisting contours.

<u>State Requirements</u>

PERMITS TO INSTALL - OAC 3745-31-05 (A): Installation of the proposed Pilot Plant facility must not prevent or interfere with the attainment or maintenance of applicable ambient water quality standards; and must not result in a violation of any applicable laws; and must employ the best available technology.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) - OAC 3745-33-02 (A): All discharges authorized under the NPDES permit shall be consistent with the terms and conditions of the permit. Facility expansions, production increases, or process modifications which result in new, different or increased discharges of pollutants must be reported.

SECTION 401 WATER QUALITY CERTIFICATIONS - OAC 3745-32-02(A)(2): The Ohio Environmental Protection Agency (OEPA) granted Section 401 State Water Quality Certification for NWP 12 on January 17, 1992. Work conducted under NWP 12 need only comply with the following conditions of the Water Quality Certification to be authorized:

- Bank Stabilization. All necessary steps shall be taken, upon completion of the project, to ensure bank stability.

- Damages to Immediate Environment. All damage by equipment needed for construction or hauling shall be repaired immediately.

- Water Quality. Care must be employed throughout the course of the project to avoid the creation of unnecessary turbidity which may degrade water quality or adversely affect aquatic life.

- Forested Wetlands. NWP 12 can not be used to authorize utility lines greater than 1000 feet in length in forested wetlands.

C. Explanation of How the Response Action Will Meet the Standards, Requirements, Criteria, or Limitations Identified in Item B Above

Federal Requirements

The proposed project will be conducted in compliance with the conditions of NWP 12 as follows:

- Navigation. The proposed project will not affect navigation.

- Proper Maintenance. Any fill discharged as a result of the project will be maintained and stabilized as soon as practicable upon completion of the project.

- Erosion and Siltation Controls. Appropriate erosion and siltation controls will be used and maintained in effective operating condition during construction, and all exposed soil and other fills will be permanently stabilized at the earliest possible date, after completion of construction.

- Aquatic Life Movements. Construction will not disrupt the movement of any indigenous aquatic species.

- Equipment. When heavy equipment must be used to conduct work within the wetland mats, or other measures will be utilized to minimize disturbance within the wetland area.

- Wild and Scenic Rivers. The wetland in which work will be conducted is not part of the National Wild and Scenic River System.

- Tribal Indian Rights. The project will not impair reserved tribal Indian rights in any manner.

- Water Quality Certification. OEPA granted State Water Quality Certification for NWP 12 on January 17, 1992.

- Endangered Species. No known threatened or endangered species inhabit the area in which work will be conducted.

- Historic Properties. The project will not affect any historic properties which are listed or eligible for listing in the National Register of Historic Places.

- Water Supply Intakes. There are no public water supply intakes in close proximity to the proposed project location.

- Shellfish Production. The project will not be conducted in an area of concentrated shellfish production.

- Suitable Material. All material discharged during the course of the project will be free of unsuitable materials (trash, debris, etc.) and toxic pollution in toxic amounts as per Section 307 of the Clean Water Act.

- Mitigation. Impacts to the wetland area will be minimized to the maximum extent practicable during construction. Disturbances will be allowed only in those areas in which they are absolutely required.

- Spawning Areas. The proposed project is not being conducted in a spawning area.

- Obstruction of High Flows. The project will not result in the permanent restriction or impediment of flows within the wetland. All fill discharged into the wetland will be removed with three (3) months.

- Waterfowl Breeding Areas. The project area is not known to be a breeding area for migratory waterfowl.

- Removal of Temporary Fills. All fill material will be removed from the wetland area immediately upon completion of construction and the affected wetland areas will be returned to their pre-existing contour elevations. In addition, any exposed areas will be stabilized as soon as practicable.

State Requirements

This project will not interfere with the attainment or maintenance of any water quality standards; nor will it result in a violation of any applicable laws. Wastewater streams generated by the vitrification process will not significantly alter the character of the plant effluent streams. Best available technology will be satisfied with the installation of a filter used for the removal of suspended solids. Effluent from the filter will be discharged to existing systems for the treatment necessary to meet current NPDES effluent limitations.

The proposed project will comply with all conditions of the Section 401 State Water Quality Certification for NWP 12 as follows:

- Bank Stabilization. All necessary steps will be taken, upon completion of the project, to ensure bank stability.

- Damages to Immediate Environment. All damage cause by equipment needed for construction or hauling will be repaired immediately, upon completion of construction.

- Water Quality. Care will be taken to avoid the creation of unnecessary turbidity which may degrade water quality or adversely affect aquatic life.

- Forested Wetlands. The proposed project does not involve work within a forested wetland.

16.5 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Activities of this Pilot Plant program include the potential for generation of wastewater streams, emission of radionuclides, off-gas emissions and the generation of RCRA hazardous waste, or waste sufficiently similar to RCRA waste to require regulation under RCRA, as discussed in Section 16.3. In addition, there is the potential for the generation of dust particulates and other emissions as the result of removal of the dome material on Silo 4, or construction and operation of the waste retrieval system and vitrification facility, and for generation of additional waste streams needing characterization.

Applicable or relevant and appropriate requirements (ARARs) and To Be Considered (TBC) criteria, which pertain to the types of contaminants that may be generated, or the location of activities associated with the Pilot Plant, have been identified. Appendix B presents the potential regulatory requirements for this project and the compliance strategies with each requirement. Since the list of requirements was developed for both phases of the Pilot Plant project, ARARs that govern design for Phase II operation must be considered during Phase I. No attempt was made to distinguish between ARARs pertaining to Phase I and Phase II of the operation, and one comprehensive list is presented. Therefore, ARARs or TBCs that govern radionuclides or specific chemical substances may not specifically relate to this phase of the Pilot Plant project.

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17.0 REFERENCES

U.S. Environmental Protection Agency, 1992, "Guide for Conducting Treatability Studies under CERCLA," EPA/540/R-92/071a, EPA Office of Solid Waste and Emergency Response, Washington, DC.

Barretto, P.M.C. "Radon-222 Emanation Characteristics of Rocks and Minerals," Radon in Uranium Mining, IAEA-PL-565/6, International Atomic Energy Agency, Vienna, 1975.

U.S. Department of Energy, Evaluation and Selection of Borosilicate Glass as the Waste Form for Hanford High-Level Radioactive Waste, DOE/RL-90-27, 1990.

Chapman, C. C., and J. L. McElroy, "Slurry-Fed Ceramic Melter - A Broadly Accepted System to Vitrify High-Level Waste." High Level Radioactive Waste and Spent Fuel Management, Volume II, American Society of Mechanical Engineers Book No. 10292B, 1989.

Chapman, C. C., and Janke, D. S., "Characteristics of Fernald's K-65 Residue Before, During and After Vitrification," February 1991, prepared by Battelle Pacific Northwest Laboratories, Richland Washington for the U.S. Department of Energy.

U.S. DOE, "Operable Unit 4 Treatability Study Report for the Vitrification of Residues from Silos 1, 2, and 3," May 1993, prepared by FERMCO and Battelle Pacific Northwest Laboratories for the U.S. Department of Energy.

FEMP Baseline for FY94-99, September 1993; As Supplemented November, 1993.

General Health & Safety Plan for OU4, (to be issued).

Preliminary Safety Analysis Report for Operable Unit 4 (to be issued).

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APPENDIX A

DOE Letter (DOE-0817-93), April 16,1993, T.J. Rowland to N.C. Kaufman, **REMOVAL SITE EVALUATION, APPLICABILITY TO OPERABLE UNIT 4 PILOT PLANT**

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Department of Energy
Fernald Environmental Management Project
P.O. Box 398705
Cincinnati, Ohio 45239-8705
(513) 738-6357

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CRU4
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APR 1 6 1993

DOE-0817-93

Mr. N. C. Kaufman, President
Fernald Environmental Restoration
Management Corporation
P. O. Box 398704
Cincinnati, OH 45239-8704

Dear Mr. Kaufman:

REMOVAL SITE EVALUATION, APPLICABILITY TO OPERABLE UNIT 4 PILOT PLANT

The Department of Energy, Fernald Field Office concurs with the enclosed Fernald Environmental Restoration Management Corporation position which states that a Removal Site Evaluation is not required for the Operable Unit 4 pilot plant project.

If you or your staff have any questions, please contact Randi Allen at FTS/Commercial 513-748-6158.

Sincerely,

for Ray Hansen

Thomas J. Rowland
Acting Manager

FN:Allen

Enclosure: As Stated

cc w/enc.:

W. Pickles, FERMCO/52-4
R. Frost, FERMCO/52-4

FERMCO		
CRU4 DIRECTOR		
NAME	CC	RT
PICKLES		
ARMSTRONG		
BEASLEY		
DALL		
EGERTON		
FROST		
GALE		
GLASSEY		
JUSELA		
MALLORY		
NIXON		
SEXTON		
SEYMORE		
FILE	103.1	
FILE		
FILE	131.2	

← letters

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Fernald Environmental

FERMCO

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

December 22, 1992

ORIGINAL
File Received CRU4
12-22-92

U. S. Department of Energy
Fernald Environmental Management Project
Letter No. C:OP:92-067

Mr. James J. Fiore, Acting Manager
DOE Field Office, Fernald
P. O. Box 398705
Cincinnati, Ohio 45239-8705

Dear Mr. Fiore:

CONTRACT DE-AC05-920R21972, RSE APPLICABILITY TO CRU4 PILOT PLANT ACTIVITIES

As part of final remediation for Silos 1, 2, and 3, CRU4 is constructing a Pilot Plant for demonstration of vitrification capability for Silo 3 and K-65 type material. Existing site Regulatory Compliance Guide (RCG) M-1, dated November 7, 1990, requires the preparation of a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Removal Site Evaluation (RSE) for all site excavation activities that involve over 1yd^3 of soil in areas with above background concentrations of hazardous substances, including radionuclides.

The purpose of this letter is to transmit for your concurrence the CRU4 position regarding the applicability of this guidance to planned Pilot Plant construction activities. Since the Pilot Plant will not be constructed over an abandoned site, but will be a part of the RI/FS treatability studies to support final remediation of the Silo contents, CRU4 does not believe an RSE is warranted or required to meet the intent of the National Contingency Plan. CRU4 desires to proceed with the Pilot Plant project as scheduled, while minimizing the procedural and regulatory complexity and paperwork associated with site requirements of limited or outdated applicability. CRU4 intends to comply with all legal requirements applicable to CRU4, and meet the ARARs and substantive requirements of 40 CFR 300.410 for an RSE using existing, approved site procedures. This approach will be outlined in the project workplan.

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FERMCO
Restoration Management Corporation

The Pilot Plant will be used initially to demonstrate the technology and process on an inert material (sand) and then be modified to perform treatability studies on the K-65 material. CRU4 is proceeding on the basis that an RSE is not required for the initial phase, but will probably be required for the second phase testing.

Our construction schedule requires site preparation activities to begin no later than March 1993. Since preparation and approval of an RSE, if required, takes several weeks to complete, it is critical to receive the concurrence of DOE-FN on our proposed direction no later than the first week in January. Please let me know if we need to meet to further discuss this approach. Our point of contact is Robert Frost (X 8941).

Very truly yours,

N. C. Kaufman
President

NCK:RHF:slk

Attachment

cc: R. B. Allen, DOE-FN
J. R. Craig, DOE-FN
D. P. Dubois
R. Mendelsohn, DOE Contract Specialist
D. Paine
W. S. Pickles
W. Quaider, DOE-FN
M. J. Strimbu
J. W. Theising

Central Files
DW:92-0477.1

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APPENDIX B

Potential ARARs and TBC Criteria for the Phase I and II OU4 Pilot Plant Program

APPENDIX B

Potential Applicable or Relevant and Appropriate Requirements (ARARs), and To Be Considered (TBC) Criteria for the Phase I and II OU4 Pilot Plant Program

<table>
<tr><th>Chemical, Location, or Action</th><th>Requirement</th><th>ARAR/TBC</th><th>Strategy for Compliance</th></tr>
<tr><td>Ohio Water Quality Standards</td><td>3745-1-07

Use Designations and Criteria

All pollutants or combinations of pollutants shall not exceed, outside the mixing zone, the Numerical and Narrative Criteria for Aquatic Life Habitat and Water Supply Use Designations listed in Tables 7-1 through 7-15 of this rule.

The following constituents of concern (COCs) for Operable Unit 4 have warm water habitat maximum concentration levels outside the mixing zone as follows:

<table>
<tr><th>Constituent</th><th>Criteria conc.[a] (ug/L)</th><th>30-day average conc. (ug/L)</th></tr>
<tr><td>Antimony</td><td>650</td><td>190</td></tr>
<tr><td>Arsenic</td><td>360</td><td>190</td></tr>
<tr><td>Beryllium</td><td>Tab. 7-10[b]</td><td>Tab. 7-11[c]</td></tr>
<tr><td>Cadmium</td><td>Tab. 7-10</td><td>Tab. 7-11</td></tr>
<tr><td>Chromium</td><td>Tab. 7-10</td><td>Tab. 7-11</td></tr>
<tr><td>Copper</td><td>Tab. 7-10</td><td>Tab. 7-11</td></tr>
<tr><td>Cyanide</td><td>46</td><td>12</td></tr>
<tr><td>Lead</td><td>Tab. 7-10</td><td>Tab. 7-11</td></tr>
<tr><td>Mercury</td><td>1.1</td><td>0.20</td></tr>
<tr><td>Nickel</td><td>Tab. 7-10</td><td>Tab. 7-11</td></tr>
<tr><td>Selenium</td><td>20</td><td>5.0</td></tr>
<tr><td>Silver</td><td>Tab. 7-10</td><td>1.3</td></tr>
<tr><td>Thallium</td><td>71</td><td>16</td></tr>
<tr><td>Zinc</td><td>Tab. 7-10</td><td>Tab. 7-11</td></tr>
<tr><td>2-Butanone</td><td>160,000</td><td>7,100</td></tr>
<tr><td>4-Nitrophenol</td><td>790</td><td>35</td></tr>
<tr><td>Acetone</td><td>550,000</td><td>78,000</td></tr>
<tr><td>Aldrin</td><td>----</td><td>0.01</td></tr>
<tr><td>Bis(2-ethylhexyl)phthalate</td><td>1,100</td><td>8.4</td></tr>
<tr><td>Carbon tetrachloride</td><td>1,800</td><td>280</td></tr>
</table>

(CONTINUED ON NEXT PAGE)</td><td>Applicable</td><td>Paddys Run and the stream segment of the Great Miami River adjacent to the FEMP are designated as warm water aquatic life habitats with use designations of agricultural and industrial water supply, and primary contact recreation. OAC 3745-1-21 establishes the classification of the receiving waters for the FEMP. Wastewater generated at the Pilot Plant will be pretreated (if required) and discharged to the existing FEMP wastewater treatment system and Advanced Wastewater Treatment System (AWWT) prior to discharge to the Great Miami River. Treatment will be in accordance with FEMP NPDES permit limits and conditions or applicable Water Quality Standards.

Stormwater discharges associated with the construction and operation of the Pilot Plant will be managed in accordance with 40 CFR 122.26 and OAC 3745-38. Existing site protocols and procedures related to stormwater management will be extended to the construction and operation of this facility.</td></tr>
</table>

Chemical, Location, or Action	Requirement			ARAR/TBC	Strategy for Compliance
Ohio Water Quality Standards (cont.)	DDT	----	0.001		
	Dieldrin	----	0.005		
	Di-n-butylphthalate	350	190		
	Diethylphthalate	2,600	120		
	Dimethylphthalate	1,700	73		
	Endosulfan[d]	----	0.003		
	Endrin	----	0.002		
	Fluoranthene	200	8.9		
	Methylene chloride	9,700	430		
	PCBs	----	0.001		
	Phenol	5,300	370		
	Tetrachloroethene	540	73		
	Toluene	2,400	1,700		
	[a] Criteria concentration shall be met outside mixing zone. [b] Criteria concentration based on hardness of water. See Table 7-10 for calculation to determine maximum concentration outside the mixing zone. [c] 30-day average criteria based on hardness of water. See Table 7-11 for calculation to determine allowable 30-day average concentration outside the mixing zone. [d] No designation was made as to whether endosulfan referred to endosulfan I or endosulfan II or the sum total of both. The remaining COCs for OU4 will have criteria concentration levels based on calculated acute aquatic criteria (AAC) or chronic aquatic criteria (CAC).				

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Radionuclide Emissions (Except Airborne Radon-222)	40 CFR 61, Subpart H Emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that will cause any member of the public to receive in any year an effective dose equivalent of 10 mrem per year. Monitoring is required at all release points which have a potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess of 1% (0.1 mrem/yr) of the standard .	Applicable	The pollution control equipment for the silos and vitrification off-gas emissions will be designed to limit the discharge of radionuclides to acceptable levels. The facility design will include HEPA filters to minimize particulate emissions. Excavations, excavated soil and other sources of particulate emissions will be controlled, as appropriate, through good construction practices. Monitoring of radionuclide emissions will be conducted in accordance with the methods referenced in 40 CFR 61.93 with compliance being demonstrated using an EPA approved computer code.
Radon-222 Emissions	40 CFR 61, Subpart Q No source at a DOE facility shall emit more than 20 pCi/m^2-s of radon-222 as an average for the entire source during periods of storage and disposal.	Applicable	While this requirement is neither applicable nor relevant and appropriate to treatment operations, it is applicable to storage of waste material in Silos 1 and 2 prior to treatment, and storage of vitrified product following treatment. Design of the waste removal system, along with appropriate procedures, controls, and monitoring, will minimize radon releases during the material removal phase. Design and operation of the vitrified product storage area will address this requirement, along with appropriate controls, procedures and monitoring systems.

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Discharge of Storm Water Runoff	40 CFR 122.26 and OAC 3745-38 Storm water discharge associated with construction sites and industrial activities must be monitored and controlled. A Stormwater Pollution Prevention Plan (SWPPP) is required for construction activities which result in a total land disturbance of 5 or more acres.	Applicable	Industrial stormwater discharges associated with the Pilot Plant are covered by the FEMP NPDES Stormwater Permit Application submitted to OEPA in September, 1992. A sitewide Stormwater Pollution Prevention Plan (SWPPP) is being prepared pursuant to this application. Construction associated with the Pilot Plant will utilize appropriate controls to ensure contamination of stormwater is minimized. Outside pads (not under roof) will have berms or curbs to contain runoff, and to prevent run on. Collected stormwater will be discharged through the existing site wastewater treatment system.
Discharge of Treatment System Effluent	40 CFR 125.100 Best Management Practices Develop and implement a Best Management Practices (BMP) program to prevent the release of toxic or hazardous constituents to waters of the U.S. Development and implementation of a sitewide BMP program is also required as a condition of the FEMP NPDES Permit. 40 CFR 125.104 The BMP program must: • Establish specific procedures for the control of toxic and hazardous pollutant spills and runoff. • Include a prediction of direction, rate of flow, and total quantity of toxic and hazardous pollutants where experience indicates a reasonable potential for equipment failure.	Relevant and Appropriate	The proposed action has the potential for releases and runoff from this operable unit. The requirement will be met by following the conditions of the sitewide Best Management Practices (BMP) program, as described in the approved BMP Plan. The design and operating procedures will be modified as necessary to ensure controls are in place that prevent contamination of receiving waters and that provide treatment of wastewaters prior to discharge.

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Ohio Water Quality Standard	OAC 3745-1-04 The following general water quality criteria apply to both discharges to surface waters as a result of remediation and on-site surface waters potentially affected by project activities. All surface waters of the state shall be free from: • objectionable suspended solids • floating debris, oil and scum • materials that create a nuisance • toxic, harmful or lethal substances • nutrients that create nuisance growth	Relevant and Appropriate	Wastewater produced at the Pilot Plant will be pretreated, if necessary, and discharged to the FEMP wastewater treatment system to comply with these aquatic quality criteria. Compliance with stormwater requirements, BMPs, and contingency plan will ensure compliance with this requirement.
Compliance with Floodplain/Wetlands Environmental Review Requirements	10 CFR 1022 (Executive Order 11990) DOE actions in a floodplain or wetland must first evaluate the potential adverse effects those actions might have on the floodplain or wetland, and consider the natural and beneficial values served by the wetlands.	Applicable	The proposed action has the potential to destroy or modify site wetland areas. Potential impacts are identified during preparation of NEPA documentation for this activity. NEPA documentation will also specify public notice requirements, wetland assessments, and any mitigative measures that may be required.

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<table>
<tr><th>Chemical, Location, or Action</th><th>Requirement</th><th>ARAR/TBC</th><th>Strategy for Compliance</th></tr>
<tr>
<td>Radiation Protection of the Public and the Environment</td>
<td>
DOE Order 5400.5 Chap. III

Residual concentrations of radionuclides in air in uncontrolled areas are limited to the following. (For known mixtures of radionuclides, the sum of the ratios of the observed concentration of each radionuclide to its corresponding limit must not exceed 1.0.)

Derived Concentration Guide[a]
(uCi/mL)

<table>
<tr><th>Isotope</th><th>D</th><th>W</th><th>Y</th></tr>
<tr><td>Actinium-227</td><td>2×10^{-15}</td><td>7×10^{-15}</td><td>1×10^{-14}</td></tr>
<tr><td>Lead-210</td><td>9×10^{-13}</td><td>——[b]</td><td>——</td></tr>
<tr><td>Polonium-210</td><td>1×10^{-12}</td><td>1×10^{-12}</td><td>——</td></tr>
<tr><td>Protactinium-231</td><td>——</td><td>9×10^{-15}</td><td>1×10^{-14}</td></tr>
<tr><td>Radium-224</td><td>——</td><td>4×10^{-12}</td><td>——</td></tr>
<tr><td>Radium-226</td><td>——</td><td>1×10^{-12}</td><td>——</td></tr>
<tr><td>Radium-228</td><td>——</td><td>3×10^{-12}</td><td>——</td></tr>
<tr><td>Technetium-99</td><td>1×10^{-8}</td><td>2×10^{-9}</td><td>——</td></tr>
<tr><td>Strontium-90[c]</td><td>5×10^{-11}</td><td>——</td><td>9×10^{-12}</td></tr>
<tr><td>Thorium-228</td><td>——</td><td>5×10^{-14}</td><td>4×10^{-14}</td></tr>
<tr><td>Thorium-230</td><td>——</td><td>4×10^{-14}</td><td>5×10^{-14}</td></tr>
<tr><td>Thorium-232</td><td>——</td><td>7×10^{-15}</td><td>1×10^{-14}</td></tr>
<tr><td>Uranium-234</td><td>4×10^{-12}</td><td>2×10^{-12}</td><td>9×10^{-14}</td></tr>
<tr><td>Uranium-235</td><td>5×10^{-12}</td><td>2×10^{-12}</td><td>1×10^{-13}</td></tr>
<tr><td>Uranium-236</td><td>5×10^{-12}</td><td>2×10^{-12}</td><td>1×10^{-13}</td></tr>
<tr><td>Uranium-238</td><td>5×10^{-12}</td><td>2×10^{-12}</td><td>1×10^{-14}</td></tr>
</table>

[a] D, W, and Y (Days, Weeks, and Years) represent lung retention classes; removal halftimes assigned to the compounds with classes D, W, and Y are 0.5, 50, and 500 days, respectively. Exposure conditions assume an inhalation rate of 8,400 m^3 of air per year (based on an exposure over 24 hours per day, 365 days per year).

[b] A hyphen means no limit has been established.

[c] The value shown for daily DCG is for strontium radionuclides with a f_1 value of 3×10^{-1}. The value shown for yearly DCG is for strontium radionuclides for a f_1 value of 1×10^{-2}.
</td>
<td>To Be Considered</td>
<td>Operation of the OU4 Pilot Plant has the potential to release radionuclides that are contained in the waste materials. The facility design will include HEPA filtration to control radionuclide and particulate emissions where appropriate. Excavations, excavated soil and other sources of particulate emissions will be controlled, as appropriate, through established construction practices. Monitoring of radionuclide emissions will be conducted in accordance with the methods referenced in 40 CFR 61.93 with compliance being demonstrated using an EPA approved computer code.</td>
</tr>
</table>

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Radiation Protection of the Public and the Environment	DOE Order 5400.5 Chapter III Residual concentrations of radionuclides in water that may be ingested are listed below. These derived concentration guides (DCGs) for the COCs are based on a committed effective dose equivalent (CEDE) of 100 mrem/yr, assuming ingestion of 2 liters/day. Note that these DCGs apply <u>only if</u> ingestion is the single pathway of exposure. Isotope — Ingested Water (uCi/mL) Actinium-227 — 1×10^{-8} Lead-210 — 3×10^{-8} Polonium-210 — 8×10^{-8} Protactinium-231 — 1×10^{-8} Radium-224 — 4×10^{-7} Radium-226 — 1×10^{-7} Radium-228 — 1×10^{-7} Technetium-99 — 1×10^{-4} Strontium-90[c] — 1×10^{-6} Thorium-228 — 4×10^{-7} Thorium-230 — 3×10^{-7} Thorium-232 — 5×10^{-8} Uranium-234 — 5×10^{-7} Uranium-235 — 6×10^{-7} Uranium-236 — 5×10^{-7} Uranium-238 — 6×10^{-7}	To Be Considered	Remediation of OU4 waste has the potential to release radionuclides that are contained in the waste materials to environmental media. Although activities anticipated by this project will take place over the Great Miami aquifer, which is used as a source of drinking water, no release of radionuclides to soil or groundwater is expected to occur as a result of Pilot Plant activities. Wastewater generated at the Pilot Plant will be pretreated and discharged to the existing FEMP wastewater treatment system. Treatment will ensure that the discharges do not violate FEMP NPDES permit limits and conditions or applicable Water Quality Standards.

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Residual Radioactive Material	DOE Order 5400.5 Chap. IV, 6.b Interim Storage: The above-background concentration of radon-222 in air above an interim storage facility must not exceed 100 pCi/L at any point, an annual average of 30 pCi/L over the facility, or an annual average of 3 pCi/L at or above any location outside the site.	To Be Considered	Management of radium bearing waste might result in the release of radon gas to the environment. Removal of radium bearing waste and storage prior to vitrification will include controls designed to prevent untreated release of radon. During operation of the Pilot Plant, the facility off-gas system design (activated carbon beds followed by HEPA filters) will provide adequate radon controls. These requirements will be met for interim storage of the vitrified product due to the low surface release rate of radon gas. Radon monitoring will be conducted outside the storage area to demonstrate compliance with these release limits.

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Hazardous Waste Determinations	40 CFR 262.11 OAC 3745-52-11 Any generator, who treats, stores, or disposes of solid wastes, must determine whether or not the waste is hazardous. The procedures to be followed include: • To identify whether a particular material of concern is a "solid waste" • To identify whether a particular exclusion applies to the material eliminating it from definition as a "solid waste" • To identify whether a particular solid waste might be classified as a hazardous waste • To determine if a material, otherwise classified as a "hazardous waste" might be excluded from RCRA regulation	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes).	These procedures are established to determine whether wastes are subject to the requirements of RCRA. The residues in Silos 1, 2, and 3 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate to determine whether OU4 wastes, whether excluded or not, are similar to hazardous wastes based on the TCLP results. To ensure protectiveness, wastes sufficiently similar to hazardous waste will be treated, stored, and disposed in accordance with RCRA requirements. Other wastes, such as those generated during construction and operation of the Pilot Plant, will also require testing or process knowledge to determine proper management and disposal requirements. Characterization of waste generated during construction projects, including soil, will be performed in accordance with site procedure SSOP-0044. All other waste characterization will be performed in accordance with site procedure SSOP-0002.

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Empty Containers	40 CFR 261.7 OAC 3745-51-07 Containers that have held hazardous wastes are "empty" and exempt from further RCRA regulations if: • no more than 2.5 cm (one inch) of residue remains on bottom of inner liner; or • the remaining residue is less than 3% by weight of the total capacity, for containers whose total capacity is less than or equal to 110 gallons, or • the remaining residue is less than 0.3% by weight of the total capacity, for containers whose total capacity is greater than 110 gallons.	Relevant and Appropriate	Containers and tanks used to store waste or the treated contents of Silos 1, 2, and 3 might contain residues that exhibit hazardous waste characteristics which must be removed before the container might be reused or disposed. Removed material, if sufficiently similar to hazardous waste, will be managed in accordance with appropriate regulatory requirements.

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Treatment, Storage, or Disposal Facility Standards	40 CFR 264, Subpart B, General Standards OAC 3745-54-13 through 16 1) Waste Analysis (OAC 3745-54-13)-Operators of a facility must obtain a detailed chemical and physical analysis of a representative sample of each hazardous waste to be treated, stored, or disposed of at the facility prior to treatment, storage, or disposal. 2) Security (OAC 3745-54-14)-Operators of a facility must prevent the unknowing or unauthorized entry of persons or livestock into the active portions of the facility, maintain a 24-hour surveillance system, or surround the facility with a controlled access barrier and maintain appropriate warning signs at facility approaches. 3) Inspections (OAC 3745-54-15)-Operators of a facility must develop a schedule and regularly inspect monitoring equipment, safety and emergency equipment, security devices and operating and structural equipment that are important to preventing, detecting or responding to environmental or human health hazards, promptly or immediately or immediately remedy defects, and maintain an inspection log. 4) Training (OAC 3745-54-16)-Operators must train personnel within 6 months of their assumption of duties at a facility in hazardous waste management procedures relevant to their position including emergency response training.	Relevant and Appropriate	Areas and activities of this project which could contain or generate hazardous waste or waste sufficiently similar to RCRA hazardous waste must comply with these RCRA requirements. 1) An OU4 Pilot Plant sampling and analysis plan will be developed. Compliance will be met by following site procedures SSOP-0044 (construction debris and soils) and SSOP-0002 (other wastes). Silo waste material has already been characterized in accordance with this requirement. 2) Existing site security measures and physical barriers around the silos and the FEMP complex are sufficient to satisfy these requirements. 3) Scheduling for inspection and monitoring of safety and emergency equipment specifically related to the Pilot Plant will be presented in the SOPs that are generated for operation of the facility. 4) All operations personnel will be trained in accordance with existing FEMP requirements. Additional training will be required for the specific job related requirements associated with CRU4 Pilot Plant operations.

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Treatment, Storage, or Disposal Facility Preparedness and Prevention	40 CFR 264, Subpart C OAC 3745-54-31 TSD operators must design, construct, maintain and operate facilities to minimize the possibility of a fire, explosion or any unplanned sudden or non-sudden release of hazardous waste to air, soil, or surface water which could threaten human health or the environment. OAC 3745-54-32 All facilities must be equipped with an internal communication or alarm system, a telephone, or a two-way radio for calling outside emergency assistance, fire control, spill control and decontamination equipment and water at an adequate volume and pressure to supply water hose streams, foam producing equipment, automatic sprinklers or water spray systems. OAC 3745-54-33 All fire and spill-control and decontamination equipment must be tested and maintained as necessary to assure proper emergency operation. OAC 3745-54-34 All personnel must have immediate access to emergency communication or alarm systems whenever hazardous waste is being handled at the facility. OAC 3745-54-35 Aisle space must be sufficient to allow unobstructed movement of personnel, fire and spill control, and decontamination equipment. OAC 3745-54-37 Operators must attempt to make arrangements, appropriate to the waste handled, for emergency response by local and state fire, police and medical personnel.	Relevant and Appropriate	The existing site-wide internal communications/alarm system will be modified as necessary to accomodate operation of the Pilot Plant facility. A fire sprinkler system will be included as part of the design of the Pilot Plant. In addition, portable fire extinguishers and spill control and decontamination equipment will be placed at accessible locations to assist in emergency response. The facility will be designed to include adequate aisle space. The site's Emergency Response Team will be available, with assistance from local and state personnel, for responding to emergency situations related to the Pilot Plant. In addition, site Emergency Response Team personnel will be trained to adequately respond to emergencies specifically related to the Pilot Plant.

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Treatment, Storage, or Disposal Facility Contingency Plan and Emergency Procedures	40 CFR 264, Subpart D 40 CFR 264.51 OAC 3745-54-51 Each facility operator must have a contingency plan designed to minimize hazards to human health or the environment due to fires, explosions, or any unplanned releases of hazardous waste constituents to the air, soil, or surface/groundwater. 40 CFR 264.52 OAC 3745-54-52 Contingency plans should address procedures to implement a response to hazardous waste incidents, and provide internal and external communications, arrangements with local emergency authorities, an emergency coordinator list, a facility emergency equipment list indicating equipment descriptions and locations, and a facility personnel evacuation plan. A copy must be maintained at the site as well as submitted to appropriate emergency agencies. 40 CFR 264.55 and .56 OAC 3745-54-55 & 56 Each facility must have an emergency coordinator who has responsibility for coordinating all emergency response measures, is on the premises or on call at all times, is thoroughly familiar with all aspects of the contingency plan, facility operations, location and characteristics of waste handled, location of pertinent records, and facility layout, and who has the authority to commit the resources necessary to implement the contingency plan in the event of an emergency.	Relevant and Appropriate	Specific procedures to respond to emergencies and unplanned events or releases associated with the Pilot Plant will be addressed in the project specific Health and Safety Plan. Existing site procedures, such as the FEMP Emergency Plan (PL-3020), Emergency Response Team Procedures Manual (ERT-001), Spill Incident Reporting and Cleanup (SSOP-0067), and Event Notification and Reporting (ED-0001) will be implemented as is appropriate for spills, fires, or other emergencies. In addition, procedures specific to operations at the K-65 silos, i.e., "K-65 Silo Numbers 1 and 2 Area Emergencies (SOP 65-C-201)" and "Radon Treatment System Emergencies (SOP 66-C-909)", will be revised and implemented as applicable to the new conditions.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Container Storage	40 CFR 264.171 - 178 Subpart I OAC 3745-55-71 through 78 1) Containers of RCRA hazardous waste must be: a) Maintained in good condition; b) Compatible with hazardous waste to be stored; and c) Closed during storage (except to add or remove waste) d) Managed in a manner that will not cause the container to rupture or leak 2) Storage areas must be inspected weekly for leaking and deteriorated containers and containment systems. 3) At closure, remove all hazardous waste and residue from the containment system, and decontaminate or remove all containers, liners, bases, and contaminated soils.	Relevant and Appropriate	Compliance with this requirement will be as follows: 1) Closed containers of vitrified product will be stored on-site in an approved storage facility. The containers will be compatible with the waste products. 2) Since the vitrified product will not contain free liquids, the storage area will be designed only to prevent run-on. Since the stored product will pose a significant radiation hazard, the frequency of inspection will be kept to a minimum in accordance with an SOP that addresses waste storage. The waste product storage area will be shielded to minimize the radiation hazard. 3) Closure of the storage area will not be included in the scope of this project. Closure of the area will be part of final remediation of the OU in which the storage facility is located. Vitrified waste product will no longer be "sufficiently similar" to hazardous waste since it will no longer exhibit a RCRA characteristic. Containers of other solid waste awaiting characterization, or material characterized as hazardous waste will be managed in accordance with Management of Soil, Debris, and Waste from a Project (SSOP-0044) and the FEMP Waste Management Plan.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Tank Systems	40 CFR 264, Subpart J (Tanks) OAC 3745-55-91 through 96; and 3745-55-97(A) Design, operating, and inspection standards for tank units within which hazardous waste is stored or treated. • Tank design must be compatible with the material being stored. • Tank must be designed and have sufficient strength to store or treat waste to ensure it will not rupture or collapse. • Tank must have secondary containment that is capable of detecting and collecting releases to prevent migration of wastes or accumulated liquid to the environment. • At closure, remove all hazardous waste and residue from the containment system, and decontaminate or remove all tanks, liners, bases, and contaminated soils.	Relevant and Appropriate	All process tanks will be constructed with durable material that is compatible with the waste and treatment process for which the tank is designed. The facility design will include secondary containment capable of collecting releases. Approved inspection and maintenance procedures, which include scheduled visual inspections of all tanks, will be established prior to initiation of Pilot Plant operations. Closure at the end of the useful life of the tanks will be included in the final remediation of OU4.
Miscellaneous Units	40 CFR 264 Subpart X OAC 3745-57-91 and 92 Environmental performance standard, monitoring, inspection, and post-closure care for treatment in miscellaneous units as defined by 40 CFR 260.10. 40 CFR 264.601 OAC 3745-57-91 Locate, design, construct, operate, close, and maintain to protect human health and the environment and prevent releases to groundwater, subsurface water, surface water, wetlands, soil, and air. Permit terms shall use Subpart I through O, Part 270, and Part 146 requirements as appropriate. 40 CFR 264.602 OAC 3745-57-92 Monitoring, testing, analytical data, inspections, response, and reporting procedures must ensure compliance with 40 CFR 264.601, 264.15 (general inspection requirements), 264.33 (testing and maintenance of emergency equipment), and 264.77 (reports of releases, fires, explosions, and closures).	Relevant and Appropriate	A vitrification unit could be considered a miscellaneous unit. Although no permit is required for this activity, the design, construction, operation, and maintenance of the unit will be in accordance with other ARARs, DOE orders, and accepted construction standards and practices, as appropriate. Included in the design will be secondary containment and emission controls to ensure that releases to air or water are prevented, or meet stipulated requirements or limits. Monitoring and inspection activities will be conducted to ensure compliance with these requirements. Closure of this unit will be conducted under final remediation of the OU4 area.

000120

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Containment Buildings	40 CFR 264, Subpart DD Hazardous waste and debris may be placed in units known as containment buildings, as defined in 40 CFR 260.10, for the purpose of interim storage or treatment. 40 CFR 264.1101 Containment buildings must be fully enclosed to prevent exposure to the elements and ensure containment of managed wastes. Floor and containment walls must be designed and constructed of materials of sufficient strength and thickness to support themselves, the waste contents, and any personnel and heavy equipment that operate within the unit. All surfaces coming in contact with hazardous waste must be chemically compatible with waste. Primary barriers must be constructed to prevent migration of hazardous constituents into barrier. Secondary containment systems including secondary barrier and leak detection system must also be constructed for containment buildings used to manage wastes containing free liquids. Controls must be implemented to ensure: the primary barrier is free of significant cracks, corrosion, or other deterioration that may allow release of hazardous waste; the level of hazardous waste does not exceed height of containment walls and is otherwise maintained within containment walls; tracking of waste out of unit by personnel or equipment used in handling waste is prevented; and fugitive dust emissions are controlled at level of no visible emissions.	Relevant and Appropriate	Containment buildings, as defined, are not land disposal units, so they can be used to store prohibited waste prior to treatment or disposal. During the operation of the Pilot Plant, waste materials might require temporary management for the purpose of staging or treating the material. Some of the waste material may be sufficiently similar to hazardous waste to make this requirement relevant and appropriate. Design, construction, operation, and maintenance of the buildings will be in accordance with this requirement, and other ARARs, DOE orders, and accepted construction standards and practices, as appropriate. Included in the design will be secondary containment devices (if free liquids are present) and emission controls to control releases, as appropriate.
Ohio Water Well Standards	OAC 3745-9-10 Upon completion of testing, a test hole or well shall be either completely filled with grout or such material as will prevent contaminants from entering groundwater.	Applicable	Test borings and/or wells might be installed or utilized as part of the project activities. Abandonment of any borings or wells during the duration of this project will comply with established site procedures that address this requirement.
Corrective Action for SWMUs (Solid Waste Management Units)	40 CFR Subpart S 40 CFR 264.552 and 553 Corrective Action Management Units (CAMUs) might be designated at the site as areas where remediation wastes (solid, hazardous, or contaminated media and debris) might be placed during the process of remediation. Temporary units (TUs) consisting of tanks and container storage units might be used to store and treat hazardous waste during the process of corrective action.	Relevant & Appropriate	During this treatability study, materials could be managed in containment buildings, TUs, stockpiles or other land-based units for the purpose of staging, treating, or disposing the material without triggering the land disposal restrictions (LDRs).

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Radiation Dose Limit (All Pathways)	DOE Order 5400.5, Chapter II, Section 1.a The exposure of members of the public to radiation sources as a consequence of all routine DOE activities shall not cause, in a year, an effective dose equivalent greater than 100 mrem from all exposure pathways.	To Be Considered	Operation of the OU4 Pilot Plant could result in release of radiation sources that could contribute to the total dose to members of the public. The facility design will include HEPA filtration to control radionuclide and particulate emissions where appropriate. Excavations, excavated soil and other sources of particulate emissions will be controlled, as appropriate, through good construction practices. Monitoring of air emissions will be conducted in accordance with the methods referenced in 40 CFR 61.93 with compliance being demonstrated using an EPA approved computer code. Releases to water will be controlled by design and operation of secondary containment features and treatment in the FEMP WWTS.
Control of Visible Particulate Emissions	OAC 3745-17-07 Particulate emissions from a stack shall not exceed specified opacity limits.	Applicable	The facility design will include HEPA filtration to limit and control particulate emissions.
Control of Fugitive Dust	OAC 3745-17-08 Requires the minimization or elimination of visible emissions of fugitive dust generated during grading, loading, or construction operations and other practices which emit fugitive dust.	Relevant and Appropriate	Excavations, excavated soil and other sources of fugitive dust emissions during construction will be controlled, as appropriate, through established FEMP construction practices.

<table>
<tr><th>Chemical, Location, or Action</th><th>Requirement</th><th>ARAR/TBC</th><th>Strategy for Compliance</th></tr>
<tr><td>Restriction on Particulate Emissions from Industrial Processes</td><td>OAC 3745-17-11

Any source (operation, process, or activity) shall be operated so that particulate emissions do not exceed allowable emission rates specified in this regulation (based on processing weights (Table 1) or uncontrolled mass rate of emissions (Figure II)).

A source complies with Table 1 requirements if its rate of particulate emission is always equal to or less than the allowable rate of particulate emission based on the maximum capacity of the source:

<table>
<tr><th>Process Rate at Maximum Capacity (lb/hr)</th><th>Allowable Rate of Particulate Emission (lb/hr)[1]</th></tr>
<tr><td>100</td><td>0.551</td></tr>
<tr><td>200</td><td>0.877</td></tr>
<tr><td>400</td><td>1.40</td></tr>
<tr><td>600</td><td>1.83</td></tr>
<tr><td>800</td><td>2.22</td></tr>
<tr><td>1000</td><td>2.58</td></tr>
</table>
[1] Excerpted from Table 1 of OAC 3745-17-1</td><td>Applicable</td><td>The facility design will include HEPA filtration to minimize particulate emissions to less than these maximum emission rates.</td></tr>
<tr><td>Prevention of Air Pollution Nuisance</td><td>ORC 3704.01-.05
OAC 3745-15-07

Measures shall be taken to adopt and maintain a program for the prevention, control, and abatement of air pollution in order to protect and enhance the quality of the state's air resource so as to promote the public health, welfare, and economic vitality of the people of the state.

The emission or escape into open air from any source whatsoever of smoke, ashes, dust, dirt, grime, acids, fumes, gases, vapors, odors, and combinations of the above in such a manner or in such amounts as to endanger the health, safety, or welfare of the public or to cause unreasonable injury or damage to property shall be declared a public nuisance and is prohibited.</td><td>Applicable</td><td>Where appropriate, the facility design will include HEPA filters to control particulate emissions and an off-gas scrubber for treatment of acidic gas emissions. Excavations, excavated soil and other sources of particulate emissions will be controlled, as appropriate, through established FEMP construction practices.</td></tr>
</table>

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Permit to Install	OAC 3745-31-05(A)(3) The installation of new sources or modification of existing sources requires the use of best available technology to control emissions.	Relevant and Appropriate	Though a permit to install is not required for the Pilot Plant (permits are administrative requirements which are excluded under CERCLA), the substantive requirements must be met by employing BAT for treating particulate and off-gas emissions from the Pilot Plant vitrification unit. This requirement will be met by using an off-gas scrubber for treatment of acidic gas emissions followed by HEPA filters for particulate removal.
Nationwide Permit Program	33 CFR 330 The discharge of dredged or fill material into wetlands or waters of the U.S. must be conducted in compliance with the terms and conditions of the U.S. Army Corps of Engineers' (ACOE) Nationwide Permits (NWPs) as promulgated in 33 CFR 330 Appendix A.	Applicable	Construction of Pilot Plant access roads and utility lines will result in minor wetland disturbances. All dredge and fill activities related to construction of these access roads and utility lines will be conducted in accordance with the substantive terms and conditions of Nationwide Permit 12 - Utility Line Backfill and Bedding. The OEPA has been granted Section 401 State Water Quality Certification for NWP 12.
NEPA Compliance	10 CFR 1021.2 DOE actions must be subjected to NEPA evaluation as outlined by Council on Environmental Quality regulations in 40 CFR 1500-1508.	Applicable	This requirement is applicable because FEMP is a DOE facility, and this requirement requires NEPA evaluation for specific actions at DOE facilities. NEPA documentation will be prepared for this project in accordance with established site procedures.