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OPERABLE UNIT 4 VITRIFICATION PILOT PLANT TREATABILITY STUDY WORK PLAN

02/22/96

DOE-0567-96
DOE-FN EPAS
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WORK PLAN

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Department of Energy
Fernald Environmental Management Project
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FEB 2 2 1996

DOE-0567-96

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Dear Mr. Saric and Mr. Schneider:

OPERABLE UNIT 4 VITRIFICATION PILOT PLANT TREATABILITY STUDY WORK PLAN

Enclosed is the Operable Unit 4 (OU4) Vitrification Pilot Plant Treatability Study Work Plan for your information. The subject document was submitted to you previously in 1995. The document since has been revised to reflect informal comments received from the Ohio Environmental Protection Agency (OEPA) and the U.S. Environmental Protection Agency (U.S. EPA) specifically regarding the sampling and analysis. The document has also been revised to include the latest information for Phase I operations of the Vitrification Pilot Plant.

Immediately following a successful Fernald Environmental Restoration Management Corporation (FERMCO) Readiness Assessment with the Department of Energy (DOE) observing, the Bake-Out step preceding Phase I operation will commence. The commencement of the Bake-Out is anticipated in April 1996.

If you have any questions, please contact Nina Akgunduz at (513) 648-3110.

Sincerely,

Johnny Reising

Johnny Reising
Fernald Remedial Action
Project Manager

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Enclosure: As Stated

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OPERABLE UNIT 4
VITRIFICATION PILOT PLANT PHASE I
TREATABILITY STUDY WORK PLAN

Revision 1
WP-25-0007

Fernald Environmental Management Project
Fernald, Ohio

February 1996

U.S. DEPARTMENT OF ENERGY
Fernald Field Office

OU4-VPPI-WP-REV 1
February 1996

Fernald Environmental Management Project
Fernald, Ohio

OPERABLE UNIT 4

VITRIFICATION PILOT PLANT PHASE I

TREATABILITY STUDY WORK PLAN

Revision 1
WP-25-0007

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OU4-VPPI-WP-REV 1
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OPERABLE UNIT 4
VITRIFICATION PILOT PLANT PHASE I
TREATABILITY STUDY WORK PLAN

Revision 1
WP-25-0007

APPROVED FOR ISSUE

2/13/96
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OPERABLE UNIT 4
VITRIFICATION PILOT PLANT PHASE I
TREATABILITY STUDY WORK PLAN

Revision 1
WP-25-0007

TABLE OF CONTENTS

Page

List of Figures v

List of Tables vi

List of Acronyms vii

List of Weights and Measures x

List of Chemical Symbols xi

List of Isotopes of Interest or Concern xi

1.0 PROJECT DESCRIPTION 1-1

1.1 OPERABLE UNIT 4 DESCRIPTION AND HISTORY 1-1

1.2 REMEDIAL ALTERNATIVE DESCRIPTION 1-3

1.3 OVERVIEW OF THE VITRIFICATION PILOT PLANT PROGRAM 1-4

1.3.1 Purpose of the Vitrification Pilot Plant Program 1-4
1.3.2 Forecast Schedule 1-6
1.3.3 Organization of the Work Plan 1-8

1.4 PREVIOUS VITRIFICATION STUDIES 1-8

1.4.1 Laboratory Testing by PNL in 1991 1-8
1.4.2 Treatability Study for the Vitrification of Residues from Silos 1, 2, and 3 1-10
1.4.3 Glass Development Program 1-14

1.5 EPA TREATABILITY STUDY GUIDANCE 1-16

2.0 REMEDIAL TECHNOLOGY DESCRIPTION 2-1

2.1 DESIGN ACTIVITIES/DESIGN BASIS 2-1

2.2 EQUIPMENT DESIGN FOR THE VITPP PROCESS 2-1

2.3 CONSTRUCTION ACTIVITIES 2-11

2.4 SYSTEMS OPERABILITY TESTING 2-11

3.0 PERFORMANCE AND DATA QUALITY OBJECTIVES 3-1

3.1 OVERALL VITRIFICATION PILOT PLANT PHASE I OBJECTIVE 3-1

3.2 PERFORMANCE OBJECTIVES 3-1

3.2.1 General 3-3
3.2.2 Pilot Plant 3-3
3.2.3 Feed Preparation and Transfer 3-3
3.2.4 Melter 3-4
3.2.5 Gem Forming Machine 3-5
3.2.6 Off-Gas System 3-5
3.2.7 Recycle Water System 3-6
3.2.8 Cooling Water Systems 3-6
3.2.9 Building Sump System 3-6
3.2.10 Process Sampling 3-7
3.2.11 Data Acquisition 3-7

3.3 DATA QUALITY OBJECTIVES 3-7

4.0 EXPERIMENTAL DESIGN 4-1

4.1 CAMPAIGNS 4-4

4.1.1 Campaign 1 - Benign Glass 4-4
4.1.2 Campaign 2 - Series D Glass Formula 4-6
4.1.3 Campaign 3 - Series C Glass Formula 4-7
4.1.4 Campaign 4 - Series A/Series B Glass Formula 4-7

5.0 EQUIPMENT AND MATERIALS 5-1

5.1 MAJOR EQUIPMENT ITEMS 5-1

5.2 FEED MATERIALS 5-3

6.0 SAMPLING AND ANALYSIS 6-1

6.1 PRECONSTRUCTION SAMPLING AND ANALYSIS RESULTS 6-1

6.2 START-UP AND OPERATIONAL SAMPLING AND ANALYSES 6-2

6.3 SAMPLING METHODOLOGY 6-3

6.4 ANALYTICAL METHODS 6-13

6.5 DATA QUALITY OBJECTIVES AND ANALYTICAL SUPPORT LEVELS 6-14

6.6 QUALITY ASSURANCE REQUIREMENTS 6-14

6.7 DATA REDUCTION, VERIFICATION AND QUANTIFICATION 6-14

6.8 PERFORMANCE AND SYSTEM AUDITS 6-14

6.9 CALCULATIONS OF DATA QUALITY INDICATORS 6-15

6.10 CORRECTIVE ACTION 6-15

6.11 QUALITY ASSURANCE REPORTS TO MANAGEMENT 6-15

7.0 DATA MANAGEMENT 7-1

8.0 DATA ANALYSIS AND INTERPRETATION 8-1

9.0 HEALTH AND SAFETY 9-1

10.0 RESIDUALS MANAGEMENT 10-1

10.1 WASTE CHARACTERIZATION 10-1

10.2 WASTE DISPOSITION 10-3

10.3 WASTE MINIMIZATION 10-4

11.0 REGULATORY COMPLIANCE 11-1

11.1 REMOVAL SITE EVALUATION (RSE) GUIDANCE 11-1

11.2 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) COMPLIANCE 11-2

11.3 RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) COMPLIANCE . . 11-2

11.4 PERMITTING ISSUES 11-3

11.4.1 Air Permits 11-3
11.4.2 Wastewater Permits 11-5

11.5 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) . 11-11

12.0 COMMUNITY RELATIONS 12-1

13.0 REPORTS 13-1

13.1 MONTHLY REPORTS 13-1

13.2 BI-WEEKLY STATUS MEETINGS 13-1

13.3 FINAL REPORT 13-1

14.0 MANAGEMENT AND STAFFING 14-1

14.1 PROJECT MANAGEMENT 14-1

14.2 STAFFING 14-4

15.0 REFERENCES 15-1

Appendices

A DOE-FN Letter No. DOE-0817-93 . . . . . A-1

B ARARs and TBC Criteria for the Phase I and II OU4
Pilot Plant Program B-1

LIST OF FIGURES

		Page
Figure 1-1	Forecast Schedule	1-7
Figure 1-2	1991 Laboratory Vitrification Testing TCLP Leachate Results for Vitrified K-65 Material: Concentration of Metals in Leachate	1-11
Figure 1-3	The Role of Treatability Studies in the RI/FS and RD/RA Process	1-17
Figure 1-4	Relationship of the OU4 Vitrification Treatability Studies to the RI/FS and RD/RA	1-18
Figure 2-1	Civil Site Plan	2-2
Figure 2-2	Vitrification Pilot Plant Process Flow Diagram - Phase I	2-3
Figure 14-1	Administrative Relationships	14-2
Figure 14-2	Operable Unit 4 Remediation	14-3
Figure 14-3	VITPP Start-Up and Operations Organizational Chart	14-5

LIST OF TABLES

		Page
Table 1-1	Summary of Vitrification Tests for OU4 Bench-Scale Treatability Testing	1-13
Table 3-1	Performance Objectives	3-2
Table 4-1	Phase I Test Campaign Overview	4-2
Table 4-2	Phase I Campaign Summary	4-9
Table 5-1	Vitrification Pilot Plant Phase I Equipment List	5-1
Table 5-2	Surrogate Feed Constituents	5-4
Table 6-1	Sampling and Analysis During Vitrification Pilot Plant Phase I	6-4
Table 13-1	Suggested Organization of Treatability Study Final Report	13-3

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
AWWTS	Advanced Wastewater Treatment System
BAT	Best Available Technology
BDAT	Best Demonstrated Available Technology
BMP	Best Management Practices
CAT	Construction Acceptance Testing
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
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
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
FHAR	Final Hazard Analysis Report
FRESH	Fernald Residents for Environmental Safety and Health
FRVP	Fernald Residues Vitrification Plant
FS	Feasibility Study

FSAR	Final Safety Analysis Report
HAZOP	Hazard and Operability Analysis
HEPA	High Efficiency Particulate Air
LLRW	Low Level Radioactive Waste
MEF	Material Evaluation Form
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NTS	Nevada Test Site
NWP	Nationwide Permit
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
ORC	Ohio Revised Code
OU4	Operable Unit 4
PCT	Product Consistency Test
PNL	Pacific Northwest Laboratory
PP	Proposed Plan
PPE	Personal Protective Equipment
PSAR	Preliminary Safety Analysis Report
PWID	Project Waste Identification and Disposition
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RI/FS	Remedial Investigation/Feasibility Study
RI	Remedial Investigation

000013

ROD	Record of Decision
RSE	Removal Site Evaluation
RTS	Radon Treatment System
SCQ	Sitewide CERCLA Quality Assurance Project Plan
SOT	Systems Operability Testing
TBC	To Be Considered
TBD	To Be Determined
TC	Toxicity Characteristic
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
VITPP	Vitrification Pilot Plant
VOA	Volatile Organic Analyses
VSL	Vitreous State Laboratory
WBS	Work Breakdown Structure
WMCO	Westinghouse Materials Company of Ohio

LIST OF WEIGHTS AND MEASURES

cfm	cubic feet per minute
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
Ba	Barium
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

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1.0 PROJECT DESCRIPTION

1.1 OPERABLE UNIT 4 DESCRIPTION AND HISTORY

The Fernald Environmental Management Project (FEMP) is a contractor-managed federal facility once used for the production of purified uranium metal for the United States 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 EPA 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 EPA 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 EPA. 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, their ancillary structures, contaminated soils within the geographic boundary, and contaminated water within the geographic boundary, both perched and groundwater. Remediation of OU4 components will be accomplished as distinct elements by separate projects that address specific work scopes. The Fernald Residues Vitrification Plant (FRVP) Project will remediate the contents of Silos 1, 2, and 3 and the decant sump tank. The Soil Remediation Project will remediate all contaminated soils, and all at or below grade structures including foundations, roadways, underground piping , and underground utility systems. The Aquifer Restoration Project will remediate all contaminated water including perched groundwater, the Great Miami Aquifer, and surface water. Remediation of OU4 will address all of these items as well as any contaminated soils within the OU4 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 existing permanent 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 was proposed and submitted for public review in the Proposed Plan (PP) (DOE 1994b). The Record of Decision (ROD) (DOE 1994c), which is the final step in the RI/FS process, was formally signed by the EPA on December 7, 1994.

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% BentoGrout® 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 is 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.

1.2 REMEDIAL ALTERNATIVE DESCRIPTION

Several remediation technologies were considered for OU4. These alternatives were described in detail in the report "Initial Screening of Alternatives for Operable Unit 4, Task 12 Report," (DOE 1990b). 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," (DOE 1994a).

Phase I of the Vitrification Pilot Plant (VITPP) program includes demonstrating the technology for:

- feed preparation;
- vitrification of surrogate Silos 1, 2 and 3 material; and
- off-gas control and treatment.

This technology will then be applied to the Phase II VITPP program to demonstrate:

- hydraulic removal of the material from Silos 2;
- pneumatic removal of the material from Silo 3;

- Silos 2 and 3 material vitrification;
- off-gas control and radon treatment.

The vitrification technology considered in the following alternatives consists of heating the residues to sufficient temperatures to induce the formation of a 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 for Silos 1, 2, and 3 contents have been developed and were identified as the preferred alternatives in the Proposed Plan.

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. The wastes would be transported to the disposal facility either by rail and/or truck.

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. The wastes would be transported to the disposal facility by rail and/or truck.

1.3 OVERVIEW OF THE VITRIFICATION PILOT PLANT PROGRAM

1.3.1 Purpose of the Vitrification Pilot Plant Program

The FRVP Project personnel and FEMP supporting departments are currently preparing for the third tier of the EPA-outlined approach for conducting treatability studies at a Superfund site (refer to Section 1.5). Although the FEMP is not using Superfund monies, this approach is applicable to the VITPP 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 ton) per day pilot scale facility for vitrification of K-65, BentoGrout®, and Silo 3 material. This third tier of treatability testing will be conducted in phases.

Phase I of the VITPP program will use BentoGrout® and surrogate materials, and the pilot scale vitrification facility for demonstrating vitrification technologies. Phase II, which follows Phase I, will use BentoGrout®, actual K-65, and Silo 3 materials which will be retrieved from the silos. A separate work plan is being developed for Phase II. Phase II addresses the treatment of radon gas since radon and radium bearing 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.

Phase I is the equipment, process, and methodology proving stage for the vitrification facility that will initially use a benign borosilicate glass for melter startup followed by operations using a nonradioactive surrogate material, consisting of silty sands, BentoGrout®, water, and nonradioactive additives to simulate the other major constituents that exist in the silo residues. This includes lead, barium, sulfate, nitrate and phosphate compounds. Four campaigns are planned to complete Phase I testing. Starting with Campaign #2, lead, barium, sulfates, nitrates, and phosphates will be added to the surrogate material to more closely simulate K-65 material. Thickener tank operation will not be introduced until Campaign #4. The number and order of the campaigns may be revised based on the results of tests currently being conducted at the Vitreous State Laboratory (VSL) or the results of VITPP Phase I testing as it progresses. The duration of the Phase I testing is currently estimated to require from four to five months.

The vitrification facility is designed for a production rate of one metric ton (1.1 ton) per day of product. It is anticipated that Phase I will require approximately 150 metric tons (165 tons) of surrogate material to adequately demonstrate vitrification.

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

- Pilot scale vitrification facility construction.
- Loading surrogate material into the thickener or slurry tanks.
- Operation of the vitrification melter with benign borosilicate glass.
- Operation of the vitrification facility with surrogate materials.

Phase II of pilot scale testing for vitrification will be implemented in the vitrification facility constructed for Phase I. Lessons learned during Phase I, with regard to the process administrative and engineering control and equipment operation, will be incorporated into Phase II and the FRVP design. The Phase

I design was developed for the use of actual K-65 and Silo 3 material; therefore, the facility should require minimal modification for Phase II operations.

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.

When identified in the test plan, Silo 3 material will be mixed with K-65 material at a predetermined ratio, then vitrified. 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 list of the major activities to be included in the scope of Phase II:

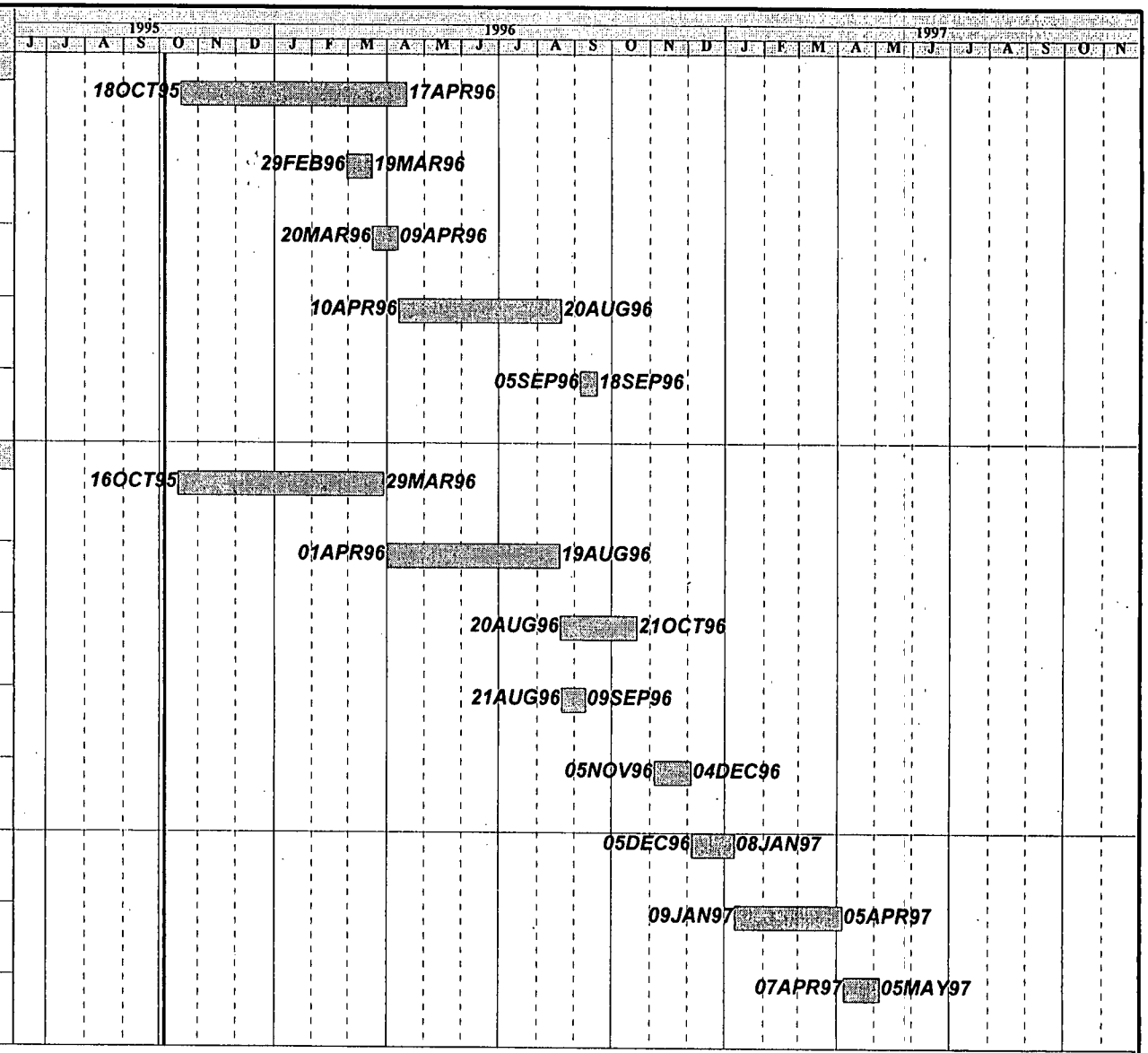
- K-65 Silo Radon Treatment System (RTS) upgrade
- Vitrification facility modification (as required)
- K-65 hydraulic material retrieval
- Silo 3 pneumatic material retrieval
- Operation of the vitrification facility using actual K-65 wastes and Silo 3 material
- Treatment of process off-gases
- Demonstration of waste packaging for shipment and disposal at the Nevada Test Site (NTS).

Information obtained from the Phase I and II VITPP program will be used to generate quantitative performance data and to further refine the cost estimate for full-scale remediation.

1.3.2 Forecast Schedule

Figure 1-1 presents the forecast schedule hammocks for the Phase I (surrogate), and the Phase II (for vitrification of K-65 and Silo 3 material) treatability study program. The schedule is driven by the RI/FS schedules that are incorporated in the ACA. The schedule displays DOE approved forecast dates for the VITPP program.

OU4 PILOT PLANT



Project Start	05OCT95	Early Bar	
Project Finish	05MAY97	Progress Bar	
Plot Date	09FEB96	Critical Activity	

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PPWC

FERMCO - FRVP PROJECT
VITRIFICATION PILOT PLANT
FIGURE 1-1 FORECAST SCHEDULE

Sheet 1 of 1

Status as of 01/22/96 1600hrs Rev 3

Date	Revision	Checked	Approved

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1.3.3 Organization of the Work Plan

This work plan describes Phase I of the VITPP program. It is organized in accordance with EPA guidance (EPA 1992). In addition to the EPA-suggested sections, a discussion of the regulatory requirements governing construction and operation of the VITPP, including a permit information summary for VITPP Phase I, are included.

This VITPP 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 vitrification processing equipment prior to the introduction of radioactive materials during VITPP Phase II. The VITPP 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 waste 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) submitted 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" (Chapman and Janke 1991). 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 EPA 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 EPA 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 1-2. 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 indicated 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 EPA approved (April, 1992) work plan (DOE 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 conducted 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 tested in

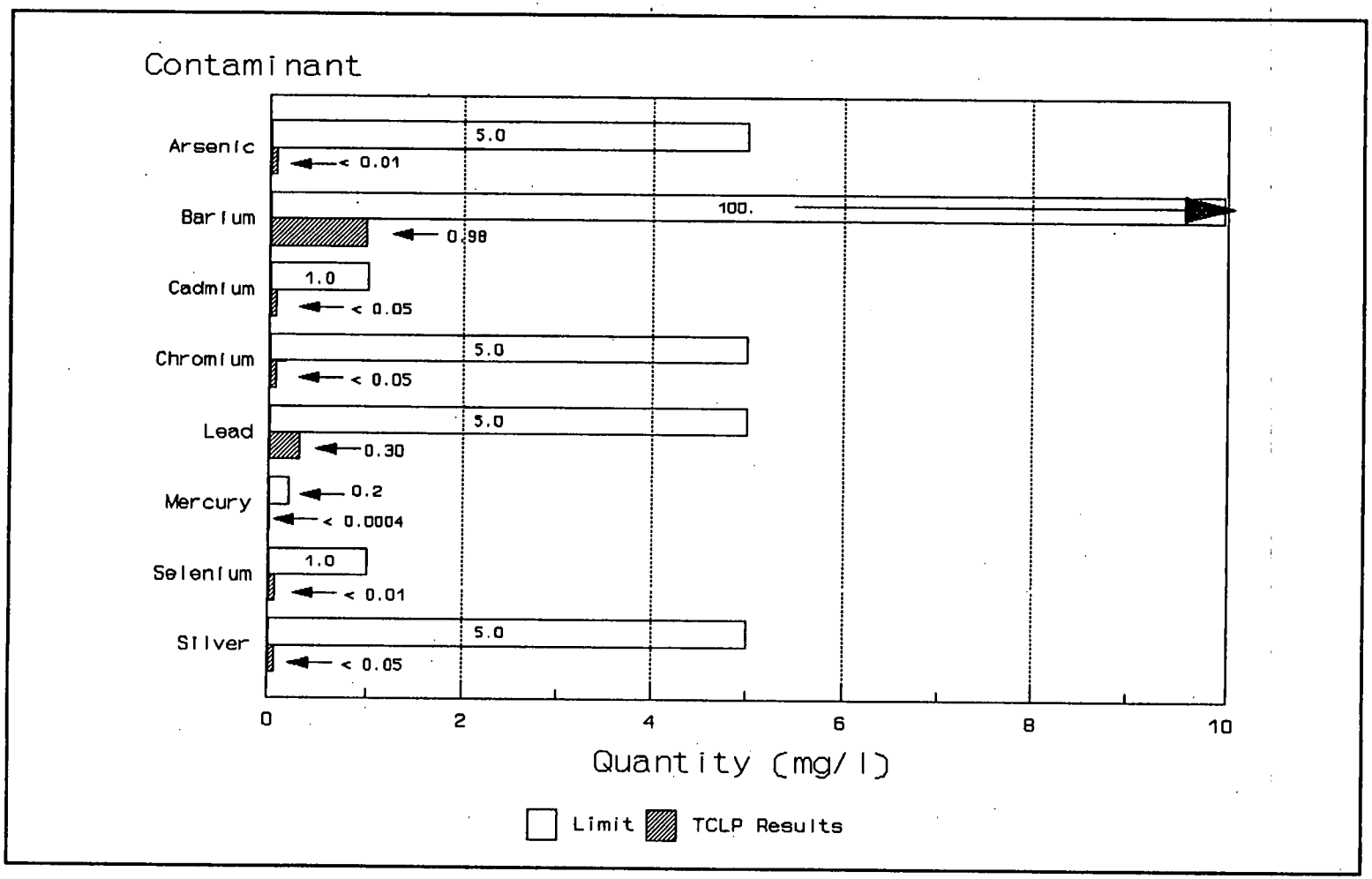

FIGURE 1-2

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

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duplicate for each of these mixtures. Table 1-1 presents a summary of the vitrification tests that were included in the OU4 Bench-Scale Treatability Testing program. The study results, which were reported in 1993 (DOE 1993a), 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/cm^3) 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/m^2/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."*

- *"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."*

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

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."*

Appropriate glass formulations are currently being pursued under an OU4 glass development project. A radon adsorption experiment utilizing granular activated carbon was conducted at Rust-Geotech Laboratory. This test indicated that the VITPP design should achieve about 85% removal of radon in the off-gas stream. This VITPP program addresses the third item.

1.4.3 Glass Development Program

The scope of work for the bench-scale treatability study performed at Battelle's Pacific Northwest Laboratories 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. This work is being done at the Vitreous State Laboratory. The VSL facility and staff, which is part of The Catholic University of America, provides technical support to GTS Duratek. The VSL work will be completed prior to initiating the Phase I test campaigns that are discussed in Section 4. Optimization of glass formulations reduces risk and will improve the VITPP operational performance.

Optimization addresses formulating a glass that has acceptable leaching characteristics, durability, viscosity, conductivity, and phase stability properties. The optimization studies will also determine an acceptable range of additives to respond to the variability in the waste composition at the lowest practical melter temperatures. Toxicity Characteristic Leachate Procedure (TCLP) results for metals will be obtained for the optimized formulation, and processability and robustness will be the basis for defining the operating envelope for the VITPP tests.

- Battelle - Pacific Northwest Laboratory Development Program

Glass formulations were 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. This study consisted of a screening phase and a formulation optimization phase. During the screening tests, 100 g (0.22 lb) test melts were made with several different glass formulations. The criteria for determining the optimum formulation was 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 were quantitatively studied during optimization of the formulation.

Optimization of the chosen formulation was accomplished through a statistically designed series of tests over a range of credible waste stream compositions. These melts included testing with simulants and testing with the actual waste material. The correlation of TCLP for the glass product and viscosity and electrical conductivity of the molten material to waste variations was quantitatively determined, and acceptable limits for variability in the waste stream was determined.

- GTS Duratek/Vitreous State Laboratory Development Program

The PNL work was done in crucible melters. The resulting preferred formulations require melt temperatures that are on the edge or outside the range of most commercial melters that are available for this application. Translation of crucible melt data to continuous melt requirements is a large step that includes some inherent uncertainties. The VSL work for GTS Duratek bridges this gap, and focusses on determining what formulation adjustments are necessary to reduce the operating temperature and to avoid other undesirable characteristics such as foaming. The VSL work includes both crucible melts and continuous melting in a minimelter whose design includes the three chamber approach and several other design features of the GTS Duratek HT-1000 melter which was purchased for the VITPP program.

The VITPP melter is a joule heated, continuous melter that includes a three compartment design to attain the specified operating temperature while addressing the problem of high temperature corrosion and erosion of the melter. Scale up of this design would result in a first of a kind production unit. One prime objective of the VSL work is to develop operating techniques and to customize the glass formulations for VITPP melter operation between 1050°C and 1350°C with the target being 1250°C. Feed materials that represent K-65, Silo 3, and BentoGrout® in various combinations are included in the test program. The data from this work will be used to finalize the formulations that will be tested in the VITPP test campaigns.

1.5 EPA TREATABILITY STUDY GUIDANCE

According to EPA guidance on conducting Treatability Studies, as many as three tiers of treatability testing may be required (see Figure 1-3):

- 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, 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 OU4, is the earlier laboratory and bench-scale treatability studies (see Figure 1-4). As the figure shows, Phase I and II of the pilot-scale testing will occur after the ROD.

The EPA Guide for Conducting Treatability Studies under CERCLA (EPA 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 VITPP 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. wastewater, radon), energy and reagent usage (i.e process additives), and sampling and analysis of the process and the final product.

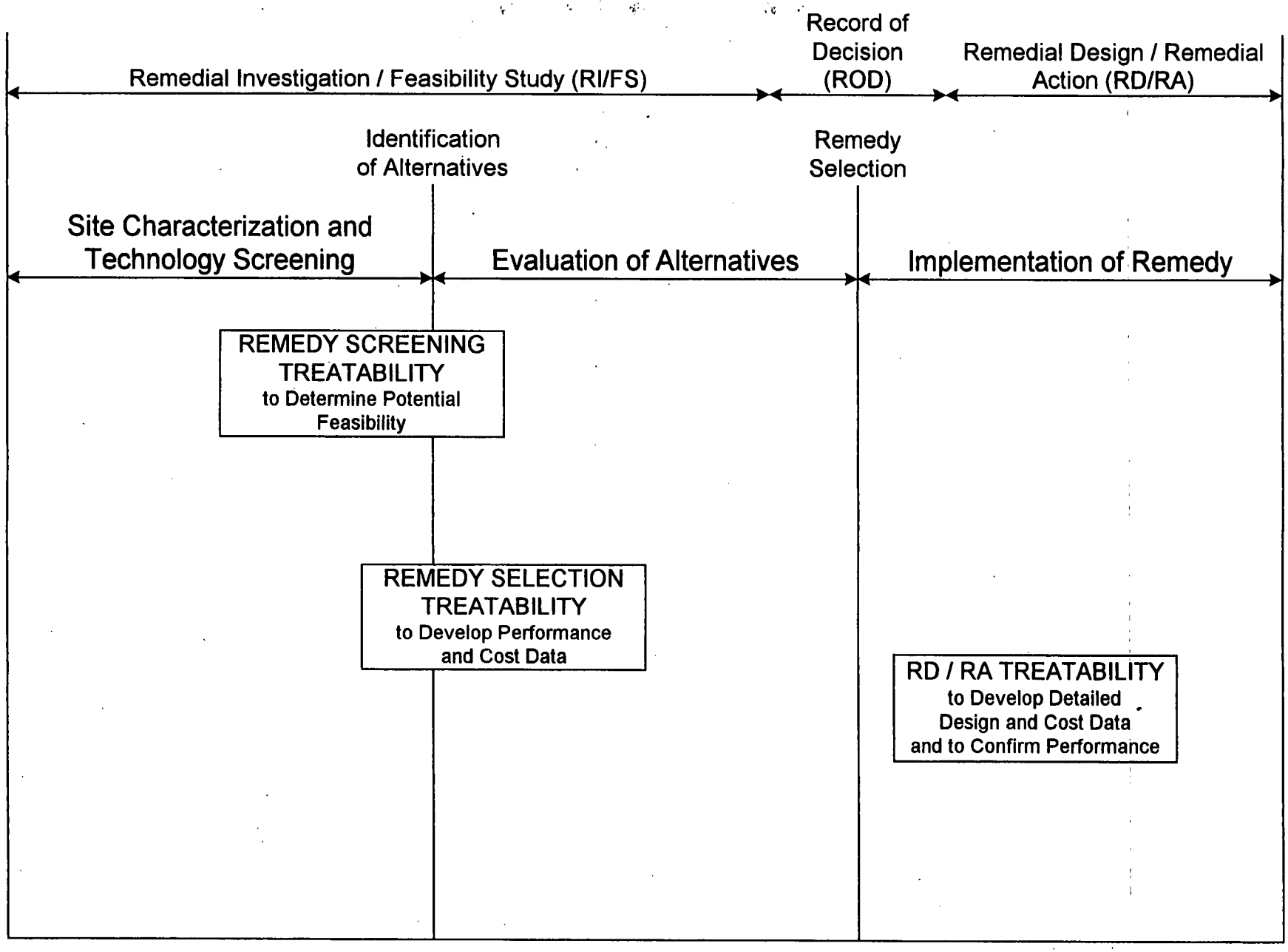

Figure 1-3
The Role of Treatability Studies in the RI/FS and RD/RA Process

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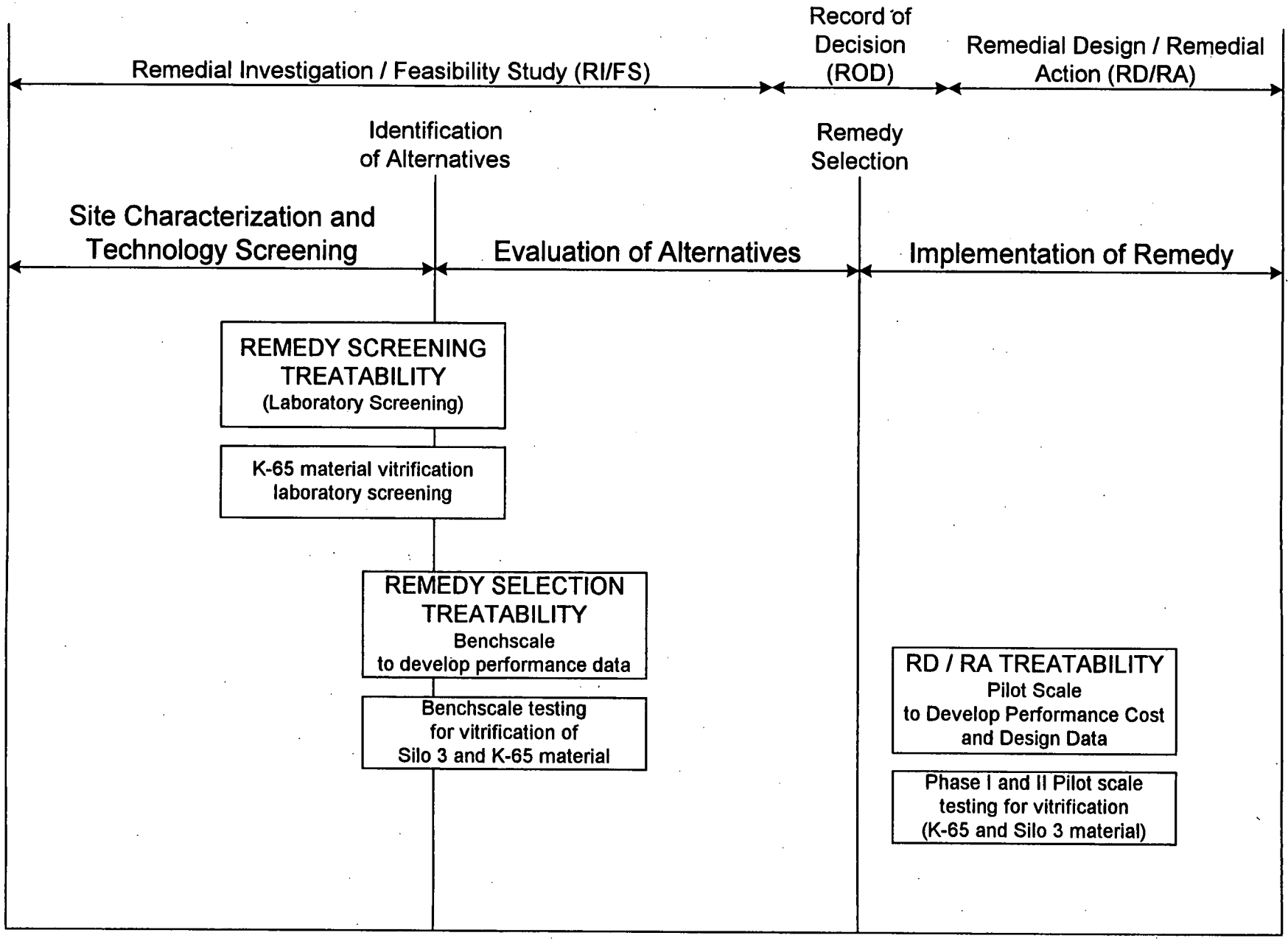

Figure 1-4
Relationship of the OU4 Vitrification Treatability Studies to the RI/FS and RD/RA

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2.0 REMEDIAL TECHNOLOGY DESCRIPTION

The pilot scale vitrification facility is located east of the K-65 Silos. The majority of the holding tanks and vitrification support equipment is located outside the building on diked concrete pads. Interim storage of the vitrified product is accommodated on a nearby covered concrete pad. The melter and product forming equipment, along with the process control system and other support functions are housed in a pre-engineered, metal building. Figure 2-1 is the civil site plan which shows the VITPP location with respect to the existing silos.

2.1 DESIGN ACTIVITIES/DESIGN BASIS

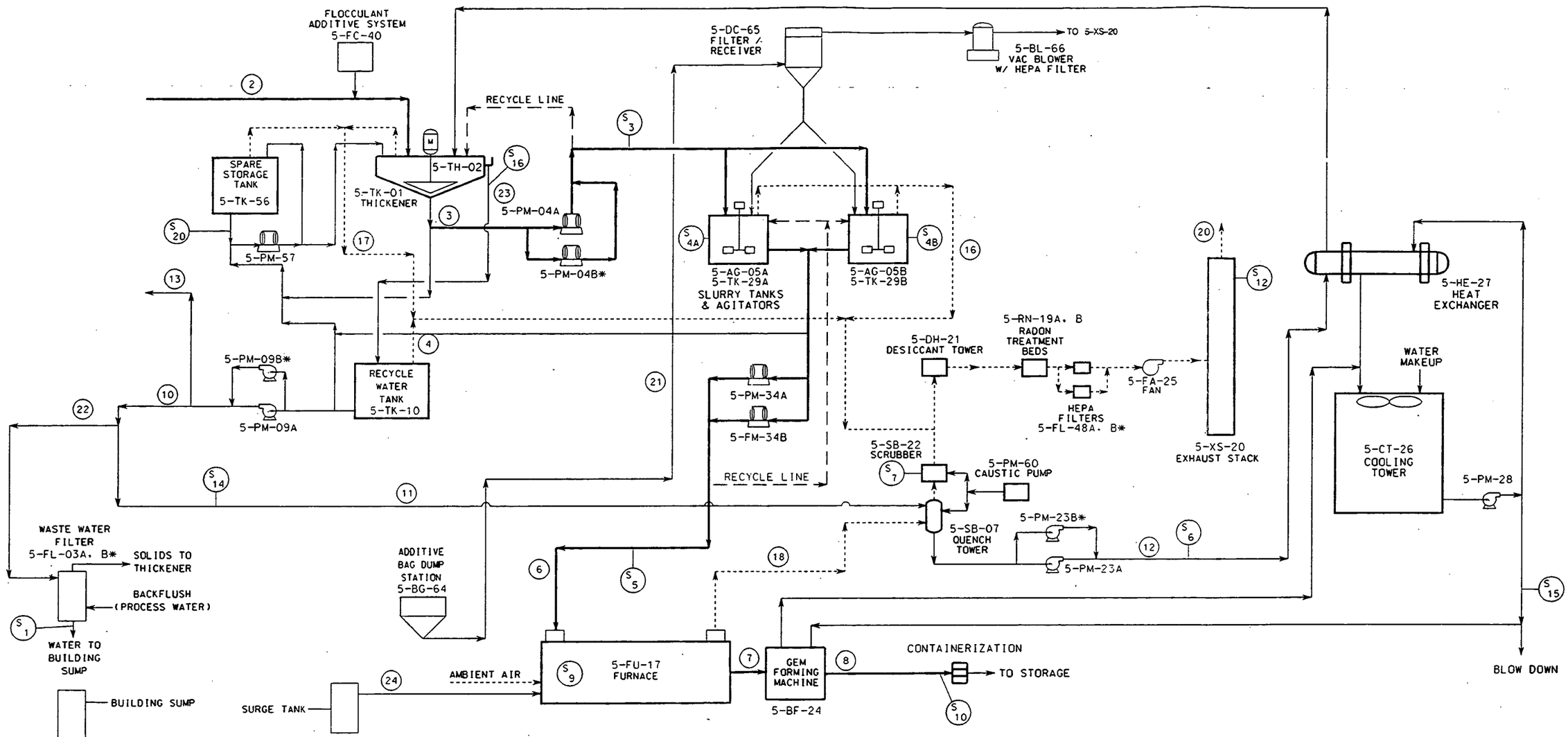
The conceptual design of an OU4 vitrification facility was developed during the preparation of the FS. The requirements of a pilot scale facility were defined, and a document entitled, "Functional Requirements Document, Vitrification Pilot Plant" (Parsons 1993) was developed to establish the basis for the VITPP design. Process and facility design to satisfy these functional requirements was conducted in compliance with criteria developed specifically for this project as documented in the "Design Criteria for the CRU-4 Pilot Plant Program" (Parsons 1994). A VITPP process flow diagram was developed, and the required equipment items were identified and specified. The process flow diagram applicable to Phase I is presented in Figure 2-2.

2.2 EQUIPMENT DESIGN FOR THE VITPP PROCESS

The key equipment item for the VITPP process is an electric, joule-heated melter capable of melting a wide range of waste materials, at moderately high temperatures. It has been designed to produce a consistent, durable, stabilized glass with minimal effluent. The molten glass can be discharged as a monolith pour or it can be fed to a product forming machine. This machine produces a glass product of shape and size that is flexible for containerization and final packaging.

An off-gas system composed of standard industry components such as a quencher to reduce melter off-gas temperature, scrubber, desiccant tower, carbon beds (Phase II only), High Efficiency Particulate Air (HEPA) filter, and blower is included in the facility design. The off-gas air is discharged to the atmosphere through a stack. The stack is equipped with an isokinetic sampler and a Pylon® radon monitoring device.

VITRIFICATION PILOT PLANT PROCESS FLOW DIAGRAM - PHASE I



NOTE:

* - INSTALLED SPARE

(S xx) - SAMPLING POINTS

FLOW NO.	1	2	3	4	6	7	8	10		11	12	13	16	17	18	20	21	22	23		24
	K-65 SILO MATERIAL	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		COOLING WATER TO MELTER ELECTRODES
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	1080	0	0	0	
WATER (LBS/HR)	1910	17300	4450	0	74	0	0	21910	20000	20000	20074	15890	0	0	74	0	0	1910	33424	20074	
OPER. TIME (HR/ 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	24

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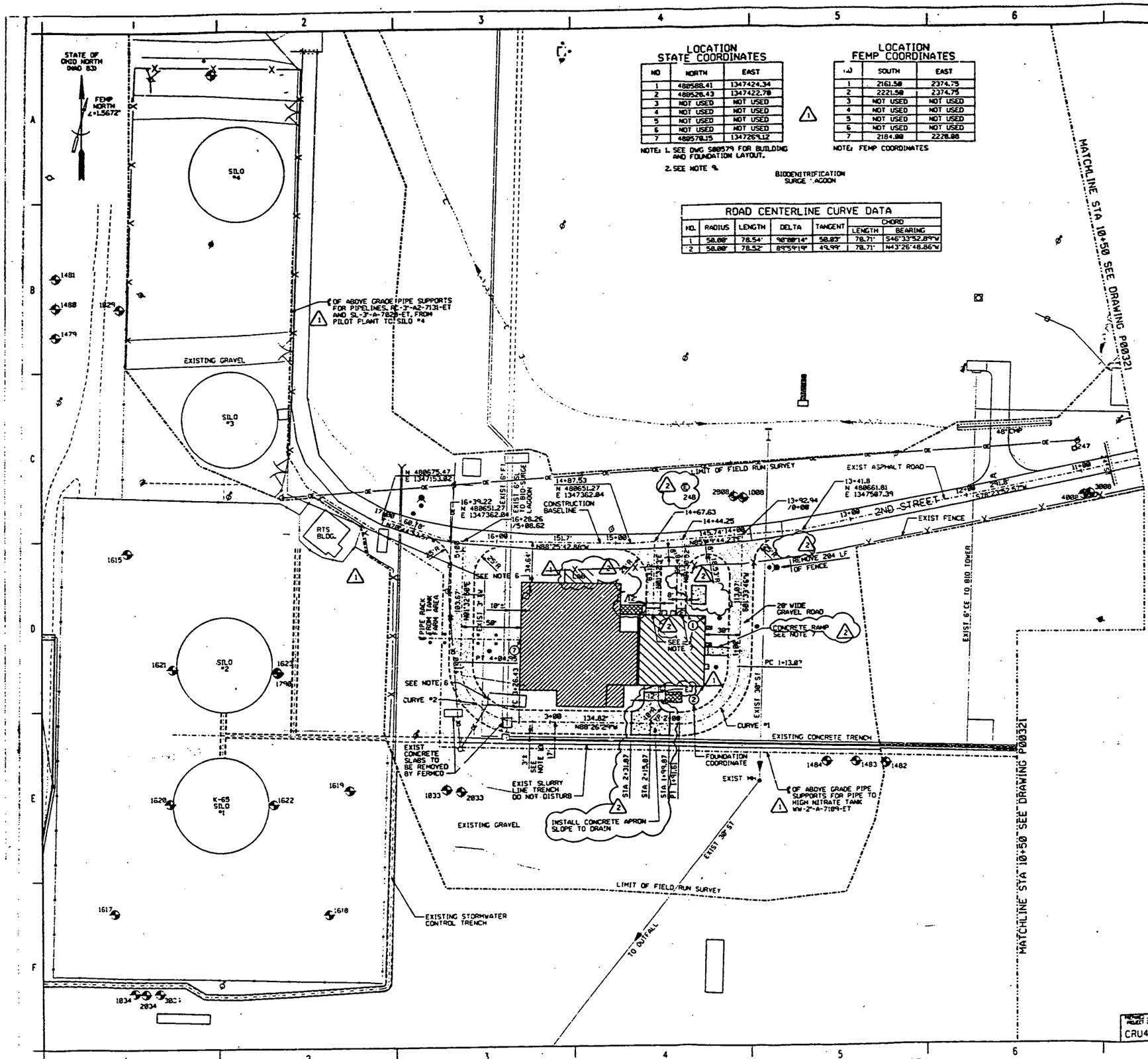
SKETCH: CRU4-PP-SK027

REV K DATE 1/29/96

/RES2050/VITFLOW3.DGN



LOCATION STATE COORDINATES

NO	NORTH	EAST
1	480588.41	1347424.34
2	480526.43	1347422.78
3	NOT USED	NOT USED
4	NOT USED	NOT USED
5	NOT USED	NOT USED
6	NOT USED	NOT USED
7	480578.15	1347269.12

NOTE: 1. SEE DWG 580579 FOR BUILDING AND FOUNDATION LAYOUT.
2. SEE NOTE 9.

LOCATION FEMP COORDINATES

NO	SOUTH	EAST
1	2161.50	2374.75
2	2221.50	2374.75
3	NOT USED	NOT USED
4	NOT USED	NOT USED
5	NOT USED	NOT USED
6	NOT USED	NOT USED
7	2184.00	2228.00

NOTE: FEMP COORDINATES

BIODENITRIFICATION SURGE LAGOON

ROAD CENTERLINE CURVE DATA

NO.	RADIUS	LENGTH	DELTA	TANGENT	CHORD LENGTH	CHORD BEARING
1	50.00'	78.54'	90°00'14"	50.03'	70.71'	S46°33'52.89"W
2	50.00'	78.52'	89°59'19"	49.99'	70.71'	N43°26'48.86"W

NOTES

1. INFORMATION ON THE LOCATION AND ELEVATION OF EXISTING FEATURES SHOWN ON THIS PLAN WERE OBTAINED FROM SEVERAL DIFFERENT SOURCES INCLUDING THE GRID/GRID UTILITY PLANS, THE 1992 FLYOVER, AND THE FIELD RUN SURVEY PROVIDED BY FERMCO IN DECEMBER 1993. LIMIT OF FIELD RUN SURVEY IS NOTED ON DRAWING.
2. THE SUBCONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS AND DIMENSIONS INCLUDING ELEVATIONS BEFORE STARTING ANY CONSTRUCTION AND FABRICATION. ANY DEVIATIONS FROM INFORMATION SHOWN SHALL BE PRESENTED IN WRITING TO THE FERMCO CONSTRUCTION CONTRACTS MANAGER IMMEDIATELY AND RESOLVED BEFORE CONTINUING. FEATURES SHOWN ON DRAWING ARE "AS DESIGNED." AS BUILT CONDITIONS CAN BE DIFFERENT. 2
3. FOR DRAWING INDEX, SEE DRAWING 94X-5900-X-00353.
4. FOR LEGEND AND SYMBOLS, SEE DRAWING 94X-5900-X-00316.
5. ALL DISTURBED SURFACES SHALL BE SEEDED AT PROJECT COMPLETION.
6. TRAILER AND ABANDONED WELL HEAD TO BE REMOVED BY FERMCO.
7. FOR CONCRETE APRON, RAMP, AND STOOP DETAILS, SEE DRAWING 94X-5900-G-00325.
8. FOR PAD LOCATIONS, SEE DRAWING 94X-5900-S-00577.
9. ALL COORDINATES GIVEN ARE IN NAD 83 STATE PLANE COORDINATE SYSTEM, AND ALL BEARINGS ARE FROM NAD 83 NORTH UNLESS NOTED OTHERWISE.
10. ALL 1600 SERIES ⊕ ARE SOIL BORINGS (NOT MONITORING WELLS).
11. 2
12. ALL EXCAVATION SHALL BE PERFORMED WITH EXTREME CARE. SUBCONTRACTOR IS RESPONSIBLE FOR IMMEDIATELY INFORMING THE FERMCO CONSTRUCTION CONTRACTS MANAGER AND REPAIRING ANY UTILITY DAMAGE TO THE SATISFACTION OF THE FERMCO CONSTRUCTION CONTRACTS MANAGER. FEATURES SHOWN ON DRAWING ARE "AS DESIGNED." AS BUILT CONDITIONS CAN BE DIFFERENT.

LEGEND

- BUILDING OR TRAILER
- OPEN PROCESS AREA (SEE NOTE 8)
- CONCRETE PAD OR PAVING
- CRUSHED AGGREGATE SURFACING
- HVAC SYSTEMS (SEE NOTE 8)
- LIMIT OF FIELD SURVEY (SEE NOTE 1)

REF DWG NO.	DRAWING TITLE
94X-5900-X-00353	DRAWING INDEX - SHEET 1 OF 4
94X-5900-X-00316	LEGEND AND SYMBOLS
94X-5900-G-00325	SITE DETAILS - SHEET 2 OF 3 1
94X-5900-S-00577	TANK FARM
94X-5900-S-00579	PROCESS AREA
94X-5900-P-00321	PLAN AND PROFILE

REV NO	REVISION	DRAWN	CHECKED	APPROVED
2	REMOVE GENERATOR HOLD, REVISED HVAC AND SURGE BIN PADS, MOVED ELECTRICAL MH'S.	05/12/95		
	ADDED CONCRETE APRON			
1	ADDED PIPELINE RUNS, MOVED LAB, REMOVED RTS BUILDING AND COORDINATES, AND UTILITY TANK	RAZ	RC / RE	05/13/94 / 05/16/94
0	APPROVED FOR CONSTRUCTION	RAZ	RE	03/12/94

REV NO | ISSUE OR REVISION PURPOSE - DESCRIPTION | DRAWN | CHECKED | APPROVED | DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
VITRIFICATION PILOT PLANT DESIGN
CRU4 - ONE METRIC TON

DRAWING TITLE
CIVIL
SITE PLAN

FIGURE 2-1

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R.H. LINDGREN	08/27/90	EDWARD J. KUBROW	03/12/94	K. GERAPO	11/16/90

PLANT/BLDG NO. | FLOOR | SCALE 1"=30' | CLASS

SUBMITTED FOR APPROVAL	FERMCO CRU APPROVAL	CERTIFIED FOR CONSTRUCTION
R.A. ZIEMINSKI 03/12/94	R.C. EMERTON 03/12/94	W. PICKLES 03/18/94
DATE	DATE	CRU DIRECTOR DATE

FERMCO JOB & PARCEL PROJECT INDEX NUMBER	JOB PROJECT NO.	TEMP PROJECT NO.	DRAWING PREFIX CODE NO.	PREFIX NO.	REV NO.
CRU4/P085		WBS 1.1.1.1.4.3.1 00-90701	94X-5900-G-00317	G0001	2

000037

Additives

The equipment for introducing additives to the feed includes a standard bag slitting and dumping station. The bag dump station has its own ventilation fan and includes filters to control fugitive dust during the dumping operation. The additives, which are introduced as dry powders, are pneumatically conveyed to a filter/receiver unit. Exhaust from the filter/receiver is vented by a vacuum blower that discharges to a HEPA filter unit prior to final discharge via the exhaust stack.

Chemical additives, such as alumina, sodium carbonate and calcium carbonate, needed for the vitrification process are weighed and then fed to the slurry tanks and blended with the surrogate material. Lead, barium, sulfate, phosphate, and nitrate compounds will be added to the surrogate material to more closely simulate the K-65 materials. The lead and barium in the K-65 material has the potential to undergo phase separation, and/or crystallization, or precipitate in the melter. Therefore, evaluation of the behavior of these metals, phosphates, and sulfates, and their effects on the glass and the melter's electrodes are important parts of the testing program.

Thickener

The surrogate material for Campaign #4 will be pumped into a 24,000-gallon carbon steel thickener tank. The feed enters the center well of the thickener at 15 to 20 percent solids. Slurry flow rates and percent solids are measured by a flow indicator that is installed in the feed line.

Control of thickened solids in the underflow is by rake height and an adjustable, air-operated diaphragm pump that pumps the material to one of two slurry tanks. A density controller in the thickener underflow line controls the density of the solids by adjusting the diaphragm pump flow rate. The underflow is designed for 50 percent solids and will be confirmed by sampling and analysis. The thickener overflow flows by gravity to the recycle water tank where it is used to supply the quench tower. A flow transmitter in the thickener discharge (underflow) line monitors thickener flow. The thickener overflow water is sampled for clarity and percent solids.

Addition of a polymer flocculant is necessary to ensure that an adequate settling rate of the solids in the thickener will occur. Addition is made via a flocculant mixing and feeding system. Laboratory tests have shown that the presence of the BentoGrout® clay makes the thickener operation more difficult, requires high levels of polymer addition and possibly pH adjustment. The ability to adequately thicken the BentoGrout® is crucial to the success of the Phase I program.

The thickener mechanism is supplied with protective instrumentation. A set of 30 ft diameter rakes are automatically raised and lowered as a function of torque. Torque alarm annunciation occurs on the activation of a high torque sensor and automatic shutdown occurs on the activation of a high-high torque sensor.

Slurry Tanks

The two carbon steel slurry tanks, approximately 2,650 liters each (700 gallons each), alternate between feed preparation and melter feed functions. While one tank feeds the melter, the other tank receives about 810 kg (1780 lb) of solids from the thickener which represents about one day's production. The complete cycle of slurry tank fill, additive addition, mixing, and verification shall occur in 24 hours (or less).

Feed material for Campaigns #1 through #3 will be loaded directly into the slurry tanks via the bag dumping station since the formulations consist of dry feed material. The feed material for Campaign #4 will be pumped from the thickener tank to one of the two slurry tanks by the thickener underflow pump at a rate of approximately 151 lpm (40 gpm).

Each feed batch of surrogate material is prepared by the following sequence of steps. Thickener underflow at 50 percent solids by weight is transferred to one of the slurry tanks and then raised to a higher percent solids by the addition of dry additives. The slurry is sampled and analyzed for percent solids and specific metals - both before and after this addition - to identify and verify the correct additive mix. The desired solids content in the final slurry is approximately 60 percent. If required, recycled water is added to lower the percent solids in the slurry tanks to approximately 60 percent.

The agitator blends the surrogate material and the additives so that a homogeneous mix is fed to the vitrification melter. The slurry tank material is sampled to ascertain the agitator's effectiveness and the slurry material density is monitored.

Crucible testing will be performed on the mixed composition. This crucible melt testing of a small sample of the slurry tank contents provides an initial indication of the behavior of that specific batch at the test temperature. Key characteristics include viscosity and electrical conductivity of the melt at various temperatures.

Melter

The pilot-scale joule-heated melter is refractory lined, welded steel construction on a steel base frame. Joule heating, means that the electric current passes directly through the molten glass. This approach allows melting the surrogate materials at moderately high temperatures. The slurry is delivered from the slurry tank to the melter by an air operated diaphragm pump. The feed enters the melting chamber and is deposited onto the molten glass surface. The slurry is fed continuously using a positive displacement pump. The melter is designed to produce a consistent, durable, stabilized glass. The melter is lined with high temperature refractory bricks and is capable of operating in the range of 1,050 to 1350 (1,922 - 2462°F). Melt chamber temperatures are controlled by power adjustments to the heating electrodes and supplemental area heaters. Agitation is incorporated into the melter design to promote uniform glass production with a minimum retention time. Agitation is achieved by bubbling air through the molten glass. The melter plenum will normally be kept at a slightly negative pressure. This is accomplished by venting the melter into an induced draft, once-through off-gas system.

The operating parameters are as follows:

Discharge Rate	1.0 metric ton (2,200 lb)/day
Operating Temperature	1,050 - 1350°C (1,922 - 2462°F)
Feed Moisture	40 - 60 percent by weight
Feed Temperature	10 - 40°C (50 - 104°F)
Bath Surface Area	9 ft^2 (0.84 m^2)
Bath Volume	25 ft^3 (0.71 m^3)

Once testing has begun, it is the intent to operate the melter system on a continuous basis with "feed" batches being prepared and run back to back. Except when going from idle to operating or from operating to idle, minimum melter temperature variations will be maintained. When going from a lower to a higher operating temperature, the melter will be allowed to stabilize at the higher temperature before a new feed composition is introduced.

Each feed batch is sampled prior to being fed to the melter. A feed batch is defined as the quantity of feed material that is required to produce one metric ton (2,200 lbs) of glass product. A feed batch, which is prepared in a slurry tank, is fed to the melter continuously over an approximate 24 hour period. It takes approximately three melter volumes (6 tons over 6 days) to displace the previous batch and obtain a representative sample. Melter operation will be carefully monitored and adjustments to temperature,

hold time, formulation, etc., will be made, as required, to ensure that an acceptable glass is produced. Operation of the melter at its lower temperature range will be tested to determine the minimum temperature required to produce an acceptable glass product. One glass product sample per batch is collected for final product acceptance testing which includes TCLP metals analysis. Under certain operating conditions, metallic lead or other heavy metals could form and settle to the bottom of the molten material within the melter. However, the formation of metallic lead is not anticipated because the glass formulations are designed to preclude reducing conditions in the melter.

Temperature Control

The melter is capable of operating at temperatures between 1,050 and 1,350°C (1,922 - 2462°F). The ability to maintain a constant glass melt temperature during operations will be tested due to its importance in producing a uniform glass product that flows from the melter at a constant rate. The melter temperature and discharge temperature are closely monitored to ensure that the melter is within the operating ranges.

Foaming

Foaming occurs in a glass melter by the release of gases that form at high temperature from the decomposition of feed materials - mostly carbon dioxide (CO_2) from carbonates and SO_x from sulfates. Because it is critical to be able to continuously operate the melter without foaming problems, the extent of foaming will be observed by remote video monitoring and the glass formulation adjusted if necessary.

The prevention of foaming can involve: 1) reducing the melter feed rate, 2) reducing the melter temperature, 3) increasing the melter temperature, 4) substituting non-gas producing additives (e.g., calcium oxide) for gas producing additives (e.g., calcium carbonate), 5) including reductants (such as urea on starch), or 6) reducing the waste proportion in the melter feed.

Molten Material Removal

Controlling the molten material flow from the melter is important to the subsequent product forming operation. The transfer of molten glass from the melting chamber to the discharge chamber is accomplished by using an air lift feature located in the discharge chamber. The air lift mechanism injects air into the bottom of the discharge chamber and the rising bubbles lift and push the molten glass toward the discharge port. The rate of discharge can be controlled by the rate of air flow applied. The air lift

provides flexibility in the control of the glass flow from the melter to the gem making machine. The air lift is used to lower the glass level in the melt chamber.

Gem Forming Machine

While feeding is in progress, molten glass inventory will be accumulated in the melting cavity and discharged through the discharge chamber into the gem forming machine. The shape and size of the glass product facilitates containerization and the anticipated final packaging configuration. The gem forming machine consists of a mechanism to break the molten glass stream into droplets which fall onto a conveyor. The gems are air-cooled on the conveyor and fall into a drum. Samples of the glass product will be collected, visually inspected, and analyzed. The operation and mechanical reliability of the system will also be tested.

Off-Gas System

Sources of off-gas are the melter, the film cooler and the VITPP tank vents. The off-gas treatment system consists of a quench tower, scrubber, desiccant tower, radon adsorption carbon beds, HEPA filter, blower, and stack. The carbon beds are included for radon control, and will not be used during VITPP Phase I operation. The melter off-gas is expected to exit at a temperature near 800°C (1472°F). Partial cooling is accomplished by the introduction of compressed air into the film cooler, and by direct heat loss to the surrounding atmosphere. The quench tower is constructed of carbon steel and is designed to receive hot gases from the film cooler and quench them using recycle water. Tower internals consist of stainless steel spray nozzles and/or baffles. The scrubber is stainless steel and removes sulfur oxides with a caustic solution.

During testing, the quench tower and scrubber are monitored for pressure drop, water inventory control, and water temperature rise. The scrubber reagent is sampled once per batch for total dissolved solids to determine salt content in the sump, and alkalinity to determine the reagent consumption. Both of these parameters are measured for process control.

The desiccant tower consists of a desiccant bed to reduce the water content to 15 percent relative humidity. A deliquescent material such as calcium chloride ($CaCl_2$) is used in the desiccant tower to absorb moisture from the off-gas stream. HEPA filtration is the final off-gas treatment process prior to discharge through the exhaust fan and the stack. One HEPA unit is always on-line while the second is maintained in a parallel configuration as a spare to be used during the filter changing process.

During operations, the routinely monitored off-gas parameters and emissions are the volumetric flow rate, the temperature and humidity, the pressure drop through the system, and the heavy metals including chromium, lead, and barium. The volumetric flow rate out the stack is continuously measured for calculation of the emission rate.

In addition, a one time performance test will be conducted during VITPP Phase I operations to evaluate the efficiency of the Best Available Technology (BAT) pollution abatement equipment. The parameters of concern that will be evaluated are the ability to remove lead, barium, chromium, total particulates, and NO_x as nitrogen dioxide.

Wastewater Treatment System

The wastewater treatment system is sized to handle approximately 38 lpm (10 gpm) of wastewater (containing suspended solids and dissolved salts) on an intermittent basis as required. Treatment consists of a multimedia, deep bed, pressure filtration system., and a radon sparge tank that will be added after Phase I operation has been completed, but prior to Phase II operation. Water is removed from the process mostly through the recycle water tank and the wastewater filters; but some is also removed by the off-gas system in the form of condensed water vapor that exits the melter. For Phase I, removal of suspended solids is the only item requiring pre-treatment of this water; therefore, Phase I treatment will consist only of a multimedia pressure filtration system.

The ability of the filter to successfully handle the BentoGrout® clay must be determined. Two filters are included and installed in parallel so one is available when the other is being backwashed. Backwash from the filter is directed to the thickener tank. The filtered water is pumped to the existing High Nitrate Tank. The Advanced Wastewater Treatment System (AWWTS) receives the effluent from the High Nitrate Tank. This wastewater stream will be characterized to determine the appropriate means of treatment in the site AWWTS with the treated effluent being discharged under the site National Pollutant Discharge Elimination System (NPDES) permit.

As previously noted, a radon stripping system will be added after Phase I has been completed. This system consists of a sparge pipe that is housed in a heated sparge tank, a circulation pump, and a supply of compressed air. The sparge tank vents to the desiccant tower. Operation consists of introducing compressed air into the sparge pipe while operating the tank heaters and the circulation pump. The purpose of this system is to reduce the concentration of dissolved radon that will exist in the wastewater

prior to discharge to the High Nitrate Tank. The ability of the radon stripping system to remove radon from the wastewater will be determined as part of the Phase II testing.

Cooling Water Systems

Two cooling water systems are included in the design; a small capacity system to cool the melter electrode holders, and a larger recycle water system that services the quench tower and the gem forming machine.

The electrode holders are cooled using a closed loop system that includes a pump, a surge tank, and an air cooled, finned heat exchanger that is serviced by a fan. The system operates at a fixed flow rate that is set manually.

The main cooling water system includes two loops that circulate through a shell and tube heat exchanger. The heat exchanger, which has a design heat transfer rate of 2 million BTUs/hr, provides cooling water to the quench tower via the tube side loop which includes the thickener and the recycle water tank. The shell side loop, which circulates through a galvanized steel cooling tower, includes a side stream that cools vitrification equipment components, primarily the gem forming machine. Chilled water, which exits the cooling tower at a design rate of 760 lpm (200 gpm) is pumped to the heat exchanger at a design rate of 494 lpm (130 gpm), leaving 266 lpm (70 gpm) for vitrification equipment cooling.

Cooling tower water will be sampled once per week to determine the buildup of soluble salts and the proper amount of treatment chemicals required. Treatment chemicals for the cooling tower water are: 1) phosphate, 2) calcium sulfate dispersant, and 3) biocide.

Distributed Control System

Process operations are controlled from the control room via the Distributed Control System (DCS).

The control system also gathers data from the vitrification operations for display on screens in the control room. Likewise, control devices [valves, dampers, pumps, motors, and Silicon Control Rectifiers (SCRs) for melter electrodes] have their status displayed.

2.3 CONSTRUCTION ACTIVITIES

Construction activities include the following construction work packages and support services:

- 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

Construction activities are deemed complete when Construction Acceptance Testing (CAT) has been completed, and the facility is turned over for startup testing and operations. These tests address the functionality of individual equipment items and components. These tests are done in accordance with the Construction Acceptance Testing Plan (18-CP-0010).

2.4 SYSTEMS OPERABILITY TESTING

Following the completion of CAT, Systems Operability Testing (SOT) will commence. The SOT activities are conducted per an approved SOT Plan (18-SU-0002) which identifies the systems and equipment that require systems operability testing, and describes the planning, execution, and documentation of those tests.

The SOT Plan defines an extensive list of checkout activities. The following activities are addressed in the SOT Plan:

A. The Thickener Tank is filled, the tank level indications and alarms, and the overflow to the Recycle Water Tank is tested. The Thickener Rake Mechanism and torque control is tested. Each Residue Slurry Pump is tested in both the recycle and feed forward modes. The function of the density controls is verified. Water is transferred to the Slurry Tanks.

B. The Flocculant Additive Tank level and flow instruments, agitator, and addition pump are tested.

C. The Recycle Water Tank level indications and alarms are checked. Both Recycle Water Pumps are tested.

D. Both Slurry Tanks are filled and agitators tested. Level, weight, and flow instruments are checked. Both slurry diaphragm pumps are tested in both the melter feed and the recirculate mode of operation.

E. The Additive System rotary airlocks and diverters are tested. The Vacuum Blower and Bag Dump Station are tested. Filter/Receiver level instruments are tested.

F. The Quench Tower is tested with recycle water pumped to the spray heads, and the flow and level controls and alarms are tested. The level instruments and alarms are tested. The Quench Tower Pumps are tested. Water is pumped through the Heat Exchanger and to the Thickener.

G. The Scrubber is filled with water and the level instruments and alarms are tested. Both Scrubber Recirculation pumps are tested.

H. The Caustic Addition Pump is tested.

I. The Off-Gas System exhaust fan is operated, the flows are balanced, and the flow control is tested.

J. The Desiccant Tower level indications and alarms are tested. The Desiccant Condensate Tank instruments and pump are tested.

K. Pressure drops across the Carbon Beds and the HEPA Filters are tested. The valves for flow path selection are tested.

L. Melter SCR controls are tested to the extent possible without heating up the Melter. Melter pressure control is tested. Melter level alarms are verified. Temperature alarms and controls are checked. The Melter Utility Rack water and air instruments and controls are tested. The Melter Feed Pump is tested and calibrated with water.

M. The Gem Machine Gob Cutter and Gob Roller speed controls are functionally tested. The startup and emergency diverters are tested. The Gem machine air and water cooling systems are tested.

N. The Gem Container Handling Conveyor equipment and controls are tested. Motor drives are tested in foreword and reverse operation.

O. The Cooling Tower level instruments, freeze protection, and fan operation are tested. Water is pumped through the Heat Exchanger and flow is tested.

P. Wastewater Filter forward and backflush operation are tested. The Wastewater Filter pressure and flow controls are tested.

Q. The Spare Storage Tank level alarms and pump operation are tested.

R. Pilot Plant Sump Systems are tested. Pump operations and level alarms are tested.

S. Building Support Systems are tested. Examples of these systems include Diesel Generator, Air Compressor, Air Dryer, Electrical Systems, HVAC Systems, and Process Water system,

T. 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.

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

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

On successful completion of the SOT, the facility and systems will be ready to commence melter bakeout. The melter will go through a bake-out cycle that is sufficient to condition the refractory brick that is in the melter. This will be followed by charging the melter with appropriate glass frit, and heating sufficient to melt the frit for the purpose of sealing the refractory.

3.0 PERFORMANCE AND DATA QUALITY OBJECTIVES

3.1 OVERALL VITRIFICATION PILOT PLANT PHASE I OBJECTIVE

The overall program objective for Phase I of the VITPP project is to demonstrate the vitrification process and its support systems prior to engaging in the treating of radioactive materials in VITPP Phase II. This will involve the construction and "cold" operation of a pilot scale vitrification facility. VITPP Phase I, and ultimately Phase II, will provide data to support the technologies and methodologies proposed for the remediation of the K-65 and Silo 3 residues and the design of the FRVP.

Section 3.3 of this work plan identifies the VITPP Phase I Data Quality Objectives (DQOs) for sampling activities including soil, water, geotechnical sampling for facility siting and design, and operation of the VITPP equipment using surrogate materials. The DQOs for Section 3.3 were developed using program requirements from the EPA approved FEMP Sitewide CERCLA Quality Assurance Project Plan (SCQ), (DOE 1993b) and other EPA treatability guidance. Optimum process parameters for the treatability of K-65 and Silo 3 material will be identified in VITPP 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 process and operability. The objectives have been developed to obtain the information necessary for successful VITPP Phase II testing and ultimately for the design and construction of a final remediation facility operating at a production rate of approximately 20 metric tons (22 tons) per day.

Both general and equipment specific objectives will be addressed. The performance objectives for the key equipment items is shown in Table 3-1.

The specific tests that will be conducted during VITPP Phase I to verify performance are addressed in the VITPP Phase I Test Plan (FERMCO 1995b).

TABLE 3-1
PERFORMANCE OBJECTIVES

TEST COMPONENT	PERFORMANCE OBJECTIVE
Thickener	Underflow: $\geq$50 wt percent solids. Overflow: $\leq$1 wt percent solids
Slurry Tanks	$\geq$60 wt percent solids.
Melter	1,050-1,400 °C (1,922-2,552°F) $\pm$50°C. 1.0 Metric tons/day (average); determine maximum rate
Product Forming Machine	1-3 metric ton/day per 24 hours
Glass Product	Pass TCLP metals limits. $\geq$50 percent volume reduction.
Quench Tower	Reduce off-gas temperature to $\leq$38°C (100°F).
Scrubber	$\geq$99 percent efficient SO_x
Desiccant Tower	$\leq$15 percent relative humidity.
HEPA Filter	$\geq$99.97 percent efficient particulate removal of 0.3M particles.

000050

3.2.1 General

1. Verify VITPP process operability on nonradioactive surrogate feed materials. This will provide the level of confidence required to operate the VITPP in Phase II and also will serve as a proving ground for developing Test Personnel operating experience.

2. Perform test activities in a safe manner such that the results will provide the data necessary to support VITPP Phase II testing and the design of the final remedial facility for OU4.

3. Perform a series of test campaigns that process and treat K-65 surrogate and Silo 3 surrogate formulas which are projected for Phase II testing. The use of surrogates in Phase I, which are chemically similar to the anticipated materials to be processed in VITPP Phase II, will improve the probability of success during Phase II operation.

3.2.2 Pilot Plant

1. Determine process parameters for VITPP Phase II testing while processing surrogate material during VITPP Phase I. By using surrogate materials, the process parameters should be applicable to VITPP Phase II operation.

2. Validate the performance and integration of the Standard Operating Procedures with the VITPP operation and the performance with the Test Plan. This will enhance the stable operation of the VITPP in preparation for VITPP Phase II testing.

3.2.3 Feed Preparation and Transfer

1. Target $\geq$50 wt percent solids content, with K-65 Surrogate and BentoGrout®, in the underflow from the thickener using a flocculant additive as necessary. (A decrease of solids content (<50 wt percent) will result in an increased off-gas volume from the excess water and a reduced glass output, both undesirable from an efficiency standpoint.)

2. Achieve sufficiently low solids content ($\leq$ 1 wt percent), with K-65 Surrogate and BentoGrout®, in the overflow from the thickener for satisfactory reuse at the thickener, quench tower, and heat exchanger. The performance of the thickener and flocculant system is critical to the recycled water system for off-gas cooling, batch blending, and mining.

3. Demonstrate consistent transfer of the thickened solids slurry to the two slurry tanks.

4. Demonstrate pneumatic transfer of actual additive materials to the two slurry tanks.

5. Demonstrate successful slurry mixing and formula matching in the two slurry tanks.

6. Successfully recirculate slurry in the slurry tank.

7. Successfully regulate the transfer of blended slurry to the melter for vitrification.

3.2.4 Melter

1. Ensure that the melter operation is controlled, monitored, and documented as required in order to evaluate the following related items:

   a. Redox state in the melter.
   b. Melter retention time for each formula campaign.
   c. Glass resistivity/conductivity.
   d. Glass behavior during glass forming operation.
   e. Electrode consumption rate and cause of any erosion.
   f. Document the melter performance at a 1 metric ton per day production rate.
   g. Document the melter maximum performance. Document limiting factors of systems or components as they relate to melter performance.

These items will be revisited during Phase II testing. Therefore, Phase I testing results will provide a basis for the control of the melter in Phase II.

2. Validate the optimum glass formulation for surrogate material loading developed during bench scale testing at the VSL, i.e., lowest possible temperature with workable viscosity and electrical conductivity, and maximum surrogate material loading. This will provide relative waste loading information for the Phase II operation with respect to the glass formulation.

3. Demonstrate control of melter operation to include temperature control, electrode current/voltage/cooling control, slurry feed control, glass level control, glass airlift control, and off-gas control.

4. Demonstrate melter ability to produce 1 metric ton of glass per 24 hour day for a continuous 36 hour period. This is required to satisfy the melter acceptance test that is specified in the procurement documents.

5. Demonstrate the ability of the melter to control, balance, and maintain the flow of molten glass from the melter.

3.2.5 Gem Forming Machine

1. Demonstrate the operation of the product forming machine in the ability to continuously produce glass gems for an eight hour period at the rate of 1 metric ton of glass per 24 hour day and the conveying of the gems to storage containers. This is required to satisfy the gem forming machine acceptance test that is specified in the procurement documents.

2. Demonstrate the operation of the product forming machine discharge chute diverter while molten glass is being produced by the melter. These chutes are required to be operated in the event that the gem cutter rollers are to be bypassed for maintenance or for monolith pours.

3. Demonstrate the operation logic functions for the gem forming machine.

3.2.6 Off-Gas System

1. Obtain design performance data of the off-gas system and maintain air flow balance.

2. Achieve temperature that is within design limits of the off-gas $<38^{o}C$ ($100^{o}F$) from the quench tower and for the quench tower bottoms discharge to the heat exchanger during slurry feed to the melter.

3. Maintain a caustic concentration of 5-10 wt% for scrubber operation using caustic solution and the caustic metering system. Ensure that the net pressure drop for the off-gas through the scrubber is within design limits.

4. Remove >99 percent SO_x from the off-gas through the scrubber.

5. Confirm that the HEPA filtration system removes 99.97% of particulates that are larger than 0.3 microns in diameter.

3.2.7 Recycle Water System

1. Demonstrate wastewater filter operation, to include filtration of discharge water, transfer of water to the building sump and transfer of the water to the High Nitrate Tank, wastewater filter backflush operation, and reseating of wastewater filter filtration material. Ensure that during this operation the melter glass production is not interrupted.

2. Demonstrate a balance of recycle water system operation as a function of thickener water overflow balance, quench tower water supply, and slurry line flushing operations.

3. Collect data to document and anticipate the buildup rates of dissolved solids in the recycle water system during melter operation.

3.2.8 Cooling Water Systems

1. Demonstrate proper operation of the main cooling water system to include cooling tower heat dissipation, heat exchanger heat transfer, and gem forming machine heat removal.

2. Demonstrate proper operation of the air cooled cooling water system to include heat dissipation by the fan, finned heat exchanger heat transfer, and electrode holder heat removal.

3.2.9 Building Sump System

1. Demonstrate the operation of the plant sump tank and pumps, especially during periods of heavy rainfall.

2. Demonstrate via SOT, the operation of the spare storage tank and pump in the ability to support the VITPP processes during melter production.

3.2.10 Process Sampling

1. Demonstrate test sampling and monitoring of exhaust stack equipment during melter slurry feed.

2. Validate the performance and integration of the Project Specific Plan (PSP) for process sampling with the VITPP operation as outlined in the Test Plan. Ensure that minimum sample result turn-around-time is achieved. This will enhance the stable operation of the VITPP in preparation for VITPP Phase II testing.

3. Verify that the Sampling Procedures tested in VITPP Phase I testing support data to be gathered are appropriate for obtaining samples during VITPP Phase II testing. This will aid in the identification of any possible problem areas that could potentially impact gathering samples during VITPP Phase II testing.

4. Demonstrate successful sample retrieval from all sample points. (NOTE: There is one exception; the line between Silo 2 and the thickener will not be used during Phase I and the sample port may be relocated prior to use.)

3.2.11 Data Acquisition

1. Demonstrate automatic and manual data collection to obtain predetermined data points for evaluation, correlation, and trend reporting.

3.3 DATA QUALITY OBJECTIVES

Environmental sampling and analysis identified in the DQOs will be implemented consistent with the "Project Specific Plan for Operable Unit 4 Vitrification Pilot Plant Phase I Process Sampling" (DOE 1995d). Sampling and laboratory analysis will be performed in accordance with applicable sections of the SCQ.

Preconstruction activities require geotechnical sampling to determine soil data such as soil classification, moisture content, specific gravity, grain size analysis, Atterberg Limits, consolidation, California Bearing Ratio, and maximum density. Data from this sampling and testing activity were reported with an Analytical Support Level of A (ASL A).

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 metals testing, and visual inspection of the final glass product to determine the optimum operating parameters of the melter; and process offgas sampling utilizing an isokinetic sampler to determine and quantify the particulate emissions during operation and to calibrate the sampler during start-up.

The following three DQOs have been developed for VITPP Phase I sampling and analysis activities; wastewater, off-gas, and product glass. VITPP wastewater will be sampled and analyzed to ensure that the wastewater can be adequately processed by site treatment facilities to meet the FEMP NPDES requirements. Per the DQO for VITPP wastewater, the wastewater will be sampled and analyzed for specific metals, pH, nitrates, and total suspended solids. The analytical results for the metals and nitrates will be reported with an ASL of B (ASL B), and the determinations of pH and total suspended solids will be reported at an ASL of A (ASL A).

Per the DQO for the glass product, the glass will be sampled and analyzed for TCLP and total metals at an ASL of B plus (ASL B+). The density of the glass will be determined at an ASL of A (ASL A). Glass product sampling and analysis supports disposition of this waste stream.

As identified in the DQO for the off-gas, the off-gas will sampled by an isokinetic sampler. The filters will be composited and analyzed for total metals at ASL B. This sampling and analysis supports Waste Management Program's disposal of this wastestream.

4.0 EXPERIMENTAL DESIGN

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 VITPP Phase I testing will simply entail equipment operation, observation, and subsequent process correction. During VITPP Phase I testing, lead, barium, phosphates, nitrates, and sulfates will be added to the surrogate material prior to being fed to the melter to more closely simulate the vitrification of OU4 silo materials.

Details of the VITPP Phase I operational testing are provided in the VITPP Phase I Test Plan (FERMCO 1995b). An overview summary of the planned test campaigns and their objectives is provided in Table 4-1. The initial surrogate recipes will be based on the results of the ongoing GTS Duratek contracted work that is being done at VSL. The VITPP Phase I surrogate campaigns are structured so the necessary data can be captured and evaluated for processing the actual K-65 and metal oxide wastes scheduled for VITPP Phase II testing. This will ensure that the characteristics (e.g., viscosity, conductance, and consistency) of the extrapolated glass formulas are within the capabilities of the pilot scale melter, the empirical glass formulas will be verified with crucible melts and subsequent mini-melter runs. If the glass is determined to have characteristics that indicate poor durability, (i.e., phase separation, or excessive leachability) or improper viscosity or an extreme electrical conductivity at the desired temperature, an adjustment to the formulation will be made.

Initial VITPP Phase I testing will process a benign glass to establish system and subsystem control of the process. Once process stability is achieved and VITPP start-up personnel are comfortable in controlling the processes, nonradioactive surrogate material will be introduced for the remaining VITPP Phase I campaigns. A narrative elaboration of the Table 4-1 information follows.

TABLE 4-1

PHASE I TEST CAMPAIGN OVERVIEW

Campaign #	Objectives, Drivers, and Justification
1	Run benign slurry through melter and establish melter control mode (temperature, current, voltage, or power). The preferred control method is automatic adjustment of power in response to the in-bath thermocouple data. It will be necessary to (1) determine the temperature profile through melter and accuracy of measurements, (2) establish alternate methods of melter control if the in-bath thermocouple is lost, (3) determine delayed temperature response during feed and non-feed conditions, and (4) determine response to mass flow rates of material into and out of the melter. It will be necessary to coordinate the Gem Making Machine operation with that of the melter, (1) confirm that good quality gems can consistently be made at various viscosities and glass flow rates, and (2) balance the Auxiliary Systems with the melter operation. Determine the melter's maximum capacity by slowly ramping up the feed rate and power. Limiting conditions include: (1) melter's electrode current or voltage becomes saturated, (2) the cold-cap's size can not be properly controlled, (3) the quality of the glass degrades, or (4) failure of the Off-Gas System to support the melter throughput.
2	This campaign includes the melter's Acceptance Test and the Gem Making Machine's Acceptance Test per the requirements of the procurement specification. Local (from Control Room) operation of the melter with a prescribed slurry, without problems, for 36 hours is required. The Acceptance Test will be performed using Series D formula. The Series D formula is designed to simulate a realistic, average blend of all the silos' constituents including BentoGrout®. The glass recipe will be formulated for temperatures as specified by VSL bench scale testing. The target melter temperature for this part of the campaign may be varied for data collection or correction of a variant condition, i.e. glass is becoming too thick, foaming or precipitates start to form in glass.
3	This campaign includes the Series C formula that is designed to simulate the vitrification of Silo 3 composition waste. The glass will be formulated and the melter will be operated at temperatures as specified by VSL bench scale testing. The main issues to be addressed include: (1) a high sulfate and phosphate feed material, (2) glass devitrification, (3) acid scrubbing of the off gas, (4) glass product quality, (5) feed rate (melter capacity), and (6) waste loading (percentage). Inconel metal coupons may be placed in the melt for erosion/corrosion testing. The results of this test will be key inputs to FRVP melter design.

Campaign #	Objectives, Drivers, and Justification
4	The main issues to be addressed include: (1) high concentrations of lead and barium in the feed, (2) control of the redox state of the melter, (3) performance of the Thickener and the flocculant addition equipment, and (4) settling rate as a function of BentoGrout® concentration. The Series A formula part of this campaign is to simulate the vitrification of K-65 composition waste. When reducing conditions exist in the glass melt, lead can precipitate as metallic lead or lead sulfide. Settling tests in the Thickener will be performed to determine the rate of settling of the surrogate sand. Flocculant addition equipment testing will occur, and the settling rate for BentoGrout® as a function of flocculant addition will also be determined near the end of this campaign. The Series B formula part of this campaign is designed to simulate the vitrification of a blend K-65 material and BentoGrout® (up to 50 wt%). The glass will be formulated and the melter will be operated at temperatures as specified by VSL bench scale testing. The main issues to be addressed include: (1) the high concentration of alumina in the BentoGrout® which tends to increase the melting point and viscosity of the glass product, (2) glass product quality, (3) feed rate (melter capacity), and (4) waste loading (percentage). Inconel metal coupons may be placed in the melt for erosion/corrosion testing. The results of this test will be key inputs to FRVP melter design.

4.1 CAMPAIGNS

The following are the currently planned campaigns that would establish glass formulations, operating base, and process control assurance prior to proceeding with Phase II testing and processing of actual radioactive wastes. Also, these campaigns are designed to obtain scale-up data to support FRVP design.

4.1.1 Campaign 1 - Benign Glass

Campaign #1 will test the melter and gem forming machine with a nonhazardous batch mix or benign glass immediately following refractory bakeout. Adjustments, correlations, calibrations, and corrections can be made without the hindrances and hazards involved with the surrogate waste glasses. The benign glass formula(s) do not contain hazardous substances (e.g., lead and barium) and will not produce hazardous acid gases (e.g., SO_x and NO_x) like the succeeding surrogate campaigns. The objective of this campaign is divided into three parts.

- Establish Melter Control

  During Part 1 of Campaign #1 the melter and glass melt parameters that can be measured and used as a means of control. The preferred parameter to measure and control is the viscosity of the molten glass in the melter (or molten bath). The next preferred parameter is the temperature of the molten bath. Such measurements will require the placement of thermocouples directly in the bath of the melt. However, this may not be possible after the benign glass run(s) because the melt may be too erosive for the thermocouples to survive. Therefore, indirect temperature measurements may be the best measurements possible for melter control. Transients or pulses will be introduced to determine how well and quickly the transient can be detected and process corrections can be made by the control system to bring the system back to normal conditions. This part of the campaign will determine the best means of control, establish thermocouple calibration, and establish temperature profiles as a function of power settings.

  This campaign provides the opportunity to establish actual bath temperature relationship to the indirect temperature measurements. Since higher temperatures are required to vitrify the surrogates in subsequent campaigns, the thermocouples may erode and dissolve into the glass before an accurate reading can be obtained. The correlation and understanding of in-bath temperatures as they relate to indirect temperatures taken within the melter walls are absolutely necessary to confirm that control of the melter can be maintained.

- Synchronize Operation of the Melter and Gem Forming Machine.

Part 2 of Campaign #1 will establish and demonstrate that feed preparation, sampling, analysis, melter operation, and gem making can be coordinated and sustained at the minimum production rate of one metric ton/day glass output.

Synchronization of the melter with all the peripheral systems is required early in Phase I testing for Test Coordinators to understand what is required to stabilize operations and operate the facility as a complete system. Synchronization steps will be checked against operating procedures as a method to finalize procedures. Step-by-step actions will continuously be revised throughout VITPP testing. However, initial controls of the process need to be as fully understood as practicable, and the best method to do this is by hands-on experience with the operation.

- Ramp Operations Up To 3 Metric Tons/day Glass Output.

Preliminary indications are that the off-gas system may not be able to handle melter production rates over one metric ton/day. If so, the only time the melter can be run at maximum operating capacity is during a benign glass run when no hazardous gases are produced. A determination of the maximum operating capacity of the melter is extremely important information for FRVP design. Ramp-up will be Part 3 of Campaign #1. This information will be used as input to determine the full-size remedial melter(s) size and design.

To achieve steady-state equilibrium, the melter needs to be sustained at this rate for a few days. This is due to the fact that it may take days for the new temperature profiles to stabilize through-out the melter (e.g, because of the ,melter's large mass and insulation). Restrictions that may impact determining the true melter capacity are analytical turn-around times and off-gas system capacity. The slurry mix tanks only hold enough feed to produce approximately one metric ton of glass. Therefore, FERMCO must be capable of preparing and analyzing three batches of feed per day (one per shift) to support this run. The thickener tank will not be used during this campaign. The surrogate and additives will be pneumatically transported to the filter/receiver which discharges directly into the slurry tanks. The auxiliary off-gas routing of the off-gas system will be used for off-gas treatment during Part 3 to eliminate potential down-stream process bottlenecks in the primary off-gas system.

In order for Campaign #1 to be successfully completed, the capabilities of the melter and gem forming machine must be known and the overall vitrification process kept under control.

4.1.2 Campaign 2 - Series D Glass Formula

- Equipment Acceptance Testing. During Campaign #2 the melter and gem forming machine acceptance test will be performed. This testing will be performed according to the FERMCO approved Acceptance Test Plan per the melter and the gem forming machine procurement specifications and the contracts with GTS Duratek. The formulation prescribed is for Series D glass as determined by results from VSL bench scale testing. Campaign #1 will demonstrate that the melter and gem forming machine can melt glass at the prescribed rate. However, it does not demonstrate that the melter can "vitrify" wastes or simulated wastes. This campaign will demonstrate that the melter is capable of vitrifying this Series "D" formula feed material. The specification requires 36-hours of continuous operation of the melter to complete the test and 8-hours Acceptance Test of the gem forming machine. It will take approximately three melter volumes to flush the melter bath before the melter actually contains the surrogate waste and the 36-hour test can begin. To help ensure compliance with the test specifications and the prescribed glass formula, the thickener tank will not be used during this campaign. To run this test and the following campaigns, the off-gas system has to be fully functional with the exception of the radon removal system.

  There is a potential for sulfate salts to form a top layer within the melter bath. However, neither this campaign or any other Phase I campaign includes testing of the sulfate drain to demonstrate a functional solution to an accumulation of molten sulfate salts. In the event that a sulfate layer forms and causes process problems, a determination will be made to operate the drain as an off-normal condition.

- Following the completion of the melter and gem machine Acceptance Test, Campaign #2 will further process the Series D glass formulating to test the melter efficiency under normal operating conditions.

4.1.3 Campaign 3 - Series C Glass Formula

The purpose of Campaign #3 is to collect the data and to establish the operating conditions to control the high sulfur, nitrate, and phosphate content feed. This campaign will demonstrate:

- The effects of sulfate, nitrate, and phosphate on the melter and glass formula;
- SO_x and NO_x handling capabilities of the off-gas system;
- Devitrification potentials of the glass formula and glass product.

Feed preparation will not include the operation of the thickener tank. Ingredients will be transferred pneumatically to the slurry tank as dry feed via the additive transportation system. Water will be added to the batch to form a slurry (~50 wt% water) that can be pumped to the melter.

Campaign #3 will also collect the data and establish the operating conditions to control the high sulfur, nitrate, and phosphate content of feed, and to observe and evaluate Inconel as an electrode material.

Inconel-690® metal coupons will be placed in the melter bath to simulate the electrodes of a low-temperature melter. The major concern with this part of the campaign is that destruction of sulfates at lower temperatures may not be possible. However, if the sulfates are destroyed and the coupons remain intact (little or no erosion), a low-temperature melt design may be possible at less capital and operating costs. Also, easier scale-up and fewer melters may be possible with further reductions in capital costs. To help ensure compliance with the test requirements and the prescribed glass formula, the thickener tank will not be used during this campaign.

4.1.4 Campaign 4 - Series A/Series B Glass Formula

The purpose of Campaign #4 is to further collect data and establish the operating conditions that are required to control high lead and barium content feed (both with and without BentoGrout® additions), to observe and evaluate alternate (Inconel and platinum) electrode materials, and to demonstrate operation of the thickener (both with and without BentoGrout® additions). Campaign #4 is the only campaign where the thickener tank will be used.

The focus of the Series A formula portion of Campaign #4 is to collect the data and to establish the operating conditions that are required to control high lead and barium content feed. Operation of the

thickener will be initiated with Series A glass formula prior to the addition of BentoGrout® for the Series B portion of this campaign.

While the Series A surrogate will be placed in the thickener tank, the lead, barium, and water soluble constituents will be introduced in the slurry mix tank(s). Powdered sand (silica) will be purchased to approximate the particle size of the silo waste. The surrogate will then be pumped from the underflow of the thickener tank to the slurry tank as a 40 - 50 wt% solids slurry. Additives will be introduced at the slurry tank to adjust the batch to the predetermined recipe composition prior to feeding to the melter for vitrification.

During the Series B portion of Campaign #4, BentoGrout® will be added to ramp-up the BentoGrout® mix in the thickener tank from an initial 10% to approximately 50% BentoGrout® by weight. BentoGrout® is considered to be the most difficult constituent in the silo wastes for the thickener tank to handle. The purpose of this part of the campaign is to collect the data and to establish the operating conditions that are required to control the BentoGrout® that is included in the feed.

Settling of the BentoGrout® during the thickener operation will be aided by a flocculant that is added to the thickener slurry. The BentoGrout® contains alumina which drives up the melting point and viscosity of the glass melt. The surrogate will be pumped from the underflow of the thickener tank to the slurry mix tank as a 40-50 wt% solids slurry. Additives and fluxes (sodium carbonate and calcium carbonate) will be added to the glass formulation to adjust the batch to the predetermined recipe composition and to lower the glass melt's temperature and viscosity. Adjustments for conductivity may need to be made to be compatible with the melter.

Inconel-690® coupons will be placed in the melter main chamber to simulate the electrodes and thermocouples of a low temperature melter. The coupons will be retrieved and analyzed to determine the effect of the glass formulation on these materials. Since platinum is already present as a thermocouple material, platinum coupons are not required. The major concern is that destruction of sulfates at lower temperatures may not be possible, therefore the status of the sulfates will be closely monitored during the campaign. If the sulfates are destroyed and the coupons survive with little or no erosion or deterioration, then a low temperature melter may be considered for the FRVP allowing for easier scale-up with fewer melters for a considerable savings in capital and operating costs.

Table 4-2 provides a campaign summary.

TABLE 4-2
PHASE I CAMPAIGN SUMMARY

CAMPAIGN	SILO WASTE SURROGATE
0. melter Bakeout	N/A
1. Benign Glass Part 1: Establish Melter Control Part 2: Synchronize Operation of the Melter and Gem Forming Machine Part 3: Ramp Operations up to 3 Tonnes/Day Glass Output	N/A
2. Series D Glass Formula* Part 1: Vendor Acceptance Test Part 2: Melter Efficiency Test	Silo 1, Silo 2 and Silo 3 with 10% BentoGrout®
3. Series C Glass Formula*	Silo 3
4. Series A Glass Formula* Series B Glass Formula*	Silo 1 and Silo 2 Silo 1 and Silo 2 with varying amounts of BentoGrout®

* The Series A, B, C,and D Glass formulas represent the optimized formulation based on VSL, Bench Scale Testing at the Catholic University. Melter operating temperatures will be as specified by VSL for each series glass formulation.

5.0 EQUIPMENT AND MATERIALS

5.1 MAJOR EQUIPMENT ITEMS

Table 5-1 provides a list of the major equipment items that have been installed to support the VITPP Phase I testing.

TABLE 5-1

VITRIFICATION PILOT PLANT - PHASE 1 EQUIPMENT LIST

EQUIP NO.	DESCRIPTION	QTY	HP	SPEC (RHN-)	CAPACITY
5-TK-01	THICKENER TANK	1		02-40-010	24,000 GAL
5-TH-02	THICKENER MECHANISM & RAKES	1	5	02-40-002	30 FT DIA
5-FL-03A,B	WASTEWATER FILTER	2			10 GPM
5-PM-04A	RESIDUE SLURRY PUMP - THICKENER	1		02-40-004	40 GPM
5-PM-04B	PUMP - INSTALLED SPARE	1		02-40-004	40 GPM
5-AG-05A	SLURRY TANK AGITATOR	1	5	02-40-005	
5-AG-05B	SLURRY TANK AGITATOR	1	5	02-40-005	
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
5-PM-09B	PUMP - INSTALLED SPARE	1	75	02-40-009	130 GPM
5-TK-10	RECYCLE WATER TANK	1			5,800 GAL
5-FU-17	VITRIFICATION MELTER	1		02-40-062	1-3 MTON/DAY
5-VL-18	DIVERTER VALVE - ADDITIVES	1		02-40-018	6000 LB/HR
5-RN-19A,B	CARBON BED VESSEL	2		02-40-019	250 SCFM
5-DH-21	DESICCANT TOWER	1	5	02-40-021	250-500 SCFM
5-PM-23A	QUENCH TOWER PUMP	1	3	02-40-009	60 GPM
5-PM-23B	PUMP - INSTALLED SPARE	1	3	02-40-009	60 GPM
5-BF-24	PRODUCT FORMING MACHINE	1	2	02-40-063	1-3 MTON/DAY

TABLE 5-1 (Cont.)

VITRIFICATION PILOT PLANT - PHASE 1 EQUIPMENT LIST					
5-FA-25	EXHAUST FAN (VIT. OFF GAS)	1	10	02-40-025	250-400 SCFM
5-CT-26	COOLING TOWER	1	5	02-40-026	200 GPM
5-HE-27	HEAT EXCHANGER	1		02-40-027	300 SQ. FT
5-PM-28	COOLING TOWER PUMP	1	10	02-40-009	220 GPM
5-TK-29A,B	SLURRY TANK (VITRIFICATION)	2		02-40-029	700 GAL
5-TF-30	TRANSFORMER	1		16311	2000 KVA
5-SG-31	HIGH VOLTAGE SWITCHGEAR	1		16311	600 AMP
5-SG-32	LOW VOLTAGE SWITCHGEAR	1		16311	3200 AMP
5-MC-33A,B	MOTOR CONTROL CENTER	2		16842	600 AMP
5-PM-34A,B	SLURRY TANK PUMP	2		02-40-004	40 GPM
5-FL-37	EMERGENCY OFF-GAS HEPA	1		15885	615 CFM
5-FC-40	FLOCCULANT ADDITIVE SYSTEM	1	1	02-40-040	0-5 GPM
5-CN-41	MELTER ROOM MONORAIL	1		02-40-041	2 TON
5-GE-43	EMERGENCY GENERATOR	1		02-40-043	150 KVA
5-CM-44	AIR COMPRESSOR	1	60	02-40-044	500 SCFM
5-BH-46	CONTAINERIZING EQUIP. (DRUMS)	1			1-3 MTON/DAY
5-CS-47	DATA ACQUISITION & CONTROL	1			1200 PTS
5-FL-48A	HEPA FILTER - (VIT. OFF-GAS)	1		18-TS-148	250-500 SCFM
5-FL-48B	HEPA - INSTALLED SPARE	1		18-TS-148	250-500 SCFM
5-PM-50A	BUILDING SUMP PUMP	1	1		30 GPM
5-PM-50B	PUMP - INSTALLED SPARE	1	1		30 GPM
5-TK-56	SPARE STORAGE TANK	1			24,000 GAL
5-PM-57	SPARE STORAGE TANK PUMP	1		02-40-057	90 GPM
5-PM-58	SPARE STORAGE CONTAIN. PUMP	1	5		100 GPM
5-BG-64	BAG DUMP STATION - ADDITIVES	1		02-40-064	6000 LB/HR
5-DC-65	FILTER/RECEIVER - ADDITIVES	1		02-40-065	6000 LB/HR

TABLE 5-1 (Cont.)

VITRIFICATION PILOT PLANT - PHASE 1 EQUIPMENT LIST					
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			6000 LB/HR
5-SC-72	PLATFORM SCALE - ADDITIVES	1			330 LB
5-SU-74	BUILDING SUMP TANK	1			700 GAL
5-FL-85A,B	BUILDING HVAC HEPA	2		15885	6000 CFM

5.2 FEED MATERIALS

VITPP Start-up will use a benign glass for the initial melter operation. This will be followed by introducing a surrogate feed material. The surrogate feed will be formulated from the chemical compounds that are listed in Table 5-2. The table includes both the chemical formula and the common name for most of the compounds that are listed.

TABLE 5-2

SURROGATE FEED CONSTITUENTS	
CHEMICAL FORMULA	COMMON NAME
Al_2O_3	Alumina
H_3BO_3	Boric Acid
$BaSO_4$	Barium Sulfate
$CaCO_3$	Calcium Carbonate
$CaSO_4$	Calcium Sulfate
Fe_2O_3	Rust
$Fe_2(SO_4)_3$	Iron Sulfate III
KNO_3	Potassium Nitrate
$MgSO_4$	Magnesium Sulfate
$Mg_3(PO_4)_2$	Magnesium Phosphate
MnO_2	Manganese Dioxide
$Na_2B_4O_7$	Borax
Na_2SO_4	Sodium Sulfate
Na_2CO_3	Sodium Carbonate
$NaNO_3$	Sodium Nitrate
NiO	Nickel Oxide
PbO	Lead Oxide
SiO_2	Silica Sand, 200+ Mesh
SiO_2	Silica Sand, 120-140 Mesh
SiO_2	BentoGrout®
V_2O_5	Vanadium Pentoxide
ZrO_2	Zirconium Oxide
Co_2O_3	Cobalt Oxide
–	Potato Starch

6.0 SAMPLING AND ANALYSIS

6.1 PRECONSTRUCTION SAMPLING AND ANALYSIS

Geotechnical sampling was performed in the proposed construction location to determine soil characteristics. The geotechnical data were used to define foundation and construction 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. This information is contained in a subcontractor, issued report (ATEC Associates, Inc. 22-03-92-00024).

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

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

The soil was characterized based on a statistical analysis of the data from the analyses of the samples identified in site media sampling plan 93-278. Also the historical data from soil borings in the vicinity of the utility tie-in area were retrieved from site data sources. The data were analyzed, and a characterization summary was issued as an internal memorandum [M:ESH:(EP):94-0049]. Only one non-radiological constituent was detected in the sample population, that being methyl ethyl ketone (MEK) at a statistical mean of 0.11 ppm. All detection limits for non-radiological analytes were well below the regulatory levels. Activity levels for radioactive isotopes were reported at 2.8 pCi/g or lower (statistical mean).

The following excerpts of text from the Process Knowledge File Narrative for this project concluded:

Soils generated from project activities will come from a relatively large area which includes the pilot plant location itself, the immediate ground around the access road leading to the silos, and the utility tie-in locations in the vicinity of the intersection of "A" and "2nd" streets. Facilities in the vicinity of these locations did not historically work with materials or processes which would have caused surrounding soils to contain listed wastes through spills or other application to the ground. A review of existing spill report data for the areas in question showed no reason to suspect the presence of hazardous substances in the soil. The only surface unit in the vicinity of the project area is the Bio-Surge Lagoon. Material from the Bio-Surge Lagoon has been characterized under MEF 1532. ..... and .....

All waste material projected to be generated from the project operations is determined to be RCRA non-hazardous. The projected waste streams for this project match the material and regulatory profiles documented in the Material Evaluation Forms (MEFs) contained in the project file. .....

However, since the revelation of preconstruction unknowns is always possible, the following caveat from the Sampling and Analysis Narrative text concluded:

Radiological sampling and/or survey may be required at the time of shipment to a disposal facility at the discretion of Radiological Assessment.

6.2 START-UP AND OPERATIONAL SAMPLING AND ANALYSIS

Phase I samples will be collected during start-up and operation of the VITPP to generate physical and analytical data for four purposes: process control of the VITPP, support design of the FRVP, demonstrate compliance with regulatory requirements, and the development of reports.

The most common sampling and analysis activity during VITPP Phase I Start-up and Operations will be for percent solids. 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.

The glass products will be sampled at least once per batch and more frequently during early operations. The products will be visually inspected for a "glassy" well-vitrified appearance and for evidence of phase

separation. Visual examination of fractured specimens will provide clues as to the uniformity of the glass product. In addition, TCLP analysis will be conducted to evaluate leachability.

Isokinetic samples 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, and total particulates will be determined. Although no radionuclide particulates will be present during VITPP Phase I, the isokinetic sampler will be calibrated and tested under operating conditions in preparation for VITPP Phase II operation. Because metals that fall under the jurisdiction of the Resource Conservation and Recovery Act (RCRA) are present in the feed material and chromium is present in the melter's fire brick, particulates from the isokinetic sampler will be analyzed, on a one-time basis, for these constituents.

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. Specific sampling points, media, rationale, and frequency are listed in Table 6-1.

6.3 SAMPLING METHODOLOGY

The PSP has been developed to support the Operable Unit 4 VITPP Phase I Treatability Study. The PSP outlines the sampling and analysis of nonradiological surrogate material (consisting of silty or washed sands, BentoGrout®, and additives to simulate the non-radiological components of the silo residues), recycle water, off-gas filters, and the vitrified glass to be produced in the VITPP during Phase I Operations. The PSP identifies analytical parameters and associated sample volumes, container-types, preservatives, quality control samples, ASL requirements, and hold times. Sampling will be conducted at a minimum of 15 sample port and monitoring locations in the process. Sampling procedures will identify and address safety hazards associated with each sampling location. All field activities shall be driven by field level procedures which will identify the appropriate personal protective equipment (PPE) and other safety requirements. The sample port locations are shown in Figure 2-2.

The sampling and analysis activities that are specified in the PSP support the VITPP Phase I Treatability Study by providing analytical results to support the demonstration of the pilot plant equipment as well as the vitrification technologies and methodologies being proposed for the remediation of the K-65 and Silo 3 residues. In addition to the samples that are taken to support VITPP process control and the FRVP design, samples are required to demonstrate compliance with regulatory requirements. Environmental sampling and analysis will be performed on the glass product, the wastewater, and the off gas.

TABLE 6-1

SAMPLING AND ANALYSIS DURING VITRIFICATION PILOT PLANT PHASE I				
SAMPLE PORT	**SAMPLING MEDIA**	**ANALYSIS**	**RATIONALE / OBJECTIVE**	**FREQUENCY**
S1	Waste Water Filter Effluent	Total Metals	Provide AWWT information	1/week
		pH	Provide data for FRVP designers	1/week
		Nitrates		1/week
		Total Suspended Solids and Size Distribution		1/week

000073

TABLE 6-1 (Cont.)

SAMPLING AND ANALYSIS DURING VITRIFICATION PILOT PLANT PHASE I				
SAMPLE PORT	SAMPLING MEDIA	ANALYSIS	RATIONALE / OBJECTIVE	FREQUENCY
S3	Slurry in the Thickener Line to the Slurry Tanks	Percent Total Solids	Measure Thickener Performance	1 to 10/Batch
		Percent Suspended Solids		1 to 10/Batch
		Particle Size Distribution		1 to 10/Batch
		Largest Particle Density	Provide data for FRVP designers	1 to 10/Batch
		Density		1 to 10/Batch

000074

222

TABLE 6-1 (Cont.)

SAMPLING AND ANALYSIS DURING VITRIFICATION PILOT PLANT PHASE I				
SAMPLE PORT	SAMPLING MEDIA	ANALYSIS	RATIONALE / OBJECTIVE	FREQUENCY
S4A/B	Slurry in the Slurry Tanks	Carbonates	Determine type and amount of additives	2/Batch
		Sulfur	Verify glass characteristics with crucible tests	2/Batch
		Total Metals	Verify the batch make up	2/Batch
		Wet Density	Verify 60% solids	2/Batch
		Soluable Nitrates		1/Batch
		Nitrates		1/Batch
		Percent Total Solids		2/Batch
		Crucible Tests[a]		1/Batch

000073

TABLE 6-1 (Cont.)

SAMPLING AND ANALYSIS DURING VITRIFICATION PILOT PLANT PHASE I				
SAMPLE PORT	**SAMPLING MEDIA**	**ANALYSIS**	**RATIONALE / OBJECTIVE**	**FREQUENCY**
S5	Slurry in the Melter Feed Line	Density	Verify percent solids present within the slurry	1 or 2/Batch
		Percent Total Solids	Provide data for FRVP designers	1 or 2/Batch
		Particle Size Distribution		1 or 2/Batch
		Largest Particle Density		1 or 2/Batch

000076

TABLE 6-1 (Cont.)

SAMPLING AND ANALYSIS DURING VITRIFICATION PILOT PLANT PHASE I				
SAMPLE PORT	**SAMPLING MEDIA**	**ANALYSIS**	**RATIONALE / OBJECTIVE**	**FREQUENCY**
S6	Quench Tower Water	Total Suspended Solids	Determine suspended solids	6/week
		pH	Field determination of pH	1/Shift
		Total Dissolved Solids	Measure buildup of soluble salts in the recycle loop	6/week
		Sulfates		1/Batch
		Nitrates	Monitor the build-up of sulfates and nitrates in the recycle water	1/Batch
		Total Metals	Determine metals for material balancing	6/week

000027

TABLE 6-1 (Cont.)

SAMPLING AND ANALYSIS DURING VITRIFICATION PILOT PLANT PHASE I				
SAMPLE PORT	**SAMPLING MEDIA**	**ANALYSIS**	**RATIONALE / OBJECTIVE**	**FREQUENCY**
S7	Scrubber Reagent	Alkalinity/pH	Density to determine salt content for process control. Design of FRVP.	3/day
		Density		3/day
		Sulfates		3/day
		Nitrates		3/day
		Total Metals		3/day
S10	Glass Gems and Monolith	TCLP Metals	Provide data for FRVP designers Leachability. Material balancing Process control	1/Batch or Glass Population
		Total Metals		1/Batch
		Bulk Density		1/Batch
		Glass output		1/Batch
		Specific Gravity		1/Batch

000078

TABLE 6-1 (Cont.)

SAMPLING AND ANALYSIS DURING VITRIFICATION PILOT PLANT PHASE I				
SAMPLE PORT	SAMPLING MEDIA	ANALYSIS	RATIONALE / OBJECTIVE	FREQUENCY
S12	Exhaust Stack Emissions	Isokinetic Monitoring	Quantify and identify particulates released in the off-gas.	1/Month of Operation
S14	Recycle Water	Percent Dissolved Solids	Measure buildup of soluble salts in the recyle loop	3/day
		pH	Control water chemistry	3/day
		Percent Suspended Solids, Total Metals, and Size Distribution	Determine thickener effectiveness Metals for material balancing	3/day
		Sulfates	Monitor the build-up of nitrates and sulfates in the recycle water	1/Batch
		Nitrates		1/Batch
		Total Metals		6/week

000079

TABLE 6-1 (Cont.)

SAMPLING AND ANALYSIS DURING VITRIFICATION PILOT PLANT PHASE I				
SAMPLE PORT	SAMPLING MEDIA	ANALYSIS	RATIONALE / OBJECTIVE	FREQUENCY
S15	Cooling Tower Water	Total Dissolved Solids	To determine buildup of soluble salts in the recycle loop	1/week
		Water Chemistry	Adjust Water Chemistry	1/week
		pH		1/week
		Total Suspended Solids	To determine build up of insolubles in the cooling water.	1/week
S16	Thickener Overflow	Percent Suspended Solids	To measure the thickener effectiveness	3/day
		Percent Dissolved Solids	To determine the buildup of soluble salts in the recycle loop	3/day
		Particle Size Distribution	To measure the thickener effectiveness	3/day

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222

TABLE 6-1 (Cont.)

SAMPLING AND ANALYSIS DURING VITRIFICATION PILOT PLANT PHASE I				
SAMPLE PORT	SAMPLING MEDIA	ANALYSIS	RATIONALE / OBJECTIVE	FREQUENCY
S17	Building Sump Effluent	Total Metals		1/week
		Nitrate		1/week
		pH		1/week
		Total Dissolved Solids		1/week
		Total Suspended Solids		1/week
S20	Spare Storage Tank	To Be Determined		As necessary

a - A crucible test includes measuring the electrical conductivity, viscosity, and liquidus of the molten glass.

000031

The regulatory drivers for sampling are:

- Resource Conservation and Recovery Act (RCRA)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- National Pollutant Discharge Elimination System (NPDES) Permit
- Ohio Administrative Code (OAC) 3745-1-07; 3745-31-05(A)3
- Ohio Revised Code (ORC) 3704.01-.05
- Occupation Safety and Health Act (OSHA)
- Hazardous Materials Transportation Act (HMTA)
- EPA "Guide for Conducting Treatability Studies under CERCLA, "Final, (EPA/540/R-92/071a, October 1992, and OSWER Directive No. 9380.2-10, November 1992.)

Sample collection procedures and sample quantities will be in accordance with Appendix K of the SCQ (DOE 1992b), as necessary. Samples collected and analyzed for process control and not for regulatory reporting do not require the conditions specified in the SCQ to be satisfied for the data users. Sample collection procedures shall also address health and safety hazards associated with each sample port. For safety reasons, plastic sample containers shall be used exclusively.

6.4 ANALYTICAL METHODS

To the extent possible, analytical methods from the SCQ will be utilized. Additional process and analytical procedures may be presented or developed by laboratories contracted to perform analyses to support this effort. These procedures will be reviewed and approved, as required by the SCQ-Quality Assurance, prior to implementation. The level of confidence in the analytical methods used for this VITPP program will be comparable to confidence levels in SCQ methods.

6.5 DATA QUALITY OBJECTIVES AND ANALYTICAL SUPPORT LEVELS

Based on the requirements of Section 3.0 and Section 4.0, Data Quality Objectives (DQO) have been developed for sampling, analysis, and data management for environmental sampling and analysis performed under this Work Plan. End use data will be presented according to the SCQ qualitative and quantitative statements for data quality. Validation of analytical data will be performed in accordance with the DQO specified ASL at which it was analyzed. Data validation process requirements for review and qualification of the analytical data are presented in Section 11.0, as well as appropriate sections of Appendix D of the SCQ.

6.6 QUALITY ASSURANCE REQUIREMENTS

Quality Assurance for the Phase I program will be in accordance with quality program elements identified in FERMCO RM-0012, "Quality Assurance Program Description," for the management of the program. The SCQ will be used for quality program elements for sampling, analysis, and data reporting activities covered by this Work Plan. For TCLP metals testing, quality assurance shall be guided by 40 CFR Part 261, Appendix II.

Project specific quality elements are addressed in the Quality Assurance Job Specific Plan (QAJSP) (25-WP-0016). This plan addresses the Program Criteria of RM-0012 and Quality Assurance (QA) Performance to support this Work Plan.

6.7 DATA REDUCTION, VERIFICATION AND QUANTIFICATION

Data reduction, verification, and quantification will be conducted according to Sections 8.0 and 11.0 of this Work Plan, and Appendix D of the SCQ.

6.8 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits of the activities covered by this Work Plan will be performed in accordance with Section 12.0 of the SCQ and FERMCO RM-0012. Per the QAJSP for the VITPP project, self-assessment in the form of surveillances will be scheduled and performed by the VITPP organization, and independent audits will be scheduled and performed by FERMCO QA. The QAPJP (25-WP-0016) also allows for independent audits by either DOE or the EPA or both. Per the project specific QA plan, self-assessments in the form of surveillances will be scheduled and performed by the

VITPP project organization, and independent audits will be scheduled and performed by FERMCO QA. Additional, independent audits may be performed by the DOE or EPA per the Project QAJSP (25-WP-0016).

6.9 CALCULATIONS OF DATA QUALITY INDICATORS

Equations used to calculate data quality indicators and results determining instrument linearity, ongoing instrument calibration compliance, precision, and accuracy will be performed in accordance with requirements of Section 14.0 of the SCQ.

6.10 CORRECTIVE ACTION

Corrective action will be performed in accordance with requirements of Section 15.0 of the SCQ and FERMCO Quality Assurance Programs and Procedures.

6.11 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Section 16.0 of the SCQ will be used to direct activities for requirements of quality reports to management.

7.0 DATA MANAGEMENT

Data and records generated during Phase I will be used to support Phase II Operations and FRVP design. Data will be managed in accordance with Section 4.4 of the FEMP Records and Document Control Administration procedures (as applicable), applicable sections of Appendix F of the SCQ respectively and with applicable project documents. 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 Project Records Management requirements.

When so designated, 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, the project 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. Many of the forms are included in the Phase I Test Plan.

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 Document Control program requirements.

8.0 DATA ANALYSIS AND INTERPRETATION

Pre-construction data generated for engineering designs were reviewed by engineering personnel for use in design work and required no further analysis and interpretation. Pre-construction sampling and analysis data generated to provide characterization for RCRA and radiological programs was validated according to the requirements of the FEMP Data Validation Program. Field sampling documents were reviewed by the FEMP Quality Control organization to verify completeness and inter-comparability of information.

VITPP operating personnel will receive the process control data generated from physical and chemical analyses of samples collected for process control during VITPP Start-up and Operations. Laboratory personnel will provide the data to VITPP personnel in a timely manner to support continuous operation of the process equipment. Data required for process control will be reported in ASL A data packages.

Environmental Compliance and VITPP program personnel will receive copies of the results of the analyses of environmental samples collected during VITPP Phase I Start-up and Operations. The data will be reported in ASL B and ASL B+ data packages. Data validation personnel will validate B+ data packages.

Personnel that are responsible for the design of the FRVP will receive copies of the physical and chemical data generated from samples collected during VITPP Phase I Start-up and Operations. The analytical data will be reported in ASL A and B data packages.

Sampling and analysis data from Phase I Start-up and Operations will be analyzed based on performance and the data quality objectives identified in Section 3.0. As stated in the SCQ, data generated by the activities defined in this work plan under ASL A and ASL B to support design and Phase I operation will not require validation.

9.0 HEALTH AND SAFETY

Per DOE Orders, a series of documents was prepared to govern the health and safety aspects of the VITPP project. An OU4 General Health & Safety Plan (FERMCO 1994a) was developed that governs all generic OU4 activities. A Project Specific Health & Safety Plan was developed for each VITPP Phase I construction subcontract. An Auditable Safety Record (FERMCO 1995a) was developed for VITPP Phase I operations. In addition, all project specific H&S requirements will be included in SOPs and standing orders as well as a H&S matrix for VITPP Phase I.

Per DOE Order 5480.23, the VITPP project requires a formal safety analysis and review. A "Preliminary Safety Analysis Report for Operable Unit 4" (FERMCO 1994b) was approved by DOE. The Preliminary Safety Analysis Report (PSAR) provides the safety basis for the construction of the VITPP. 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 PSAR, the risks associated with construction and operation of the VITPP are within the limits defined in the applicable regulations, DOE orders, and proposed standard DOE-DP-STD-3005-93, "DOE Standard, Definitions and Criteria for Accident Analysis," March 8, 1993.

10.0 RESIDUALS MANAGEMENT

10.1 WASTE CHARACTERIZATION

This section describes the management of residual materials resulting from VITPP construction and Phase I operations. Sampling locations and parameters are identified in Section 6.0. Regulatory applicable or relevant and appropriate requirements (ARARs) for management of residuals are described in Section 11.0 and listed in Appendix C.

Waste characterization will be performed in accordance with existing site procedures to determine the type of waste management procedures that are required. Generally, it is desirable that project waste be identified and characterized prior to its actual generation. Characterization of waste generated during construction projects, including soils, is currently performed according to Environmental Restoration and Waste Management Procedure EW-0006. The Project initiated this process by completing the Construction Waste Identification/Disposition (CWID) form, which identified the types of waste and approximate quantities that were expected to be generated during the construction phase of the Project. Characterization of all waste generated at the FEMP is documented on a 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.

The completed CWID was forwarded to the FERMCO Waste Characterization group, where the waste identified on the form was 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 a project will match the waste stream profiles documented in MEFs:

- 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.

Frequent 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 is required to

initiate a new MEF. This process is conducted per procedure EW-0001. When all waste materials identified on the CWID have been assigned to completed MEFs, the Waste Characterization group issues 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 generates waste requiring characterization via procedure EW-0006:

- Trenching, earth moving and grading
- Vitrification facility construction
- Equipment installation

Waste streams generated during the activities listed above were expected to include the following:

- Soil
- Rubble (concrete, blocks, firebrick etc...)
- Metal, scrap
- Miscellaneous liquids (excess solvents, paints, thinners, etc...)
- Wood, scrap
- Miscellaneous trash (paper, plastic, PPE, drywall, tile, etc.)
- Conduit/wiring
- Oil solvents and sweeping compounds

The following streams will be generated during operation of the VITPP during Phase I and will require characterization via procedure EW-0001:

- Vitrified surrogate material
- Non-vitrified surrogate material, (i.e., bentonite, sand, water)
- HEPA filter cartridges
- Wastewater filter media
- Laboratory waste
- Miscellaneous trash (i.e., PPE, paper)

10.2 WASTE DISPOSITION

Waste disposition is be dictated by characterization of the identified waste stream as described in Section 10.1. Therefore, final disposition of the waste cannot be specified until characterization is complete. Listed below are potential categories of characterized waste with corresponding disposal options. Management and disposition of all wastes will be in accordance with the OU4 ROD, and associated ARARs and TBCs. Management and disposal of soil and debris will be in accordance with the OU5 and OU3 RODs, respectively, and the Removal Action 17 Work Plan (DOE 1995), site procedures, and OU4 ARARs.

- Process wastewater and accumulated rainwater - pumped to the FEMP Wastewater 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 EW-0006 and the Removal Action 17 Work Plan (as revised), and OU3 and OU5 RODs as appropriate.
- Low Level Radioactive Waste - disposal at NTS or properly stored on site until alternate, appropriate disposal methods or facilities are identified.
- Nonhazardous, nonradioactive - recycled, disposal at sanitary landfill or properly stored on site until appropriate disposal methods or facilities are identified.
- Hazardous, nonradioactive - properly managed on site in accordance with RCRA requirements until appropriate disposal methods or facilities are identified.
- Mixed - properly managed on site in accordance with RCRA requirements until appropriate disposal methods or facilities are identified.

Pre-construction waste was characterized based on a statistical analysis of the data gathered from the execution of site media sampling Plan 93-278. The characterization summary was issued as an internal FERMCO memorandum, M:ESH:(EP):94-0049. Waste Management then issued a memorandum to the Project that discussed the waste characterization results and their implications, together with the required handling and disposition of the individual waste streams, M:(RSO):(WM):94-0413. Attached was a copy of the Project Waste Identification and Disposition (PWID) form (PWID file 94-001) that is used to document this information. Construction waste disposal is being accomplished per the requirements stipulated therein.

10.3 WASTE MINIMIZATION

As a 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. Several aspects of VITPP construction and operation provide opportunities to facilitate waste minimization practices.

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

Process water will be recycled in a closed loop system. This approach substantially reduces the quantity of wastewater requiring treatment. This further reduces costs related to transferring the water to the site treatment system, wastewater treatment, 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 successfully support the vitrification of surrogate silo residues. The use of nonradioactive uncontaminated materials for the VITPP Phase I testing will reduce or eliminate the generation of radioactive waste from the vitrification processes. Release of wastes generated during operation of the VITPP, once they are characterized as non-RCRA and nonradioactive, 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 need arises.

11.0 REGULATORY COMPLIANCE

Regulatory requirements governing construction and operation of the VITPP Phase I are discussed in this section. The vitrification facility will be designed to produce a consistent stabilized glass with minimal effluent. In VITPP Phase I, the systems will be tested using surrogate material. Some campaigns will include lead and barium compounds to more closely simulate the actual silo material.

The project will include the VITPP construction, operation of the vitrification facility, and the disposition of construction rubble and other debris under existing site procedures.

11.1 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 Oil and Hazardous Substance Pollution 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 EW-0006, "Management of Excess 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.

11.2 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 (EP-0001). 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).

11.3 RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) COMPLIANCE

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 Part 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.

Surrogate material utilized during Phase I operations will contain compounds of lead and barium which will be added to the feed material to determine the impacts on the vitrification process. Because both lead and barium bearing wastes are considered hazardous waste, due to the characteristic of toxicity, when they exceed their respective toxicity characteristic (TC) leach limits (5 mg/L for lead and 100 mg/L for barium), there is a potential to generate hazardous waste during Phase I operations. Vitrified glass produced during Phase I operations, as well as other residues generated during any campaign using lead and barium in the feed formula, will be tested for the TC for lead and barium to determine if the waste

is hazardous. Residues that exhibit a RCRA characteristic will either undergo reprocessing in the melter, or be managed as a hazardous waste in accordance with the RCRA regulations identified as ARARs in Appendix B of this document.

11.4 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 VITPP 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 (ACA) 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 EPA, 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.

11.4.1 Air Permits

Construction and Phase I operations of the VITPP may generate nuisance dust during construction, and off-gases from operating the vitrification melter 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

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 VITPP.

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 VITPP.

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

State Requirements

PERMIT TO INSTALL - OAC 3745-31-05 (A): Installation of the proposed VITPP 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 VITPP 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

The VITPP emission control systems will employ BAT to meet State air quality standards. The emission control systems will include an off-gas scrubber for treatment of acidic gas emissions followed by HEPA filters for particulate removal including removal of lead and barium.

11.4.2 Wastewater Permits

This project will result in the generation of wastewater which will be discharged to the FEMP AWWT System under the NPDES permit.

Generated wastewater streams will include discharge of process wastewaters and the potential accumulations of rain water caused by construction in the VITPP area. Each of these wastewater streams will be characterized to determine the appropriate means of treatment in the site AWWT System, 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 U.S. waters (including wetlands). Although the VITPP 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 VITPP.

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 VITPP.

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. Standards and specifications for design of erosion and sedimentation control devices can be found in the USDA-SCS Water Management and Sediment Control for Urbanizing Areas Manual.
- 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.

State Requirements

PERMITS TO INSTALL - OAC 3745-31-05 (A): Installation of the proposed VITPP 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 within 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.

11.5 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Activities of this VITPP program, in either VITPP Phase I or Phase II, 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 11.3. In addition, there is the potential for the generation of dust particulates and other emissions as the result of construction and operation of the 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 VITPP have been identified. Appendix B presents the regulatory requirements for this project and the compliance strategies associated with each requirement. Since the list of requirements was developed for both phases of the VITPP project, ARARs that govern design for VITPP Phase II operation must be considered during VITPP Phase I. No attempt was made to distinguish between ARARs pertaining to VITPP 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 I of the VITPP project.

12.0 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 that will take place during the VITPP Phase I operations. This will confirm confidence in the final remediation for OU4.

In accordance with CERCLA and the 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 7 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 VITPP 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. Gary Stegner
Public Information Director
DOE Field Office, Fernald
P.O. Box 538705
Cincinnati, OH 45253-8705
Phone: 513-648-3153

13.0 REPORTS

13.1 MONTHLY REPORTS

The monthly report will summarize the progress made in meeting the VITPP Phase I Program milestones and present any technical issues which may develop during the course of work. These reports will be prepared by the VITPP Project Manager 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.

13.2 BI-WEEKLY STATUS MEETINGS

A bi-weekly status meeting with the DOE-FN will be scheduled to summarize the progress made in the VITPP 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 VITPP Engineering Supervisors.
- Reporting of construction aspects is the responsibility of the Construction Supervisors.
- Reporting of start-up and operational aspects is the responsibility of the VITPP Startup and Operations Supervisor.

13.3 FINAL REPORT

An interim report will be prepared following completion of Phase I of the VITPP. A final report will be prepared following completion of Phase II of the VITPP. The final report will include a description of all of the work performed in VITPP Phases I and II, along with data from both laboratory and site operations performed in the project, technical discussion, results, and conclusions.

Preparation of these reports is the responsibility of the Project Manager. Submittal of the interim report to DOE-FN be scheduled to occur within sixty days after completion of Phase I. Submittal to the DOE of the final report will be scheduled to occur within ninety days after completion of Phase II. A suggested format of the final report is outlined in Table 13-1. This format is based on EPA guidance for Treatability Study Reports that are conducted as CERCLA activities.

TABLE 13-1

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 13-1 (Cont.)

References

Appendices

A. Data summaries

B. Standard operating procedures

14.0 MANAGEMENT AND STAFFING

This treatability study program supports the remediation of OU4 at the FEMP. As such, the governing document is the Amended Consent Agreement between the DOE and the EPA Region V which was signed in September, 1991. Thus, ultimate project management responsibility lies with these two agencies as defined by this agreement. In addition, OEPA has been granted regulatory authority over certain RCRA activities and has jurisdiction over those aspects. Within each agency, various organizations and offices have been delegated specific program responsibilities.

Each agency has engaged contractors to perform identified scopes of work related to their prime areas of responsibility for site remediation. The DOE Office of Environmental Restoration will implement this program via its Fernald Field Office (DOE-FN). The DOE has retained FERMCO as the Environmental Restoration Management Contractor (ERMC) for FEMP remediation. Within FERMCO, the FEMP site remediation will be accomplished by project organizations. The VITPP program supports the FRVP Project which will remediate the contents of Silos 1, 2, and 3 and the decant sump. Figure 14-1 shows this responsibility matrix, and Figure 14-2 identifies the lead personnel.

The VITPP program will be implemented as the third tier of an EPA RD/RA Treatability Study as described in Section 1. Thus, the project will be conducted in compliance with EPA guidance for CERCLA activities with site operations being conducted in compliance with DOE Orders. The VITPP Phase I program will be conducted in compliance with this work plan document as approved by DOE.

14.1 PROJECT MANAGEMENT

Project management responsibilities within the FRVP Project organization are as follows. The FRVP Project Manager is responsible for managing all aspects of the program to vitrify the OU4 silo waste residues. This includes facility design, construction, operation, and all supporting activities. The VITPP Project supports the FRVP Project, and as such, the VITPP Project Manager reports to the FRVP Project Manager. The VITPP Project Manager has lead responsibility for implementing the VITPP program.

The VITPP Project is being conducted in accordance with the Project Execution Plan (FERMCO 1995c) that was developed for this project.

FEMP OU4 Remediation

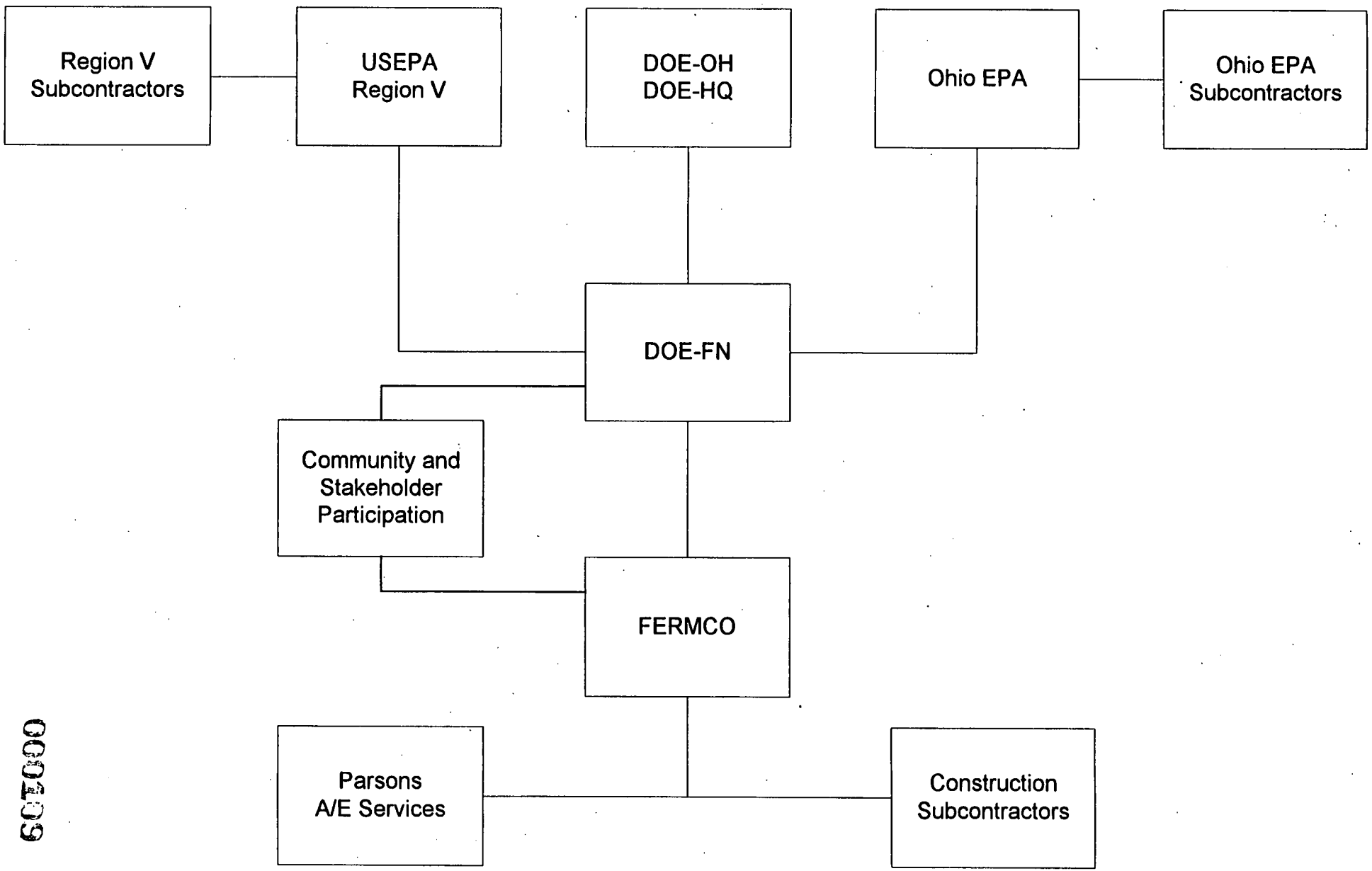

Figure 14-1 Administrative Relationships

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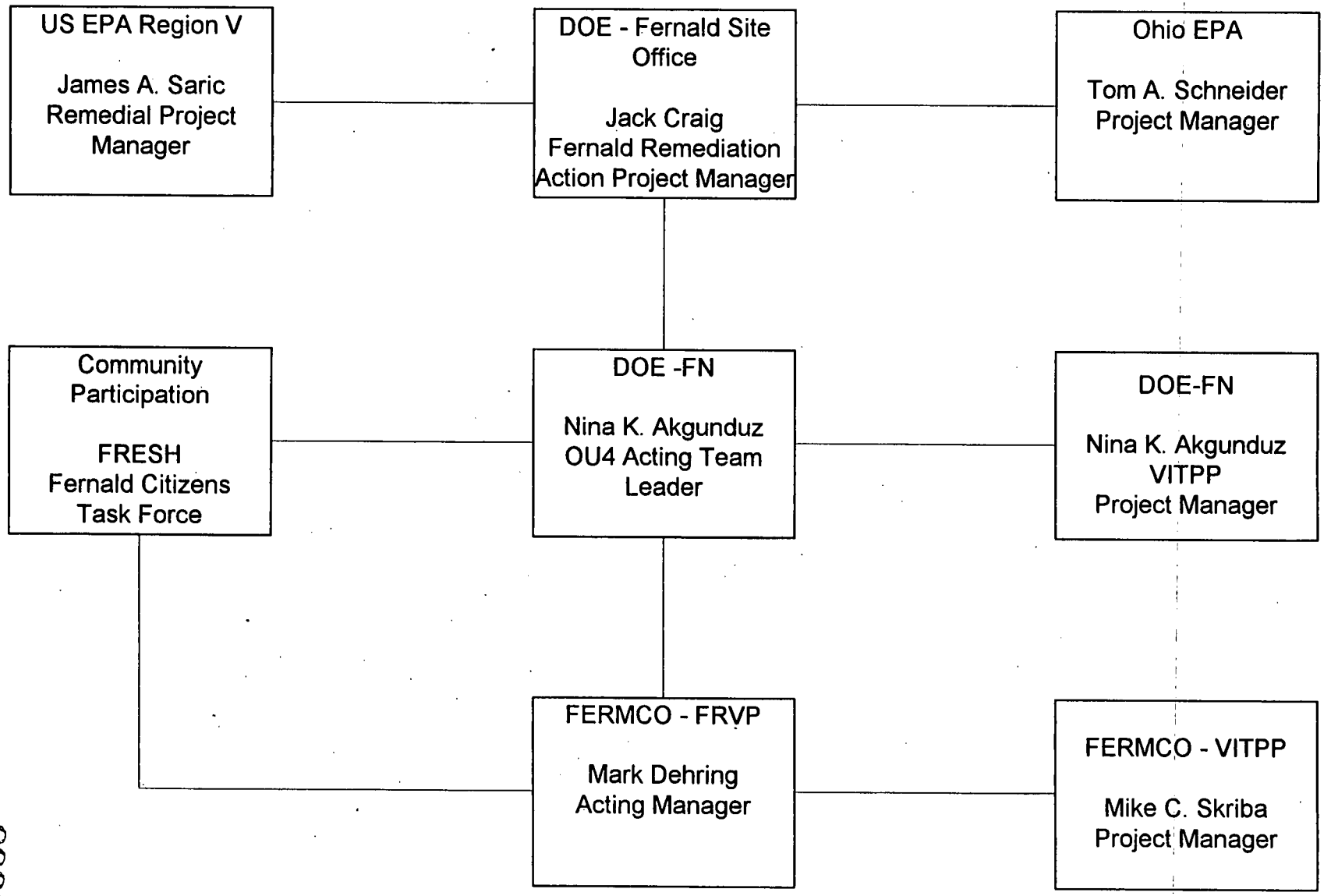

Figure 14-2 Operable Unit 4 Remediation

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Within the FRVP project organization, operations are conducted in accordance with "Site Procedures Functional Area #17 CRU Operating Procedures," (FERMCO 1995f) which became effective on February 3, 1995. These division procedures address the 12 major areas of operations for which the project manager is responsible. These procedures define responsibilities, interactions within the project organization, and relationships with the home divisions for matrixed personnel. As a treatability test program, the actual VITPP Phase I testing will be directed by professional staff.

Currently, VITPP construction is nearing completion, and the project is entering its start-up phase. Figure 14-3 is an organization chart that depicts the functional responsibilities for the VITPP Start-Up and Operations portion of the VITPP Phase I program activities. The Deputy Project Manager has the lead responsibility for successful completion of this portion of the VITPP Project.

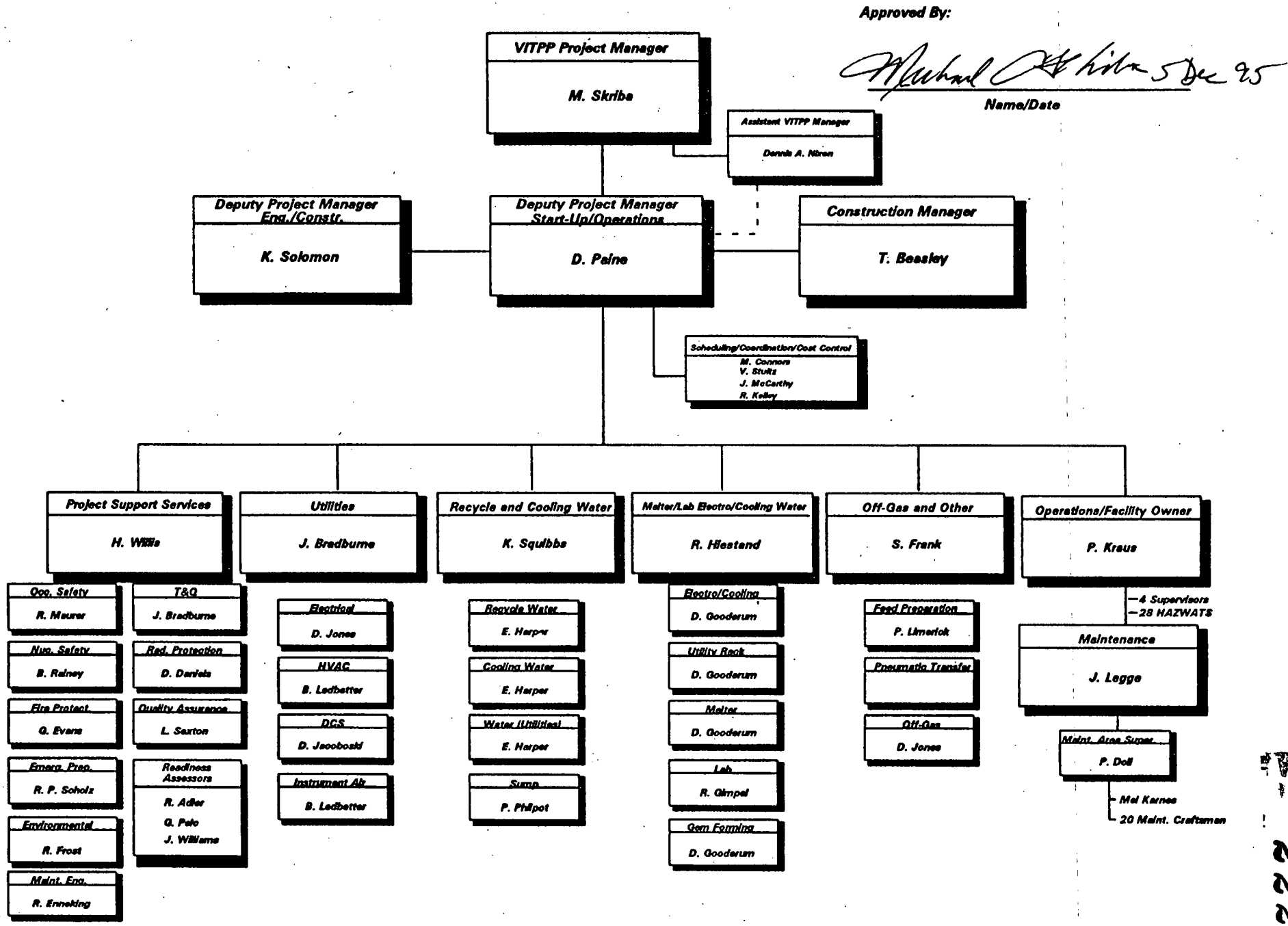
14.2 STAFFING

FERMCO will implement the VITPP program using its own work force 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.

The FERMCO organization consists of project organizations (such as the VITPP and the FRVP for OU4 remediation), support divisions (such as Engineering), and service departments (such as Analytical Services). The support divisions supply full-time personnel to projects on a matrix basis. This may range from a single point of contact (such as a procurement representative) to a full department (such as 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

VITPP START-UP AND OPERATIONS ORGANIZATIONAL CHART



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15.0 REFERENCES

ATEC Associates, Inc., 1993, "Geotechnical Investigation Report, Pilot Plant Vitrification Facility," Fernald Environmental Management Project, prepared for DOE, Fernald Field Office, Cincinnati, OH.

Chapman, C.C. and D.S. Janke, 1991, "Characteristics of Fernald's K-65 Residue Before, During and After Vitrification," prepared by Battelle Pacific Northwest Laboratories for DOE, Richland, WA.

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

Fernald Environmental Restoration Management Corp., 1994a, "General Health & Safety Plan for OU4 Operations," FERMCO, Cincinnati, OH.

Fernald Environmental Restoration Management Corp., 1994b, "Preliminary Safety Analysis Report for Operable Unit 4," Fernald Environmental Management Project, FEMP-2337, FERMCO, Cincinnati, OH.

Fernald Environmental Restoration Management Corp., 1995a, "Auditable Safety Record 95-0006 for Phase I Vitrification Pilot Plant Operations," FERMCO, Cincinnati, OH.

Fernald Environmental Restoration Management Corp., 1995b, "Operable Unit 4, Vitrification Pilot Plant Phase I Test Plan," FERMCO, Cincinnati, OH.

Fernald Environmental Restoration Management Corp., 1995c, "Project Execution Plan for Operable Unit 4, Vitrification Pilot Plant," Rev. 2, FERMCO, Cincinnati, OH.

Fernald Environmental Restoration Management Corp., 1995d, "Project Specific Plan for Operable Unit 4, Vitrification Pilot Plant Phase I Process Sampling," FERMCO, Cincinnati, OH.

Fernald Environmental Restoration Management Corp., 1995e, "Quality Assurance Job Specific Plan for the Vitrification Pilot Plant Project," FERMCO, Cincinnati, OH.

Fernald Environmental Restoration Management Corp., 1995f, "Site Procedures, Functional Area #17, CRU Operating Procedures," Vol. 4, FERMCO, Cincinnati, OH.

Parsons, Ralph M., Co., 1993, "Functional Requirements Document, Vitrification Pilot Plant," Fernald Environmental Management Project, prepared for DOE, Fernald Field Office, Cincinnati, OH.

Parsons, Ralph M., Co., 1994, "Design Criteria for the CRU 4 Pilot Plant Program," Fernald Environmental Management Project, prepared for DOE, Fernald Field Office, Cincinnati, OH.

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

U.S. Dept. of Energy, 1990b, "Initial Screening of Alternatives for Operable Unit 4, Task 12 Report," DOE, Oak Ridge Operations Office, Oak Ridge, TN.

U.S. Dept. of Energy, 1992, "Operable Unit 4 Treatability Study Work Plan for the Vitrification of Residues from Silos 1, 2, and 3," prepared by Westinghouse Environmental Management Co. of Ohio and Battelle Pacific Northwest Laboratories for DOE, Fernald Office, Cincinnati, OH.

U.S. Dept. of Energy, 1993a, "Operable Unit 4 Treatability Study Report for the Vitrification of Residues from Silos 1, 2, and 3," prepared by Fernald Environmental Management Co. of Ohio and Battelle Pacific Northwest Laboratories for DOE, Fernald Field Office, Cincinnati, OH.

U.S. Dept. of Energy, 1993b, "Sitewide CERCLA Quality Assurance Project Plan," Fernald Environmental Management Project, DOE, Fernald Field Office, Cincinnati, OH.

U.S. Dept. of Energy, 1994a, "Feasibility Study Report for Operable Unit 4," Final, Fernald Environmental Management Project, DOE, Fernald Field Office, Cincinnati, OH.

U.S. Dept. of Energy, 1994b, "Proposed Plan for Remedial Actions at Operable Unit 4," Final, Fernald Environmental Management Project, DOE/EA-0953, Fernald Field Office, Cincinnati, OH.

U.S. Dept. of Energy, 1994c, "Record of Decision for Remedial Actions at Operable Unit 4," Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Dept. of Energy, 1995, "Removal Action 17 Work Plan," Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Environmental Protection Agency, 1992, "Guide for Conducting Treatability Studies Under CERCLA, Final," EPA/540/R-92/07la, Office of Solid Waste and Emergency Response, Washington, DC.

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**

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

APR 16 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,

Ray Hansen
for Thomas J. Rowland
Acting Manager

FN:Allen

Enclosure: As Stated

cc w/enc.:

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

Recycled and Recyclable

Fernald Environmental

FERMCO

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

P- 222

December 22, 1992

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 1 yd^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.

Fernald Environmental

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

APPENDIX B

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

APPENDIX B

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

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Ohio Water Quality Standards	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: Constituent — Criteria conc.[a] (ug/L) — 30-day average conc. (ug/L) Antimony — 650 — 190 Arsenic — 360 — 190 Beryllium — Tab. 7-10[b] — Tab. 7-11[c] Cadmium — Tab. 7-10 — Tab. 7-11 Chromium — Tab. 7-10 — Tab. 7-11 Copper — Tab. 7-10 — Tab. 7-11 Cyanide — 46 — 12 Lead — Tab. 7-10 — Tab. 7-11 Mercury — 1.1 — 0.20 Nickel — Tab. 7-10 — Tab. 7-11 Selenium — 20 — 5.0 Silver — Tab. 7-10 — 1.3 Thallium — 71 — 16 Zinc — Tab. 7-10 — Tab. 7-11 2-Butanone — 160,000 — 7,100 4-Nitrophenol — 790 — 35 Acetone — 550,000 — 78,000 Aldrin — ---- — 0.01 Bis(2-ethylhexyl)phthalate — 1,100 — 8.4 Carbon tetrachloride — 1,800 — 280 (CONTINUED ON NEXT PAGE)	Applicable	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.

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221

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).				

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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.

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222

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.

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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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222

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Radiation Protection of the Public and the Environment	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) Isotope / D / W / Y Actinium-227: 2×10^{-15} / 7×10^{-15} / 1×10^{-14} Lead-210: 9×10^{-13} / ------[b] / ------ Polonium-210: 1×10^{-12} / 1×10^{-12} / ------ Protactinium-231: ------ / 9×10^{-15} / 1×10^{-14} Radium-224: ------ / 4×10^{-12} / ------ Radium-226: ------ / 1×10^{-12} / ------ Radium-228: ------ / 3×10^{-12} / ------ Technetium-99: 1×10^{-8} / 2×10^{-9} / ------ Strontium-90[c]: 5×10^{-11} / ------ / 9×10^{-12} Thorium-228: ------ / 5×10^{-14} / 4×10^{-14} Thorium-230: ------ / 4×10^{-14} / 5×10^{-14} Thorium-232: ------ / 7×10^{-15} / 1×10^{-14} Uranium-234: 4×10^{-12} / 2×10^{-12} / 9×10^{-14} Uranium-235: 5×10^{-12} / 2×10^{-12} / 1×10^{-13} Uranium-236: 5×10^{-12} / 2×10^{-12} / 1×10^{-13} Uranium-238: 5×10^{-12} / 2×10^{-12} / 1×10^{-14} [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}.	To Be Considered	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.

000238

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 only if 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.

000227

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.

000438

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.

000439

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.

000430

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.

000131

222

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.

000432

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.

000213

222

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.

000234

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.

000135

222

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.

000136

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
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).
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.

000137

222

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
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.
Restriction on Particulate Emissions from Industrial Processes	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: Process Rate at Maximum Capacity (lb/hr) — Allowable Rate of Particulate Emission (lb/hr)[1] 100 — 0.551 200 — 0.877 400 — 1.40 600 — 1.83 800 — 2.22 1000 — 2.58 [1] Excerpted from Table 1 of OAC 3745-17-1	Applicable	The facility design will include HEPA filtration to minimize particulate emissions to less than these maximum emission rates.

000138

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Prevention of Air Pollution Nuisance	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.	Applicable	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.
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.

000139

222

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
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.

000340